Implementing Forest Landscape Restoration – A Practitioner's Guide

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IMPLEMENTING FOREST LANDSCAPE RESTORATION

A Practitioner's Guide

Editors: John Stanturf, Stephanie Mansourian, Michael Kleine

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LIST OF ACRONYMS

AFR100	African Forest Landscape Restoration Initiative
AFRP	Atlantic Forest Restoration Pact
AIIM	Alignment, Interest and Influence Matrix
CBD	United Nations Convention on Biological Diversity
CDM	Clean Development Mechanism
CIFOR	Centre for International Forestry Research
CITES	Convention on International Trade in Endangered Species
CPF	Collaborative Partnership on Forests
FAO	Food and Agriculture Organisation of the United Nations
FLAT	Forest Landscape Assessment Tool
FLR	Forest Landscape Restoration
FMU	Forest Management Unit
FPIC	Free Prior and Informed Consent
FRA	Forest Resources Assessment
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
GIS	Geographic Information System
GMO	Genetically Modified Organism
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
LADA	Land Degradation Assessment in Drylands
NDC	Nationally Determined Contribution
NFP	National Forest Programme
NGO	Non-Governmental Organisation
NTFP	Non-Timber Forest Product
PIPA	Participatory Impact Pathways Analysis
REDD+	Reducing Emissions from Deforestation and forest Degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stock
ROAM	Restoration Opportunities Assessment Methodology
RRI	Rights and Resources Institute

SDG	Sustainable Development Goal
SER	Society for Ecological Restoration
SFM	Sustainable Forest Management
SNA	Social Network Analysis
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
VCS	Verified Carbon Standard
WRI	World Resources Institute
WWF	World Wide Fund for Nature

PREFACE

Large-scale restoration initiatives are underway to counter global loss and degradation of the world's forests. These include the Bonn Challenge (150 million ha by 2020), the New York Declaration on Forests (350 million ha by 2030), and land net degradation neutrality (LDN) by 2030 set by the United Nations Convention to Combat Desertification (UNCCD). The Convention on Biological Diversity (CBD) has a goal of no net biodiversity loss, and net positive impacts on biodiversity, with a target (Aichi Target 15) of 15% of degraded lands restored by 2020. To implement the Bonn Challenge and other international commitments that require forest restoration and conservation, the German Environment Ministry (BMU) approved a four-year project led by the World Resources Institute called "Inspire, Support and Mobilize Forest Landscape Restoration." As one of the partners in this effort, IUFRO is providing scientific information, knowledge and expertise on ecological, social and economic aspects of forest landscape restoration (FLR), in particular the potential contribution of FLR to climate change mitigation and adaptation.

Recognising the challenge of implementing these high-level targets and initiatives, and realising that obtaining results on the ground will confront many context-specific questions, a team of scientists from relevant IUFRO units has prepared this practitioner's guide to *Implementing Forest Landscape Restoration*. The guide follows from, and builds upon the IUFRO World Series *"Forest Landscape Restoration as a Key Component of Climate Change Mitigation and Adaptation"* (Stanturf et al. 2015). This guide addresses FLR implementation as a whole but with a view toward climate change mitigation and adaptation; only if the landscape is changing and FLR is successful will climate benefits materialise.

Even though guidelines for broad national planning and ecological assessments are available, implementing FLR in practice goes beyond generalized concepts. Implementing FLR generally requires a group of stakeholders rather than being the responsibility of a single stakeholder. Often one or more facilitators are needed to organise a multi-stakeholder team and these facilitators are the main target audience for this FLR implementation guide. We intend this guide to be a training resource for FLR facilitators who have a broad approach to land management. The guide is also aimed at anyone who implements FLR in a specific country or local context. Thus, policymakers and practitioners considering FLR commitments can use this guide to gain an understanding of the complexities of actual implementation.

The guide is comprised of separate modules that address important aspects of FLR implementation. Each module is based on the IUFRO World Series report, which goes into greater depth and has many more references. Underlying our approach to FLR implementation is the concept of project cycle management that takes users on a systematic path from the initial project idea to measurable results in the landscape. Each module gives details on important aspects of the journey from broad FLR policy to local implementation activities, including getting started with FLR implementation, governance, FLR project design, implementation activities, monitoring and evaluation, climate change mitigation and adaptation methods, and communication. Users are encouraged to read all modules, but each module can be read independently. Some key concepts are duplicated among modules or cross-referenced to facilitate reading.

We are grateful to the authors and co-authors for sharing their expertise and long-term experience in the restoration of forests and forested landscapes, and for making it available through this guide. Stephanie Mansourian did double duty as co-author and editor of the guide; Michael Kleine also performed doubly as co-author and task master. The assistance by Margareta Khorchidi in proofreading and Janice Burns contributing as co-author and helping shape the final version of the guidebook as well as by Eva-Maria Schimpf in proofreading and coordinating lay-out and printing is much appreciated.

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Coordinator IUFRO Research Group 1.06.00
"Restoration of degraded sites"

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INTRODUCTION AND OVERVIEW

Why a guide for FLR implementation?

Forest landscape restoration (FLR) is being widely promoted as a solution to the global loss and degradation of the world's forests and as a contribution to sustainable development through restoring the ecological, social and economic values and functionalities of degraded landscapes. Much interest and political momentum has been generated around restoration and FLR in particular (Box I.1). Ambitious hectare-based targets have been set through various global and regional efforts such as – for example–the Bonn Challenge and New York Declaration on Forests at the global level, the AFR100 target in Africa, as well as the Initiative 20x20 in Latin America. At the same time forest restoration, particularly at scale, can contribute to other global objectives such as the sustainable development goals (SDGs), notably by improving resilience; supporting social and environmental adaptation, protecting soils and water resources; and thus contributing to food security and rural livelihoods. It can also contribute to the three Rio Conventions: the UN Framework Convention on Climate Change through the nationally determined contributions (NDCs) under the Paris Agreement, the UN Convention on Biological Diversity Aichi targets through the National Biodiversity Strategies and Action Plans, and the National Action Programmes under the UN Convention on Combating Desertification.

This guide addresses FLR implementation as a whole but with a view toward climate change mitigation and adaptation. Only if the landscape is changing and FLR is successful will climate benefits materialise in terms of, for example, higher biomass (carbon) per ha, diversity of tree species, or increased proportion of trees species adapted to a future climate.

Yet, translating these high-level targets and initiatives into action on the ground remains a challenge. Realities on the ground, in all parts of the globe, may at times hamper ambitious and, sometimes unrealistic, objectives. Furthermore, global hectare-based objectives require careful interpretation and adaptation at the landscape or local level in order to provide more than just tree cover. How can a hectare-based target translate into improved resilience and better access to clean water on the ground; or improved agricultural yields and better soil conservation; or to absorbing greenhouse gases and helping rural communities adapt to harsher climate-induced conditions, while improving income and/or job opportunities? These very context-specific questions and many more, frequently remain unanswered by those in political circles expressing the desire to see millions of hectares of forests restored.

Transforming FLR policies into concrete action on the ground can be accomplished in many different ways depending on local circumstances. However, it should be emphasised that restoration projects aiming at lasting changes to the landscape need to address the underlying causes of land degradation and thus restoration requires interventions into a social system. For example, reversing the unsustainable exploitation of forests and other natural resources requires significant changes from "business as usual". The new management regime may be comprised of revised technical land management

Box 1.1

Forest landscape restoration (FLR) in a nutshell

FLR was defined in 2000 by a group of 30 specialists as "a planned process that aims to regain ecological integrity and enhance human wellbeing in deforested or degraded landscapes". It does not seek to recreate past ecosystems given the uncertainty concerning the "past", the significantly altered conditions of the present as well as anticipated but uncertain future changes. However, it does seek to restore a forested ecosystem that is self-sustaining and that provides benefits both to people and to biodiversity. For this reason, the landscape scale is particularly important as it provides the opportunity to balance ecological, social, and economic priorities. The emphasis on the landscape also indicates that tree cover is not needed throughout the landscape, but rather the focus of FLR is on restoring functional forest ecosystems within landscapes so that forests can co-exist and subsist in a landscape mosaic together with other land uses. The restored forests within the forest landscape may also form mosaics of forest types emphasizing the various objectives and functions of the forests depending on the landscape, sites, and people living there. Some parts of the restored forests may serve protective functions for watersheds, soils, livestock or crops; other parts may be highly productive and efficiently produce high-quality timber, firewood or biomass while yet other parts may restore habitats for flora and fauna.

approaches, new or amended laws and regulations addressing tenure and access-rights, taxation and incentive systems, or marketing and development of new value chains or revisions of existing ones. Changing these drivers will often have a significant and positive long-term effect on the landscape.

To date, a diversity of guidelines and best practice guides on restoration of degraded lands has been published, including on FLR. Older guidelines include those by ITTO (2002) on the restoration of degraded secondary forests and the ITTO/IUCN (2009) guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests. Recently published broader International Standards for the Practice

of Ecological Restoration explain different approaches to ecological restoration and environmental repair activities across ecosystems (McDonald et al. 2016).
More specific FLR guidelines that emphasise planning and prioritisation of restoration activities for given landscapes include the following:

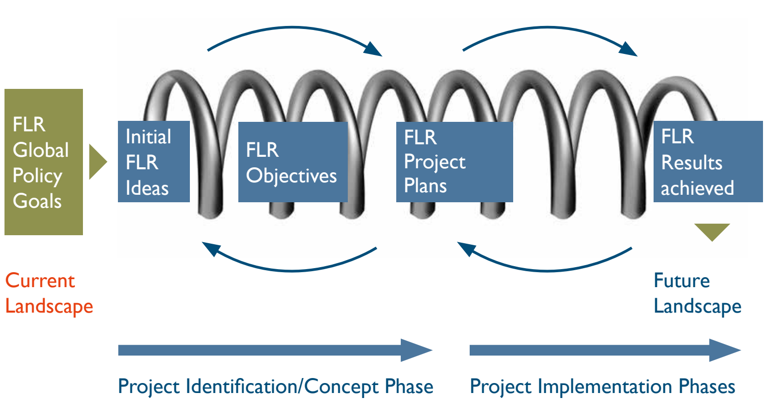
- *Restoration Opportunity Assessment Methodology (ROAM), a guideline that contributes to creating a shared understanding of FLR opportunities and the value of multifunctional landscapes among decision-makers and land managers. ROAM represents an approach for countries to rapidly identify and analyse forest landscape restoration potential and locate specific areas of opportunity at national and sub-national levels (http://www.bonnchallenge.org/content/restoration-opportunities-assessment-methodology-roam) (IUCN/WRI 2014).*

- *Forest Landscape Assessment Tool (FLAT), a set of tools for determining ecological conditions and potential threats to forest ecosystems. FLAT enables planners and managers to understand baseline conditions, determine and prioritise restoration needs across a landscape system, and conduct ongoing monitoring to achieve land management goals (https://www.treesearch.fs.fed.us/pubs/53245). The tool described in this publication is focused on ecological assessment and provides methods and approaches for project planning, restoration operations, and monitoring and evaluation (Ciecko et al. 2016).*

Implementing FLR in practice goes beyond guidelines, broad national planning, and ecological assessments, hence the need for this FLR implementation guide. Forest landscape restoration projects always strive to achieve multiple social and environmental objectives, in order to contribute to regaining ecological integrity as well as enhancing wellbeing of people within a particular landscape. This guide originates from a project focused on FLR as a key component of climate change mitigation and adaptation. A special module on FLR for climate change mitigation and adaptation has been included in this guide, in order to highlight the approaches needed to obtain climate benefits through FLR.

Climate benefits will materialise only if FLR implementation is successful on the ground and the landscape is changing in terms of higher biomass (carbon) stocks per hectare, diversity of tree species or increased proportion of trees species adapted to future climate.

The broad spectrum of goals and objectives desired may delay or jeopardise FLR implementation because it is common for stakeholders to differ significantly in their interests and preferences. Reaching consensus on actions to be taken and/or changes to be pursued is frequently difficult. Therefore, FLR projects require systematic procedures for consultations and negotiations among stakeholders in order to reconcile conflicting interests and objectives. In this context, participatory planning processes can assist stakeholders in discussing, defining and agreeing on priorities. Agreement on priorities allows the FLR project to concentrate on key issues to bringing about desirable changes. To this end, this publication provides practical guidance on how best to deal with



Systematic development path "from the project idea to measurable results"
Source: adapted from European Commission 2004

Figure I.1

complex realities, account for uncertainties and unexpected changes in the project environment, and to develop a consistent course of action over a specified period.

The various tools and approaches suitable for FLR implementation on the ground, ranging from project planning and FLR operations to monitoring and evaluation, are elements of a systematic path taking users "from the initial project idea to measurable results in the landscape," as illustrated in Figure I.1.

This approach builds a consistent strategy for implementing FLR at various scales, starting with the broad Bonn Challenge commitments or global restoration goals, adapted to national level priorities and landscape opportunities that define FLR objectives, and finally translated into detailed project plans to produce results locally. The local context is important because it is the critical scale for assessing baseline conditions (the prevailing ecological and socio-economic realities), holding stakeholder consultations that result in a series of specific objectives, developing operational planning, monitoring progress, and adjusting for subsequent project interventions.

Successful FLR implementation on the ground will also require coordinating and harmonizing the work of existing local governmental and non-governmental actors, such as agricultural extension services, forest and wildlife departments, water departments, forest and agriculture plantation companies, farmers' associations/cooperatives, as well as environmental NGOs and advocacy groups.

Who is this guide for?

We intend this guide primarily to support practitioners working in a local context to restore a particular landscape. The target audience includes local authorities, employees of the forest service, NGOs, researchers, community associations, or stakeholders. In general, FLR implementation requires a group of stakeholders rather than being the responsibility of a single stakeholder. Often one or more facilitators are needed to organise a multi-stakeholder team and they will benefit from elements of this guide. More generally, policymakers and practitioners considering FLR commitments to gain an understanding of the complexities of actual implementation can use this guide.

Applying the various methods described in the several modules of this guide will help facilitators and coordinators of FLR initiatives at national, subnational (landscape) and local levels to implement FLR projects and programmes. The modules can be used alone or in combination to identify issues to be addressed in the project, set priorities, negotiate responsibilities, clarify the scope of interventions, and specify the resources needed. This systematic approach will help to better organise the work on FLR and to be more transparent—a prerequisite in projects involving many stakeholders with different interests.

How to use this guide?

This guide is organised in modules progressing from conceptualisation, to design, practical implementation, monitoring and evaluation, and communicating results of FLR. While users are encouraged to read all modules, each module can also be read independently. Some key concepts are duplicated among modules or cross-referenced to facilitate reading.

In total, this guide consists of seven modules as follows:

Module I, "Getting started", describes the processes and activities preceding actual FLR implementation on the ground. These entail visioning and conceptualizing FLR within a given local context, prioritizing landscapes or parts of landscapes that require specific restoration, collecting and analysing data and baseline information about these targeted landscapes as well as sufficiently defining local FLR objectives and associated measurable indicators.

In Module II, "Governance and Forest Landscape Restoration", governance challenges constraining FLR implementation are described. The module explains important aspects of decision-making processes at national, sub-national, and local levels that affect the way people manage landscapes. Understanding the extent of governance influence on the FLR process helps to define strategies to turn governance challenges into governance opportunities.

Module III, "Designing a Forest Landscape Restoration Project", provides guidance on best approaches to conceptualise an FLR project by following a systematic and hierarchical development path. Such approaches incorporate continued consultations and joint learning with involved stakeholders, repeated evaluation and adjustments to the project targets and plans. Iteration and learning along the way provides sufficient flexibility to adapt to unexpected changes in the project environment, particularly in terms of altered policy and economic conditions.

Module IV, "Technical Aspects of Forest Landscape Restoration Project Implementation", presents a wide range of basic types of FLR operations. Besides describing practical technical tools useful for restoration, emphasis is also placed on the specific local context in which suitable methods of FLR operations will successfully restore degraded landscapes.

Module V, "Monitoring Mitigation and Adaptation Outcomes of Forest Landscape Restoration", explores in more detail the monitoring and evaluation needs and applications within the context of FLR. Reasons for monitoring, important monitoring characteristics, and types of monitoring are explored. The importance of establishing a baseline at the outset, in order to evaluate FLR effectiveness, is stressed.

Module VI describes "Climate Mitigation and Adaptation Methods in Forest Landscape Restoration". Mitigation and adaptation are intimately linked in practice, although separated in international policy discussions. At the level of FLR implementation, they should be addressed in tandem and synergies among climate change and restoration objectives maximised.

Module VII addresses "Communicating Forest Landscape Restoration Results" to meet the need for interaction and communication with stakeholders. By their nature, FLR projects are complex; they cover large landscapes involving a multitude of landowners and different stakeholders with differing interests, objectives and aspirations. Thus, successful development and implementation of FLR projects depends on many motivated actors at different levels doing the right things and communication among everyone involved or interested in FLR is critical. This module focuses on different methods for effectively communicating the FLR vision, goals, objectives, implementation plan and outcomes to multiple audiences at different stages of the FLR process.

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MODULE I.
Getting Started

Getting started on a forest landscape restoration (FLR) project is a daunting task; the objective of this module is to break the task down into manageable chunks. An FLR project or programme can be broken down into four stages, or phases. Phase 1 is visioning forest landscape restoration in a specific context. Our underlying assumption in this module, and the ones that follow, is that FLR is taking place in the context of the Bonn Challenge (or one of the related developments including the New York Declaration on Forests, the AFR 100, or the Initiative 20 x 20). Thus, visioning includes a pledge (or commitment) to restore an area; this sets the framework of an FLR undertaking in a given country.

Phases of Forest Landscape Restoration

- *Visioning—what constitutes forest landscape restoration within a country (scale, degradation or deforestation drivers)*
- *Conceptualising—prioritising landscapes and identifying ecological and social goals*
- *Designing—turning goals into objectives, identifying starting and ending points*
- *Implementing (including monitoring)—developing detailed plans of what will be done where, when, by whom and at what cost*

Phase 2 is conceptualising the FLR project, including identifying priority landscapes (where restoration will occur) and setting ecological and social goals. A key element of Phase 3, designing the FLR project, is to turn goals into objectives and to identify starting and ending points for restoration of specific landscape elements. Phase 4 is implementing the project design; this means developing detailed plans for activities that will result in accomplishments or meet targets. Key elements of a plan are sequenced lists of what will be done, where, when, by whom and at what cost (Table M1.1).

Phase 1. Visioning forest landscape restoration in a specific context requires knowing where degradation or forest loss has occurred and what constitutes FLR. The "Bonn Challenge on forests, climate change and biodiversity" called on governments, the private sector and civil society to restore 150 million hectares of lost and degraded forests by 2020 . The New York Declaration on Forests expanded that challenge to restore 350 million hectares by 2030. Although the response to these challenges has been immediate and encouraging, there has been limited clarity on what pledges actually signify and to what parties are actually contributing (Mansourian et al. 2013).

FLR is a loose concept, defined and redefined by different institutions, with different interests and views on the process (Table M1.2). Nevertheless, there are some basic, critical dimensions at the core of FLR. A recent paper (Newton and Tejedor 2012) suggests four key principles for FLR:

- *FLR is a **flexible** process, which embodies three key features: (i) it is participatory, requiring the engagement of stakeholders to be successful; (ii) it is based on adaptive management and is therefore responsive to social, economic and environmental change; and (iii) it requires both an adequate monitoring programme and an appropriate learning process.*
- *FLR seeks to restore **ecological processes** at the landscape scale that will ensure maintenance of biodiversity and ecosystem functions, and confer **resilience** to environmental change.*
- *FLR seeks to **enhance human well-being**, through restoration of ecosystem services.*
- *FLR implementation is at a **landscape scale**; in other words, site-level decisions need to be made within a landscape context.*

To these, we would add that FLR is a long-term process, even though commitments to the Bonn Challenge may be short-term. A clear baseline is particularly important, as the process of FLR assumes a change (an improvement) in the landscape. We use the term baseline loosely here to refer to the starting conditions.

Another element of Phase 1 is the scale of intervention, which has two aspects. Obviously, it matters whether the FLR project under consideration follows from a national,

Table MI.I

Forest landscape restoration starts with a vision of restoring ecological integrity and enhancing human well-being. Turning that vision into reality on the ground is a process of developing goals for a project and turning them into tangible objectives that can drive activities and result in accomplishments.

	Goal	Objective	Plan
Meaning	The purpose toward which an FLR project is directed	Accomplishments or targets of one's efforts or actions	Activities that will result in accomplishments or meet targets
Measure	Goals may not be strictly measurable or tangible.	Must be measurable and tangible.	Sequenced list of what will be done, where, when, by whom, at what cost
Time frame	Longer term	Mid to short term	Mid to short term

Table M1.2

Different frameworks and planning approaches to restoration

SER 2004	Vallauri et al. 2005	Keenleyside et al. 2012	Lammerant et al. 2013	IUCN and WRI 2014
1. a clear rationale for restoration; 2. an ecological description of the site; 3. a statement of the project goals and objective; 4. a designation and description of the reference; 5. an explanation of how the proposed restoration will integrate with the landscape and its flows of organisms and materials; 6. explicit plans, schedules and budgets for site preparation, installation and post-installation activities, including a strategy for making prompt mid-course corrections 7. well-developed and explicitly stated performance standards, with monitoring protocols to evaluate the project; 8. strategies for long-term protection and maintenance of the restored ecosystem.	1. Initiate a restoration programme and partnerships 2. Define restoration needs and link restoration to a large scale conservation vision 3. Define restoration strategy and tactics, including land-use scenarios 4. Implement restoration 5. Pilot systems towards fully restored ecosystems	1. Define the problem and engage stakeholders 2. Assess the problem 3. Develop ecological restoration goals 4. Develop ecological restoration objectives 5. design ecological restoration approach 6. implement ecological restoration approach 7. Manage adaptively: monitor, evaluate, adjust, communicate	1. Scope (team and resources, planning area, governance, goals) 2. Information (biophysical, socio-economic and political, data preparation) 3. Analysis (situation analysis, stakeholder analysis, current conservation status, threats assessment) 4. Strategies (objectives and targets, criteria, prioritisation) 5. Actions (implementation, M&E, reporting)	1. identify need, 2. assess potential for restoration 3. financial cost/benefit analysis 4. analysis of the broader legal, institutional and financial context.

top-down process in which multiple landscapes are targeted for restoration or the FLR project is for a specific landscape. In either case, the phases that follow are the same but the level of effort necessarily differs. Another aspect of scale relates to governance structure, broadly classified as a hierarchy, a network, or a hybrid. FLR projects done on public land or by one or more large private owners acting together will likely be organised hierarchically, in a top-down manner (see Module 2 for more on governance). Some recent examples are the Bonn Challenge commitment made by the US Forest Service (15 million hectares; Schultz et al. 2012) or the post-war restoration of the Republic of Korea (Lee and Suh 2005). Alternatively, network organisation is illustrated by the Atlantic Forest Restoration Pact in Brazil (Brancalion et al. 2013), which brought together many small restoration projects that were already underway into an umbrella initiative.

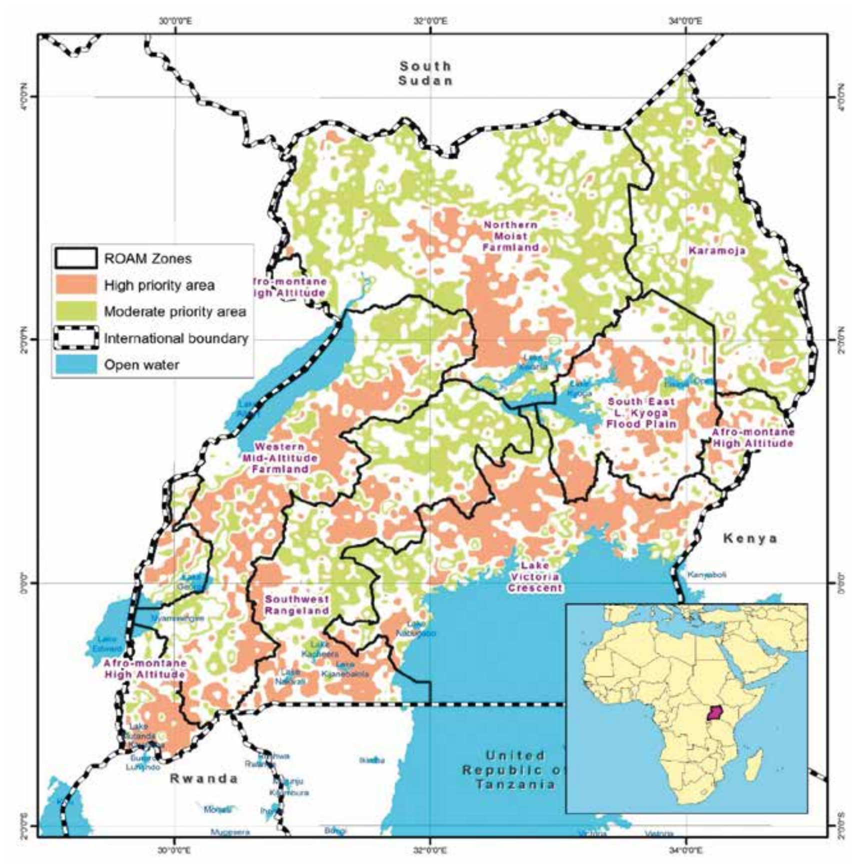

Figure M1.1

Prioritising areas for forest landscape restoration at the national-level. Location of priority areas for forest landscape restoration in Uganda (brown indicates areas of high priority for restoration, green are moderate priority areas)
Source: Ministry of Water and Environment, Uganda, and IUCN 2016

In a severely fragmented landscape, a hybrid organisational structure would be appropriate where an external driver such as a government agency implemented FLR by providing incentives to small landowners to undertake (or allow) restoration on portions of their land. An example of the hybrid organisation is the Wetlands Reserve Program and bottomland hardwood restoration in the southern United States (Gardiner and Oliver 2005).

Phase 2. Conceptualising the FLR project includes identifying priority landscapes (where restoration will occur) and the specific ecological and social goals to be pursued (what benefits to the environment and livelihoods will be produced). There are many ways to identify deforested and degraded forests, from remotely sensed data such as satellite imagery to ground-based surveys. The scale and criteria used to map degradation or deforestation determine the utility of such maps for identifying priority areas for restoration. International assessments of degraded lands such as LADA (Land Degradation Assessment in Drylands) provide guidance over large areas of where to find degraded land. The global map of restoration potential published by the World Resources Institute (WRI) highlights the amount of land potentially available for restoration, based on where closed canopy forests should occur and currently do not (Minnemeyer et al.

Table M1.3

Priority areas for restoration in degraded landscapes to improve functional outcomes

Location of new forests	Advantage of new forests at this location
Areas able to regenerate naturally	The cost of restoration is low (although the costs of protecting these areas may be significant)
Buffer strips planted around remnant patches of natural forests	Protect these remnants from further disturbances, enlarge their effective areas and soften edge effects (highest priority being given to remnants with endangered or vulnerable species)
Corridors planted between remnant patches of natural forests	Facilitate movement of species and genetic exchange between isolated populations
Corridors or 'stepping stones' planted along altitudinal and longitudinal gradients	Facilitate movement of species in response to environmental stresses such as climate change
Steep slopes	Protect erosion-prone soils
Riparian strips	Protect erosion-prone soils and act as filters to limit sediments reaching waterways. Act as corridors for species movement
Areas subject to sheet erosion and with compacted soils	Protect erosion-prone soils and increase infiltration capacity
Groundwater recharge areas in salinity-prone areas	Increase evapotranspiration thereby increasing depth of water table and decreasing salinity problems
Coastal protection zones	Decrease storm impacts
Urban areas	To improve recreational opportunities

Source: Lamb et al. 2012

2011). The Restoration Opportunities Assessment Methodology, developed by the International Union for Conservation of Nature and WRI (IUCN/WRI 2014), has been applied at the national level (e.g., Ministry Natural Resources—Rwanda 2014). The primary purpose of such assessments is to identify the types of degradation to overcome and identify the areas to prioritise for restoration. An example of national-level FLR prioritisation is illustrated in the map of priority areas for forest landscape restoration in Uganda (Figure M1.1).

Assessments may be based on environmental degradation criteria (i.e., what are the problems?) that may or may not be accompanied by feasibility considerations such as cost, access, etc. In the Atlantic Forest Restoration Pact, for example, anticipated increased population and food needs dictated a two-pronged approach of keeping agriculture on lands already cleared (avoided deforestation) by intensification and targeting low productivity lands for restoration (Brancalion et al. 2013). Due consideration was given to avoiding leakage. Where higher productivity lands have fragile or rare habitats, the goal was to protect them legally. Restoring ecological functioning to cleared or degraded lands by regenerating forests may prioritise some areas; examples are given in Table M1.3.
Assessments provide a menu of degradation problems but selecting goals needs to be a collaborative process with many stakeholders. Lamb et al. (2012) suggest that the combined top-down and bottom-up approach used for land use planning in many countries is a useful model. Typically, this involves a regional planning group developing several alternative restoration scenarios and then presenting the alternatives to stakeholders for discussion.

Table M1.4

A typology of goals for forest landscape restoration

	Main Goals
Ecosystem goals	Connectivity for wildlife
	Strengthening the value of protected areas
	Securing endemic plant species and maintaining genetic pool
	Ecosystem resilience
Both ecosystem and socio-economic goals	Water protection
	Soil stabilisation
	Carbon sequestration
Socio-economic goals	Alternative income generation
	Building capacity in alternative approaches to tree planting
	Improved agriculture and agroforestry
	Cultural values
	Knowledge of indigenous species and restoration
	Education and awareness-raising purposes

Source: Mansourian and Vallauri 2014

Whole-island planning for conservation, Manus, Papua New Guinea.
Photo © James Hardcastle

The stakeholder group may choose one of the alternatives or develop a new alternative of their own, which could combine elements of the original proposals or something new. Examples of this approach can be found in Bourgoin and Castella (2011) and several chapters in Stanturf et al. (2012). The approach is inherently iterative, allowing for full participation of stakeholders, who may individually have an agenda or specific interests that may conflict with the interests of other stakeholders. An advantage of FLR is the ability to manage trade-offs; the restoration scenarios should offer a menu of approaches that can be accommodated within a landscape. A typology of goals (Table M1.4) can also be a helpful means of identifying categories of objectives (Mansourian and Vallauri 2014).

Identifying all the individuals or organisations holding a stake in an FLR project is not an easy task. Obvious stakeholders are those owning or managing land located in the landscape. Organisations with a direct interest are likely to be the relevant national and local government agencies responsible for managing lands, conserving habitat, protecting species and regulating land uses. In many countries, where land ownership is vaguely defined and tenure rights there may be overlapping (see Module 2), the principles of Free Prior and Informed Consent (FPIC) applies (FAO 2016).

Differences among stakeholders in technical knowledge, financial resources, power and influence mean that it is difficult to guarantee that everyone will be able to express their views. Even more challenging will be maintaining their commitment and participation over the long-term required for fully implementing FLR (Lamb et al. 2012). Capacity building, especially of local stakeholders, will be critical to long-term sustainability and successful restoration (Brancalion et al. 2013).

Phase 3. Designing the FLR project is the process of turning goals into clear and measurable objectives and actions, and identifying starting and ending points for restoration of specific landscape elements. Deciding on objectives begins with a shared understanding of the initial conditions (a baseline) in terms of both ecosystem and social characteristics (Table M1.5). From this common foundation, four general questions arise: Has the underlying cause of degradation been addressed? What needs to be repaired or improved? What needs to be maintained or preserved? What are feasible interventions?

A flexible approach to implementing FLR at the local level is project cycle management (Figure M1.2). Inputs to the process come from the preceding FLR phases;

Table M1.5 Generic types of biophysical, ecological, and socioeconomic data needed for baseline characterisation

Data Types	Examples
Biophysical	Land cover, geomorphology, soil properties (including water infiltration and erosion) and climate (including climate scenarios and projected climate-change-related disturbances);
Ecological	Species information, inventories, genetic diversity, distribution maps, ecological processes and environmental services;
Socioeconomic	Demographic variables (such as age and household size), living standards, livelihood strategies, ability to adapt, social environments, gender relations;

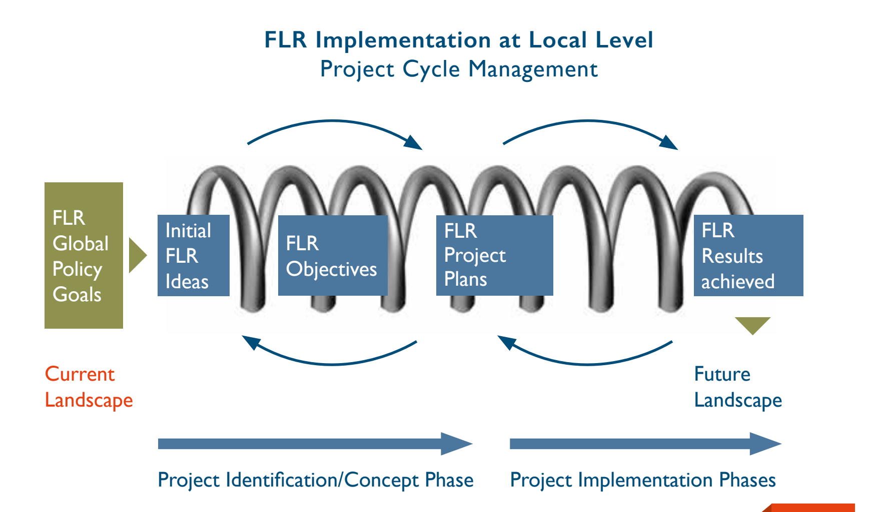

Figure M1.2 Project cycle management – a flexible approach to project implementation
Source: adapted from European Commission 2004

visioning produces the overall FLR goals and conceptualising develops the initial ideas or alternative scenarios. Turning these generalised ideas into concrete, measurable objectives constitutes the design phase that answers the question, "What do we wish to accomplish?"
The baseline should give a clear description of the starting point for the FLR project while the objectives collectively describe the desired endpoint: a restored landscape (see example in Box M1.1).

For large projects with diverse landscape conditions, it is advisable to break the landscape down into smaller, relatively homogeneous units for planning specific interventions. Mapping important attributes of the landscape that relate to goals may be used to

Box
M1.1

The process of turning goals into objectives can be illustrated with an example from Rwanda (IUCN/WRI 2014). The national goal of "increasing forest cover and restoring degraded land" arose from the ROAM assessment (IUCN/WRI 2014). From this goal, several objectives emerge. Protecting and restoring natural forests was one objective that included sub-objectives of planting 3,000 ha of new forests on cleared land using native species, replacing 20,000 ha of non-native *Eucalyptus* plantations with native species and planting 100 m buffers of native forests around natural areas. Another objective was to restore degraded areas within parks and reserves. Other goals for FLR in Rwanda include introducing agroforestry in order to reduce soil erosion, improve management of woodlots to increase productivity, and provide access to clean water. Clearly, one objective may contribute to several goals, and attaining each goal may require more than one objective. In short, goals are not necessarily mutually exclusive and multiple benefits can be gained from an objective.

identify baseline conditions. For example, the Atlantic Forest Restoration Pact in Brazil mapped degraded areas, eligible areas for carbon projects under the Verified Carbon Standard (VCS), urban water supply areas needing restoration, and priority areas for improving connectivity (Brancalion et al. 2013). In Rwanda, steep slopes, riparian zones and protected areas were mapped and objectives set for each.

Describing the causal mechanisms for how interventions move a current landscape unit from baseline, degraded condition to the restored future landscape condition enables identification of important intermediate conditions along a restoration trajectory that can be used to design efficient monitoring. If monitoring indicates significant deviation from the expected trajectory, further corrective interventions may be needed. Remember, FLR is a long-term process!

Phase 4. Implementing the project design means developing detailed plans for activities that will result in accomplishments or meet the objectives. Key elements of a plan are sequenced lists of what will be done, where, when, by whom and at what cost.

Riparian zone, Rwanda.
Photo © Janice Burns

Monitoring is a key element of implementation. The key questions to be answered in Phase 4 are "What will be done to accomplish objectives and how will we know if we are successful?" For example in Rwanda, we deconstructed the sub-objective of "planting buffers of native species along rivers to protect water courses" into several specific activities, one of which is: "by October 2016, local farmers will plant 100 ha of native species in 20m buffers along rivers in Kigali Province." Of course, this is just the beginning of the actual planning.

Tree nursery, Rwanda.
Photo © Michael Kleine

The many decisions needed often cascade into other decisions and considerations. For example, deciding on which species to plant means knowing what species are adapted to local ecological conditions and available in Rwanda (or introduced from other countries in East Africa). The desired species may be those that serve multiple purposes such as timber, fuelwood, food, non-timber forest products, or rapidly sequester carbon. Critically, who chooses the species? Where the planting will start; will it be on public or private land? Are there funding or programme objectives/constraints that affect the decision, such as cost? In Rwanda, as in many other countries, there are import restrictions, so unless policies are changed, obtaining material from other countries is precluded.

Implementing restoration requires consideration of many logistical factors, especially with biological material. There is generally an optimum time for planting seedlings, depending on local weather conditions and planting stock. Working back from planting season, how much lead-time is needed to procure planting material or must a local nursery be established? How long will it take to get seed and grow seedlings? In many tropical countries, commercial infrastructure may be lacking. Even in developed countries, nurseries may be oriented toward commercial timber trees or horticultural plants; native species may not be available.

Different planting designs are available to meet different objectives (e.g., Stanturf et al. 2014a); choice of design and area to be planted determines how many seedlings are needed. Species selected and site conditions influence the activities needed to prepare the planting sites, possibly months before planting begins. Because restoration is a long-term process, further tending may be needed such as thinning; this will need to be scheduled and noted in project documentation. In addition, it is important to document how, when and where interventions were conducted, and to geo-reference these activities on GIS data layers; this information will be useful in designing the monitoring protocol.

Monitoring is an integral part of project implementation (see Module V for more details). The reasons for monitoring are for documenting, reporting, learning, adapting and communicating. Specifically, monitoring is needed to gauge short- and long-term success; to determine if, and when further intervention is needed; and to identify unintended consequences that threaten the sustainability of the restoration project. If the FLR project incorporates smaller site-level restorations or pilot projects, it will be necessary to harmonise multiple stakeholders' methods to allow valid comparisons (Brancalion et al. 2013).

Key questions:

- *Is there a clear and agreed vision?*
- *Have priority landscapes (or priority areas within landscapes) been identified?*
- *Have assessments been made for each landscape?*
- *What are the objectives and are they measurable?*
- *Are baselines clear?*

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MODULE II.
Governance and Forest Landscape Restoration

This module focuses on governance and FLR implementation, particularly on challenges related to governance. Because people are central to an FLR effort, this module begins with a discussion of stakeholders before discussing governance more generally.

Stakeholders

Who are stakeholders?

Proponents of restoration will be the first stakeholders engaged in the restoration process. However, numerous other stakeholders will be implicated, or at least affected by the restoration process. This is particularly true when restoration takes place within a large scale such as a landscape. Stakeholders are "persons, groups, or organizations that must somehow be taken into account by leaders, managers, and front-line staff" (Bryson 2004).

They may be categorised according to their sector: private, public or civil society. For example, the forest authority and the local government authorities will be public sector stakeholders. Private sector stakeholders will be private landowners, forest owners, or logging companies for example operating within the area. In contrast, civil society may be communities living within the landscape or NGOs working on environmental conservation in the area.

Another way of categorising stakeholders will be to consider whether they are affected as winners or losers from the restoration effort. For example, restoration on private land may cost landowners, thereby potentially making them losers. On the other hand, the benefit of this restoration effort in terms of shade, wind protection for crops and soil protection, may in fact turn them into winners.

Another means of considering stakeholders is by their stake in the landscape. Are they landowners? Are they users of ecosystem services? Is the area sacred for them or does it hold some other cultural significance? Understanding how stakeholders relate to the landscape and the forest is critical to engaging them in the restoration effort and to ensuring their full participation.

Checklist

- *Who owns the land?*
- *Who is affected by the restoration endeavour? (and how?)*
- *Who benefits and who loses?*
- *Are there mechanisms to compensate losers?*
- *What are stakeholders' attitudes to the restoration effort?*
- *Do stakeholders have the capacity to participate or do they need it built?*
- *Are there institutions to support stakeholder participation?*

Engaging stakeholders

A first step in any restoration effort is to identify and engage all key stakeholders. Engagement can take place to varying depths:

Stakeholders may for example:

- *Provide their seal of approval*
- *Be a silent participant at relevant planning meetings*
- *Actively support and engage in the planning of restoration*
- *Earn money actively through implementing restoration (e.g. via seed collection, tending nurseries, planting saplings, tending saplings etc.)*
- *Engage in the monitoring of the restoration effort*

Stakeholder mapping tools are useful to not only identify stakeholders but also to better define their stakes in the restoration effort and to engage them in a dialogue.

Some tools include:

- ***Alignment, Interest and Influence Matrix*** *(AIIM) (www.odi.org.uk/publications/5288-stakeholder-engagement-stakeholder-analysis-aiim-alignment-interest-influence-matrix-roma)*
- ***Participatory Impact Pathways Analysis*** *(PIPA) (http://boru.pbworks.com/w/page/13774903/FrontPage)*
- ***Network Mapping*** *(Net-Map) (Schiffer and Hauck 2010)*
- ***Social Network Analysis*** *(SNA) – (http://en.wikipedia.org/wiki/Social_network_analysis)*

For example, in the Atlantic Forest Restoration Pact (AFRP) over 250 stakeholder representatives were engaged via a complex governance architecture intended to ensure broad membership, engagement and participation across the wide area represented by the Atlantic Forest (Pinto et al. 2014).

Stakeholders can be engaged in restoration at different levels:

- *They may provide their seal of approval*
- *They may be a silent participant at relevant planning meetings*
- *They may actively support and engage in the planning of restoration*
- *They may earn money actively engaging in the implementation of restoration (e.g. via seed collection, tending nurseries, planting saplings, tending saplings etc.)*
- *They may engage in the monitoring of the restoration effort*

Left picture: Participatory community planning for ecotimber and forest management, Chivoko Solomon Islands. Right picture: Ka Tu girls mapping, Song Thanh Nature Reserve, Vietnam.
Photos © James Hardcastle

Understanding objectives of other stakeholders

Because each individual stakeholder and stakeholder group comes from their own personal circumstances, with their own needs, desires and wishes, it is important to recognise these and to understand their desired objectives from the restoration endeavour (and/or from the landscape). For example, landowners may wish to convert their land to pasture to graze cattle and may be against any attempt at restoring forest cover. Other landowners, on the other hand may perceive the benefits of restoration and wish to include certain valuable species on their land. Negotiating with stakeholders may prove to be a lengthy process for FLR, but is essential to ensure ownership and therefore, long term sustainability of restoration results.

Stakeholders' objectives may be split according to:

- *their desired future state of the landscape*
- *specific areas they would like to restore within the landscape*
- *specifics goods and services they wish to restore*
- *ecosystem functions they feel need to be restored*
- *specific tree species (species mix) they would like to restore*

Individual discussions with stakeholders will help to understand their objectives. Equally, user group discussions may be useful to bring different stakeholders together or different stakeholders from the same group together. Objectives evolve over time, and with changes, notably climate change, but also economic and political changes, these objectives may fluctuate or require adaptation. Nevertheless, it is important to have a common vision or overall direction towards which stakeholders agree to aim, while acknowledging the need to revisit steps along the way.

Conflict and negotiation

Once objectives have been aired, it may appear that different stakeholders desire different things from their landscape, leading to potential conflict. The process of stakeholder engagement will require negotiation, an understanding of power relations and discussion of trade-offs (Table M2.1). Win-win solutions are not always apparent, and trade-offs and compromises may be necessary. This is particularly true when it comes to restoration that implies a change in land use.

Left picture: Community mapping for conservation, climate change and cultural heritage management, BoeBoe, Choiseul, Solomon Islands. Right picture: 3D model used in whole-island planning for conservation, Manus, Papua New Guinea.
Photos © James Hardcastle

Potential losers may be compensated through:

- *Payments for ecosystem services*
- *Subsidies*
- *Job-creation*
- *Other in-kind benefits (e.g. building of a school, provision of a service, training etc.)*
- *Access to products from the restoration effort (e.g. fruit, nuts, fuelwood)*

Useful negotiation tools include simple conceptual models such as 3-D models of the landscape where stakeholders can visualise the impact of restoration (see e.g. Hardcastle et al. 2004).

Capacity building

In order to engage in restoration fully, many stakeholders will require new skills. Frequently for example, landowners and the forest service are only aware of techniques to restore a small number of species. This was the case in New Caledonia, where until recently nurseries sold essentially exotic species, and much effort was spent on training experts in commercial nurseries in the reproduction of indigenous species, thereby, making these species more widely available to the public (Mansourian and Vallauri 2014). In order to expand the range of species used, particularly focusing on indigenous species, requires acquisition of new knowledge.

At a more fundamental level, relevant but not directly related skills may be necessary. For example, in order to engage better with other land users, specific negotiation skills may be necessary. Also in cases where payments may be part of a project, financial management skills may be required before participants can engage in a restoration project.

Key questions:

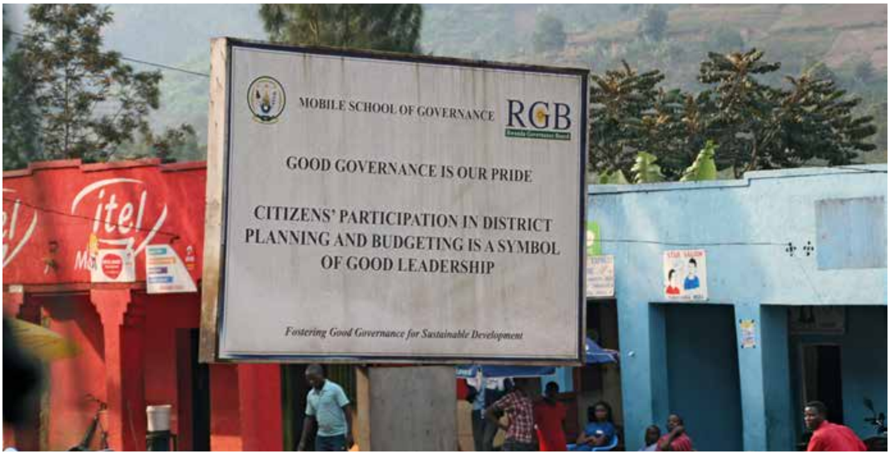
- *Who are the stakeholders? Do we understand where they are coming from? (What is their context?) How do we engage them?*
- *Do we have the skills in our team to negotiate with stakeholders?*
- *How can we address potential conflicts?*
- *What sort of governance structure can we rely on?*
- *Have issues of free, prior and informed consent (FPIC) been taken into account?*

Some Principles and Skills Involved in Negotiating Forest Landscape Restoration

Table M2.1

Be clear on what everyone means by the issue and the problems, opportunities, and people/agencies involved Adopt a positive attitude, for example, being clear that conflicts are not just problems but also opportunities Have in mind some kind of a route map, some idea about ways in which key stakeholders wish to proceed Address role, responsibility, and legitimacy issues, including the limitations (boundaries) to your negotiating authority Build and maintain effective rapport and relationships Active listening Identify high-quality, relevant questions Embrace multiple perspectives and perceptions Build on what is already there (including cultural aspects of conflict management and problem solving) Consider process (law, custom, institutional) as well as structural conflicts and conflicts of interest Keep in mind options for withdrawing or not getting involved further Keep an eye on capacity building for self-development and organisational development Separate and focus on the problem and not on the personalities Separate and focus on underlying needs and motivations, not initial positions Know what you would do if the negotiations did not work, perhaps because the other party broke the ground rules or tried to use unacceptable force (this is also called knowing your BATNA: best alternative to a negotiated agreement; see Box 18.1) Seek, explore, and emphasise common ground Put your case in terms of their needs, not just why you want something	The more you know about the other's position, the better able you are to find consensus-based solutions; do some homework to find out their situation Maintain a creative, positive approach Use paraphrasing and other communication skills to understand and describe the other's points Create a positive environment for the negotiation (think about the physical setting, the comfort and acceptability of the place, the time, and the way you manage yourself) Look for an early, small success (reach agreement on something early, even if that is just the venue, then emphasise that agreement; common ground—start small) Make sure your preparations are as complete and accurate as possible. Write down what you have done to prepare. Check with a colleague. Check with another colleague. Seek constructive feedback. Keep in mind: The process and conflict management style Your goals and boundaries (your limit or bottom line) Opportunities to address power inequalities Your colleagues' needs, expectations and ability to act as resources Your personal values and principles Time and space for reframing issues Capacity building needs that may emerge The needs for more analysis that may emerge Multiple perspectives and perceptions can be useful. A diversity of opinion helps us shed light on the issue from different directions. Treat difference and diversity not as an emotional trigger to fight against, but as a moment of opportunity to engage with.

Source: from Jones and Dudley, 2005



"Good governance is our pride" Rwanda.
Photo © Janice Burns

Governance

While many definitions of governance exist, what they all have in common is people (categorised for example as stakeholders, actors, partners or groups), decision-making actions (such as shaping, deciding, influencing etc.) and tools that enable people to make those decisions (e.g. rules, regulations, institutions, policies etc.). (Mansourian 2017). Understanding the extent to which governance influences the FLR process helps to define strategies to turn governance challenges into governance opportunities.
Key aspects of governance that directly affect FLR implementation are ownership and tenure rights, and stakeholder engagement.

Unclear or insecure tenure frequently leads to deforestation and/or poor restoration choices.

- *It can affect the choice of species used for restoration*
- *It can affect the place where trees are restored in a landscape*
- *It can affect who gets involved in the restoration effort*
- *It can affect the value granted or not to regenerating trees*
- *Ultimately, it can affect sustainability*

How do tenure and ownership issues relate to FLR?

In many tropical countries, there are *de jure* owners (generally, the government) and *de facto* owners (generally, traditional and indigenous communities). While the former have official titles to the land/forest under modern legislations, the latter may consider it theirs by virtue of traditions spanning centuries. Several countries tolerate the overlapping claims, but the lack of clarity frequently leads to conflict, especially when it comes to changing land use, such as by restoring tree cover. Indeed restoring tree cover may alter the designation of an area (from agricultural land to forestland for example) or change its value thereby, generating external interest. Understanding who owns the land and forest is necessary before engaging in FLR. This is particularly important, as within a landscape there are likely to be several owners and possibly overlapping rights. Furthermore, in some countries, ownership and access rights to forests differ from those to trees or tree products or even the services from trees. Therefore, for successful

Typologies		Table M2.2
Ownership	■ **Private property** - rights belong to an individual, a married couple, a group of people, or a corporate body such as a commercial entity or non-profit organisation. ■ **State** - property rights assigned to the public sector. ■ **Communal** - where the rights of commons may exist within a community, may be owned by Indigenous Peoples and local communities who have full legal rights to secure their claims to forests. ■ **Owned by the state but designated** for use by Indigenous Peoples and local communities who have some rights ■ **Open access** where no specific rights are assigned to anyone and no-one can be excluded	
Rights	■ Right of **access** to a forest or land area; ■ Right of **withdrawal** of goods from the land/forest; ■ Right of **management** which relates to regulation of use of the area; ■ Right of **exclusion** which enables rights holders to legally keep others off the property: ■ **Alienation** right which is the ability of rights holders to sell the property.	

Sources: FAO 2002; RRI 2014; Schlager and Ostrom 1992

restoration it is important to have an adequate understanding of such claims and to reflect them in FLR plans.

Based on a sample of 52 countries, the Rights and Resources Institute (RRI) estimated in 2014 that 73% of the world's forests were under state ownership. An estimated 11% were under private ownership, 12.6% were under communal or indigenous ownership while indigenous peoples and local communities controlled 2.9% (RRI, 2014). Even in the western world, there are only a few countries where private individuals (e.g. Portugal, Finland, Austria, Norway and Sweden, amongst others) own the majority of forests. In many instances however, in part due to colonial legacies, ownership and access rights are contested, with overlapping claims to land and forest by different entities. Different rights apply to each type of control (see Table M2.2.).

Plantation carried out Haryana Forest Development Corporation (HFDC) for Indian Railways.

Photos © Haryana Forest Development Corporation (HFDC)

Photo © Haryana Forest Development Corporation (HFDC)

Whatever the ownership, when it is clear and there is one owner, restoring forests is relatively straightforward and falls under the responsibility of the owner, with or without support from outside, and with or without an incentive or a duty to restore. However, frequently, in larger areas such as landscapes, several landowners may need to agree on their desired outcomes for restoration. In addition, where there is a lack of clarity or contested claims over land and/or forests, restoration becomes more challenging. In some instances, successful forest landscape restoration may require talking to several individual landowners (e.g. in Paraguay, see Mansourian et al. 2014) so as to meet objectives of restoring a forested landscape. Thus, complexity arises when: a) there are several owners and b) ownership and access rights are contested. Nevertheless, that does not signify that FLR cannot be undertaken. Pilot demonstration projects may serve to engage and enthuse stakeholders, while larger scale challenges may need to be tackled in parallel.

Recent attention to restoration under the global climate convention (UNFCCC) has brought about the realisation that in many instances formal deeds do not exist or there are overlapping claims, and communities that manage many forested areas do not have a formal title to that area. This has proven to be a challenge notably for restoration under REDD+ (reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stock) where not only are there issues associated with the ownership of land and trees, but also of the carbon sequestered through the trees. In this latter case for example, it becomes unclear who the recipients of carbon payments should be (Cotula and Mayers 2009).

To add to the complexity, in many societies, rights to land, trees and tree products may each be held by different stakeholders (Bruce et al. 1993). For example, in Morocco the state owns all argan trees, even if they are on privately owned land (Biermayr-Jenzano et al. 2014). In some cases, the restoration of trees or tree cover may stake the claim of one stakeholder over another. In many countries, regenerating trees are by default state property; however, the fruit on the trees may be open access. For example, in Cameroon, while people may own trees on their land if they plant them, that is not the case for trees regenerating naturally (Cotula and Mayers 2009). The principles of Free Prior and Informed Consent apply in many countries with vaguely defined land ownership and possibly overlapping tenure rights, (FAO 2016).

Boundary between a fully protected Sal (*Shorea robusta*) forest (Rajaji Tiger Reserve, Uttarakhant, India), pictured right, and forest open to grazing and fodder production, pictured left.
Photo © Michael Kleine

Free Prior and Informed Consent

- ***Free***: *Consent given voluntarily and without coercion, intimidation or manipulation.*
- ***Prior***: *Consent is sought sufficiently in advance of any authorisation or commencement of activities, at the early stages of a development or investment plan, and not only when the need arises to obtain approval from the community.*
- ***Informed***: *Engagement and information should be provided prior to seeking consent and also as part of the ongoing consent process.*
- ***Consent***: *Collective decisions made by the rights-holders that are reached through the customary decision-making processes of the affected Indigenous Peoples or communities.*

Why are tenure and access rights important?

While tenure cannot always be easily (or rapidly) clarified and addressed, it is an important pre-requisite to successful restoration. Without secure tenure, there is limited incentive to invest in restoring landscapes, leading to short term thinking. Investment may take place through opportunity cost (not using the land for something else) or through actual expenditure (e.g. seedlings, fertiliser, labour etc.) Secure access to the trees and the products from the trees is also important to ensure that there is an incentive not only to restore but also to maintain trees once they have been planted or once natural regeneration has taken place. Conflict over restored areas may be generated when restoration takes place on areas of land or forests that are being contested or where there is a lack of clarity over ownership or rights. In such cases, restoration may be perceived as a hostile attempt to stake a claim.

Impacts of unclear and/or contested tenure FLR:

- *Lack of incentive to invest in land and forests*
- *Lack of incentive to invest in inputs and labour*
- *Short-term thinking*
- *Conflict*

Key questions:

- *Is land/forest ownership clear?*
- *Are there several owners?*
- *Is ownership contested?*
- *Are their open or latent conflicts over ownership and/or access/rights?*
- *Are formal deeds available?*
- *Is ownership recognised in some legal form?*
- *Is ownership of restored trees and benefits from trees clear?*

Governance structures

Different governance structures can be applied to a landscape, and these may generally be organised as a hierarchy, a network, or a hybrid structure. For example, the Bonn Challenge commitment made by the US Forest Service (15 million hectares; Schultz et al. 2012) and the post-war restoration of South Korea (Lee and Suh 2005) were both hierarchically organised. The Atlantic Forest Restoration Pact in Brazil is a network (Brancalion et al. 2013) that brought together many small restoration projects already underway into an umbrella initiative. In a severely fragmented landscape, a hybrid organisational structure would be appropriate where an external driver such as a government agency implemented FLR by providing incentives to small landowners to undertake (or allow) restoration on portions of their land. An example of the hybrid organisation is the Wetlands Reserve Program and bottomland hardwood restoration in the southern United States (Gardiner and Oliver 2005).

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MODULE III.
Designing a Forest Landscape Restoration Project

FLR implementation on the ground always takes place within a rather complex reality, more often than not involving a wide array of stakeholders with differences in interest, lifestyle, socio-economic/political backgrounds and business models. Forest landscape restoration addresses them in a spatially explicit and ecosystem-driven manner that reconciles stakeholders' multiple needs, preferences and aspirations.

Key features of landscapes:

- *Landscapes and their components have multiple uses and purposes and they provide a diverse range of values, goods and services*
- *Each component is valued in different ways by different stakeholders*
- *Trade-offs exist among the differing landscape uses and need to be reconciled*

When setting up a project that aims to promote FLR and bring about lasting changes in the landscape, it is helpful to revisit the FLR hierarchical logic introduced in Module I (shown here in Figure M3.1), and highlight to all project partners the absolute need for developing a clear vertical logic (vision, goals, objectives). Based on this logic, one can then specify concrete results to be achieved within shorter (2-5 years) or medium (<10 years) timeframes.

FLR success depends on:

- *Identifying clear goals and turning them into measurable objectives*
- *Agreement among stakeholders on objectives; if there are disagreements, objectives can be prioritised*

In many countries, the vision, goals and more general objectives at the national level have already been identified and developed as part of ongoing policy processes such as the Bonn Challenge on forest landscape restoration or the New York Declaration on forests together with their regional offshoots (AFR 100, 20x20 in LAC etc.). Based on these higher-level goals, stakeholders can discuss and identify specific targets to be achieved at the landscape and local levels. This is essential for developing more concrete projects with detailed and reconciled plans of action, project steering arrangements, and monitoring processes.

Figure M3.1 illustrates the hierarchical logic of implementing forest landscape restoration. The hierarchy of goals, objectives and results to be achieved through concrete projects, plans and describes their main attributes such as meaning, measure, and time frame (Table M3.1). The examples in Table M3.1 were developed from the analysis

Time Frame: Longer-term → Short-term

Monitoring: General → Specific

FLR Strategy		Description
Project Conceptualisation Phase		
Vision	FLR is a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded landscapes.	
Goals	■ Restore degraded land ■ Increase forest cover ■ Provide access to clean water ■ Improve management of woodlots ■ Introduce agroforestry	■ Goals may refer to the entire nation or specific landscapes ■ Stakeholders identified and involved in setting goals ■ Target landscapes identified
Objectives	■ Establish protective forests on 50% of ridgetops and slopes >55% ■ Avoid exotic plantations in buffers around protected areas ■ Preserve corridors between PA ■ Eliminate row crop agriculture on 20-55% slopes	(see matrix below)
Project Implementation Phase		
Results Activities Monitoring	■ Site-specific targets to be achieved in specific area ■ Steps needed to accomplish the results (who, what, when, where, costs) ■ Continuous; different questions are asked at different phases of implementation	

Do we have it?	Do we want it? YES	Do we want it? NO
NO	Achieve	Avoid
YES	Preserve	Eliminate

Hierarchical logic of implementing forest landscape restoration **Figure M3.1**

of restoration opportunities in Rwanda (Ministry of Natural Resources-Rwanda 2014). From these examples, it becomes clear, that only the plan has sufficient specificity to guide actual implementation and – in addition – allows for adequate monitoring. Note, however, that the actions taken on the ground must be consistent with higher-level goals, thus all levels are needed for meaningful implementation of FLR.

One of the approaches called "Project Cycle Management" is a systematic framework (Figure M3.2), which helps to adequately design, plan, steer and monitor an FLR project within the context of a constantly evolving socio-economic, political and natural environment. To this end, this systematic framework allows for recurrent consultations with stakeholders, planning, steering activities, learning from intermediate results through monitoring, and thus provides the foundation for successful FLR projects. The coil illustrating the approach to project cycle management emphasises the revolving process of recurrent activities within the project and feedback loops. As shown in the second image these include informing, setting objectives, planning/deciding, motivating, organising, steering and controlling. As project implementation progresses, all project partners undergo a learning process that allows for changing project priorities, means of implementation and resources at regular intervals in the cycle, when this is deemed necessary.

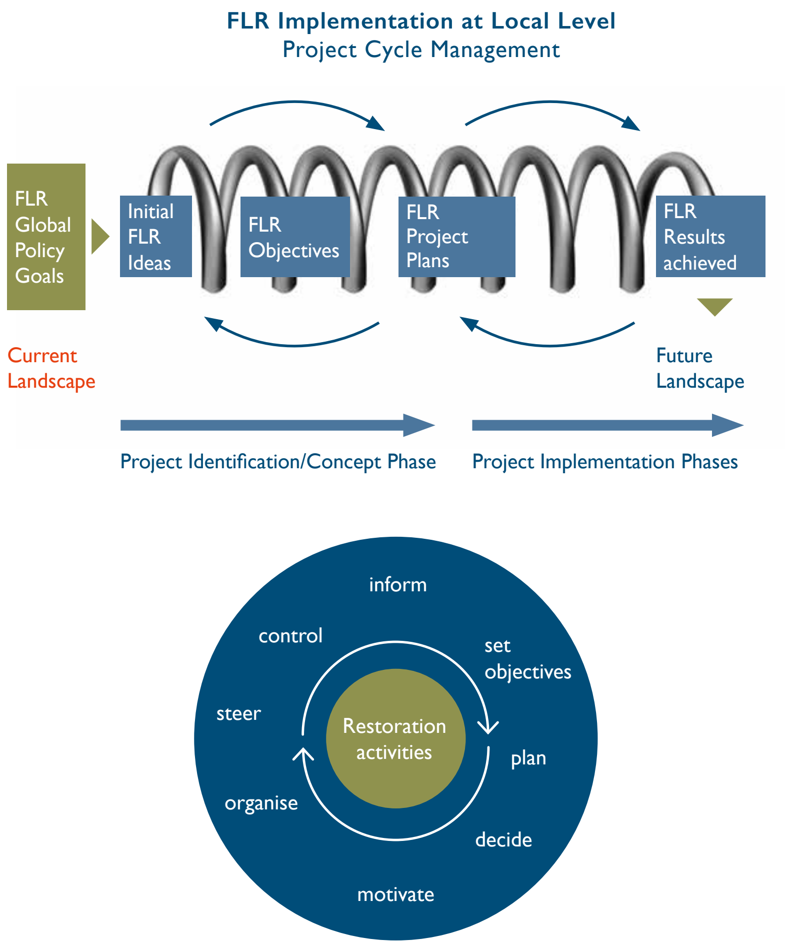
To achieve the restoration vision of the Bonn Challenge and related initiatives, the design of FLR projects should result in sustainable, resilient and diverse landscapes over

Table M3.1 The hierarchical logic in detail with examples from Rwanda

	Goal	Objective	Plan
Meaning	The purpose toward which an FLR project is directed	Accomplishments or targets of one's efforts or actions	Activities that will result in accomplishments or meet targets
Measure	Goals may not be strictly measurable or tangible	Must be measurable and tangible	Sequenced list of what will be done, where, when, by whom, at what cost
Time frame	Longer term	Mid to short term	Mid to short term
Example	Increase forest cover and restore degraded land Provide access to clean water Improve management of existing woodlots Reduce soil erosion by introducing agroforestry Contribute to climate change adaptation	Protect and restore natural forests ■ 3000 ha new forests ■ 20, 000 ha ***Eucalyptus*** replaced ■ 100m buffers natural forests planted around natural areas ■ Restore degraded areas within reserves and parks	Plant 100 ha native species in 20m buffers along rivers in Kigali Province in October 2016 by local farmers

the long-term. Such projects can differ significantly in terms of complexity depending on the number and diversity of stakeholders, thematic focus and the means employed to achieve the objectives. In all FLR projects, the first phase always is about the identification of potential project objectives involving a solid analysis of the so-called outset situation and consultations with potential stakeholders. This analysis will reveal the level of complexity inherent in the project. The level of complexity has significant implications on the duration of and progress expected from the project, as well as the type of activities contemplated. For example, re-vegetating ex-mining sites at larger scale are rather straightforward projects with only moderate complexity in terms of consultation with stakeholders; nevertheless, they may be technically challenging. Often the mining permits specify the requirements for reclamation and the challenge is enforcing the requirements.

In practice, the majority of FLR projects, particularly those in economically disadvantaged countries, are definitely more complex as they frequently take place in rather densely populated regions and attempt to improve the livelihoods of poor rural communities while simultaneously enhancing environmental quality and services. Under such conditions, project cycle management offers a systematic but still flexible approach to project design and implementation. In the following section, an example from Ghana



Project cycle management – a flexible approach to project implementation *(Source: adapted from European Commission 2004)*

Figure **M3.2**

(Offinso District) illustrates the major components of project cycle management, particularly in the initial phase preparing the ground for forest landscape restoration: https://www.fornis.net/system/files/FORNESSA%20Factsheet%20Ghana%20final.pdf.

The actual activities in the project cycle commence with the following assumptions:

- Stakeholders setting goals and participating in the project have already been identified;
- Tenure relationships in the project area are understood;
- The landscapes targeted for restoration have been identified; and
- Project planning cycle is understood.

Project Identification/Concept Phase

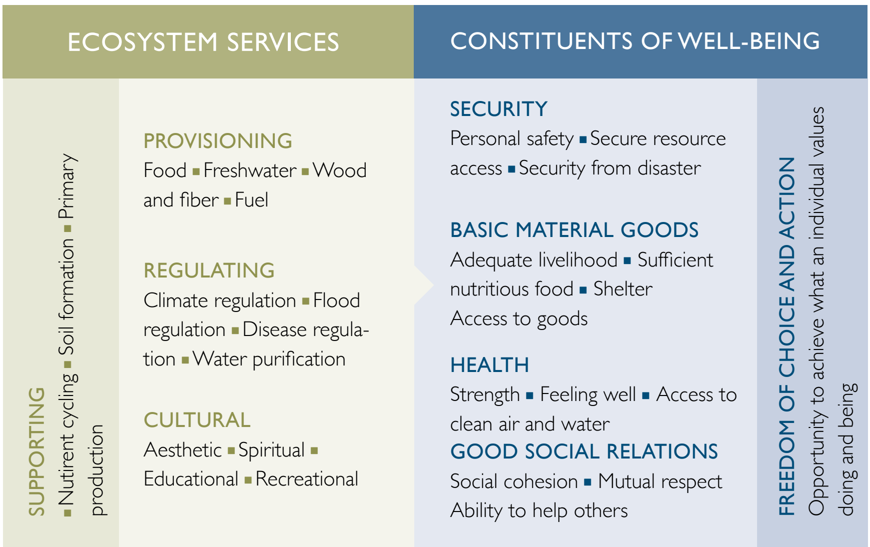
Designing a sustainable project begins with developing sustainable objectives, objectives that are scientifically valid, technically feasible, and socially acceptable. Restoration objectives may be constrained or limited by policies that must be changed or modified, governance challenges, programme objectives or funding sources that may limit

Table M3.2

Focus restoration objectives on maintaining, increasing, or improving ecosystems functions (regulating, supporting, provisioning and cultural functions)

Maintain, Increase or Improve Ecosystem Functioning	
Ecosystem Function Category	**Description**
Regulating Functions	Maintenance of essential ecological processes and life support systems
Supporting Functions	Providing habitat for wild plant and animal species at local and regional scales
Provisioning Functions	Provision of natural resources
Cultural Functions	Providing life fulfilment opportunities and cognitive development through exposure to life processes and natural systems

Source: MEA 2005



Relationships of ecosystem services to human well-being
Source: MEA 2005; Pramova et al. 2012

Figure M3.3

the kinds of restoration activities that can be implemented. Private actors in particular may have legal or certification requirements that place restrictions on some activities or conversely, provide opportunities for restoration to take place in parts of the landscape for example riparian areas (as is the case with legislation to restore riparian forests in Paraguay and Brazil for example). Focusing objectives on maintaining, increasing or improving ecosystem functions (Table M3.2), rather than aiming to re-create historic conditions, increases the likelihood that an FLR project will be sustainable and improve the well-being of affected communities. Ecosystem functions can be related to human well-being (Figure M3.3) in ways that support freedom of choice and action (Pramova et al. 2012).

Deciding on objectives as part of the concept phase begins with a shared understanding of the current conditions and the desired future landscape attributes. Engaging stakeholders to develop this common understanding of what is needed and what is feasible is the starting point for developing objectives. Different stakeholders may have different objectives and achieving consensus may be difficult, but if everyone agrees on the overarching objectives, trade-offs and compromises can be identified before delving into the details. If there is a legacy of mistrust, it may be necessary to build trust by identifying short-term objectives and easy-to-reach intermediate targets. Bringing in an external (neutral) facilitator may help the negotiation process.

Deciding on objectives begins with shared understanding of:

- *Baseline of ecosystem and social characteristics*
- *What needs to be repaired or improved?*
- *What needs to be maintained or preserved?*
- *What are feasible interventions?*

In the Offinso District in Ghana, it was not surprising that local people were well aware of the ongoing processes of land degradation. Causes were unsustainable agricultural practices, over-exploitation of timber resources (both legally and illegally), regular occurrence of forest fire, increasing populations, inadequate governance through weak institutions and corruption, and insufficient involvement of local chiefs in land management decisions.

Based on this analysis, the stakeholders elaborated a number of strategies including: (a) community based fire prevention; (b) establishment of community woodlots for firewood and domestic use; (c) community-based enterprises as alternative livelihood schemes; and (d) promotion of on-farm agroforestry practices. Although these multiple objectives have, in the long term, a better potential of transforming the landscape to provide environmental goods and services, including climate benefits, it is unrealistic to expect them all to be addressed from the start of the project.

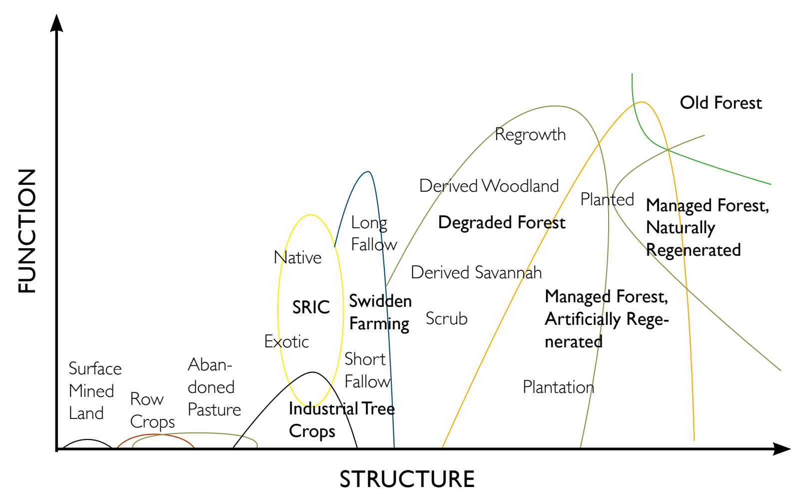
Stakeholder consultations in Offinso District, Ghana.
Photo © Ernest Foli

Therefore, another round of intensive consultations with stakeholders was needed to prioritise the objectives. These resulted in a decision to commence with forest landscape restoration by establishing a community-based fire prevention and management system on a demonstration scale, self-financed by local villagers. Such an approach would help convince other communities to also enter into this initiative, thus significantly reduce uncontrolled vegetation burning in the region. Due to the fact that such fires cause heavy damage to forests and agricultural crops, their reduction would also help increase annual harvests and improve overall environmental quality.

Bringing together diverse stakeholders to develop a common understanding of the landscape is a necessary starting point within the concept phase of designing an FLR project. This includes an awareness of the wider context of environmental and social variables that affect the landscape now, and those that will likely do so in the future. Formally modelling the system may be attempted, but if resources are insufficient to construct a quantitative model, a simple diagram may suffice. If degraded areas needing restoration have already been identified, for example by a national process such as the ROAM (Ministry Natural Resources—Rwanda 2014), landscapes targeted for restoration may be known. Even so, target landscapes will need to be divided into smaller, relatively homogeneous units based on biophysical and socioeconomic factors in order to plan restoration activities. Continuing the example from Rwanda, an objective to eliminate row cropping on steep slopes means that cropped slopes need to be mapped, along with any other factors such as differences in tenure that potentially affect feasibility or sustainability of planned restoration treatments.

Project Implementation Phase

The actual implementation phase is composed of a mix of activities ranging from organising demonstration sites and/or operations, holding workshops in order to further



Conceptual model of land use condition based on vegetation structure and ecosystem function

Source: adapted from Stanturf et al. 2014b

Figure M3.4



Following an El Nino related wildfire about 30 years ago, the landscape in Northern Sabah (Pulau Jembogan) has been invaded by Imperata grassland (*Imperata cylindrical*) and fern cover (top/middle image foreground). In 2011, part of the degraded area was planted with fast-growing tree species (plantation close-up, bottom) as a first step to re-establish productive forest cover (top/middle image background). Without intervention the entire area would likely look the same as the degraded areas in the foreground.

Photos © Robert Ong

explain FLR objectives and specific actions to be taken, motivating new stakeholders to come on-board, training of FLR facilitators and extension staff and so forth. Thus, the implementation phase is all about explaining, informing, organising, steering, monitoring and evaluation. Besides these activities, the implementation phase is also the time to develop a deeper understanding of what should be achieved with FLR in the long term.

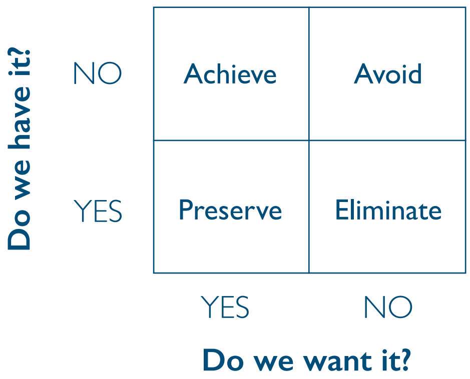
Well-defined expectations are a hallmark of successful restoration and must include in addition to the starting point and desired endpoint, the mechanism and trajectory of change. Historic conditions as endpoints (e.g., reference sites) or regaining historical trajectories of ecosystem development as a guide may not be adapted to future conditions. A diversity of forest and non-forest conditions may best be suited to meet multiple social needs. Plotting starting point and desired end points on Figure M3.4 is a way to visually indicate the restoration trajectory. For example, moving from row cropping on slopes could be in the direction of agroforestry or a planted forest; either endpoint is in a less degraded space than row crops.

There are no consensus definitions of forest degradation but land use/land cover conditions can be arrayed according to structure and function. Certainly, a multi-layered, species-diverse old forest and mined land spoils represent the two extremes of the spectrum, but many terms for intermediate conditions overlap in the situations they name.

A simple way to guide the discussion and summarise objectives is to focus on two questions: Do we have the conditions we want; and do we want a given condition? The four possible outcomes are summarised in Figure M3.5. For example in Rwanda (Figure M3.1), row crop agriculture was practiced on steep slopes due to scarcity of arable land, with resulting accelerated erosion. A goal in Rwanda was to reduce soil erosion; answering the two questions ("yes we have it", "no we don't want it") resulted in an objective to *eliminate* row cropping on slopes greater than 20%. How to achieve this objective is answered in the implementation phase.

Example objectives from Rwanda:

- ***Achieve*** *(establish) protective forests on 50% of ridgetops and slopes greater than 55%*
- ***Avoid*** *exotic plantations in buffer areas around protected areas*
- ***Preserve*** *corridors between protected areas*
- ***Eliminate*** *row crop agriculture on lands with 20-55% slope*



Answering these two questions leads to four possible objectives of preserving or eliminating current conditions, or achieving or avoiding certain future conditions.

A schematic for developing objectives uses two questions: Do we have it? Do we want it?

Figure M3.5

In the case of the Offinso District in Ghana where during the conceptualising phase stakeholders identified wildfire prevention and management as being of highest priority, the implementation phase attempts to organise a community-based fire prevention system. Since not all stakeholders are convinced right from the start, several pilot sites demonstrating the positive effects of such measures need to be established, gradually building a critical mass within the communities so that such decentralised fire prevention systems gradually become "business as usual" in land management in the district. At the same time other streams of project activities such as establishment of woodlots and agroforestry systems are pursued, eventually covering all the objectives identified in the concept phase.

Communicating priorities

Module VII introduces a tool for communicating about an FLR project. The tool can be used to communicate among stakeholders and planners during the project design and planning phases in several ways, especially as a summary of priorities. The involvement of a wide range of stakeholders is essential for any FLR project to be successful. At an early stage, a design team could develop the full array of potential restoration activities, possibly resulting from an assessment such as ROAM (IUCN/WRI 2014). A stoplight matrix can then be developed as a communication tool and presented to groups of stakeholders who assign consensus ratings to each activity. In the example shown in Table M7.2, green stands for fully appropriate or desirable, red for not appropriate or undesirable, and yellow for possibly appropriate (perhaps not enough information is available to evaluate the activity or there is not a consensus among the stakeholders). The use of the tool here begins to answer the question, "Where do we want to go?" Initially, the stoplight summarises priorities without assessing the feasibility in advance. The stoplight tool summarises final objectives, as more information on feasibility and costs become available. Larger FLR projects may involve multiple stakeholder groups. Table M3.3 sows the stoplight as an example of a project with multiple stakeholder groups (also Table M7.3). These may be geographically defined (for example, in different parts of a

Table M3.3

A stoplight table to illustrate priorities assigned to FLR project activities by multiple stakeholder groups

	Objective	Mechanism	Restoration Activity	Priority assigned by different stakeholder groups				
				1	*2*	*3*	*4*	*Overall Rating*
Mitigation	Sequester carbon	Increase forest area	Afforestation	Yellow	Green	Green	Green	Green
		Increase biomass/ unit area	Increase productivity	Green	Yellow	Yellow	Green	Yellow
			Longer – lived species	Yellow	Green	Green	Green	Green
		Increase soil carbon	Increase rooting depth	Green	Green	Green	Green	Green
	Reduce emissions	Bioenergy	Bioenergy plantations	Yellow	Red	Red	Green	Yellow

A stoplight table to illustrate priorities assigned to FLR project activities by multiple stakeholder groups

	Objective	Mechanism	Restoration Activity	Priority assigned by different stakeholder groups				
				1	*2*	*3*	*4*	*Overall Rating*
Adaptation	Maintain forest area	Reduce deforestation drivers	Policy reform – wetlands drainage regulations	Desirable	Desirable	Desirable	Maybe	Desirable
			Conservation easements	Undesirable	Desirable	Desirable	Undesirable	Maybe
			Improve silviculture	Desirable	Maybe	Maybe	Desirable	Maybe
	Maintain carbon stocks	Reduce degradation	Sustainable forest management (improve regeneration)	Desirable	Maybe	Maybe	Desirable	Maybe
	Maintain other forest functions	Improve biodiversity	Afforest with mixed species	Desirable	Maybe	Desirable	Desirable	Desirable
			Recover endangered species (Louisiana black bear, pondberry)	Undesirable	Desirable	Desirable	Maybe	Maybe
			Manage for species of concern (Neotropical migratory songbirds)	Maybe	Desirable	Desirable	Maybe	Maybe
		Improve hydrology	Restore microsites	Undesirable	Desirable	Desirable	Maybe	Maybe
			Plant stream buffers	Undesirable	Desirable	Desirable	Maybe	Maybe
	Manage for resistance	Reduce vulnerability to stressors	Integrated pest management of *Populus deltoides* only	Maybe	Undesirable	Undesirable	Maybe	Maybe
		Overcome regeneration barriers	Secure advance *Quercus* regeneration	Maybe	Maybe	Desirable	Maybe	Maybe
		Reduce vulnerability by breeding, introduce new provenances, genetic modification		Undesirable	Undesirable	Maybe	Undesirable	Undesirable
	Manage for resilience	Expand population (within range)	Emphasize *Quercus* spp. in afforestation	Desirable	Desirable	Maybe	Maybe	Maybe
		Expand range		Undesirable	Desirable	Maybe	Undesirable	Maybe
		Create refugia		Undesirable	Desirable	Maybe	Undesirable	Maybe
Transformation	Novel ecosystems	Manage spontaneous ecosystems	Management of mixed plantings	Undesirable	Maybe	Maybe	Desirable	Maybe
		Create ecosystems	Translocate species	Undesirable	Undesirable	Maybe	Desirable	Maybe
			Replace species within assemblages with desired functional traits	Undesirable	Undesirable	Maybe	Desirable	Maybe
			Introduce exotics (non-native species) with desired functional traits	Undesirable	Undesirable	Maybe	Desirable	Maybe

● Desirable ● Maybe ● Undesirable

watershed) or by interest/livelihood sector (for example, smallholders, large landowners, conservation NGOs). Multiple columns might be used, each representing a stakeholder group with a final column representing an overall rating for an activity. More detail in the use of the stoplight tool can be found in Module VII.

Climate objectives of FLR

Forest restoration and landscape restoration can contribute to climate change mitigation and adaptation by increasing productivity of landscapes, enhancing the resilience of forest ecosystems, and reducing the vulnerability of forest-dependent human communities. Actions to conserve, sustainably manage and restore forests can contribute to economic growth, poverty alleviation, rule of law, food security, climate resilience and biodiversity conservation. The climate change literature generally separates mitigation and adaptation, but within a landscape, the two are intimately connected. Mitigation takes aim at the causes of climate change, the emission of greenhouse gases (GHG) and their accumulation in the atmosphere; mitigation interventions either reduce the sources of, or enhance the sinks for greenhouse gases. Narrowly focused mitigation actions potentially can increase the vulnerability of forests and forest-dependent communities but this can be avoided by incorporating adaptation practices into mitigation.

Natural and social systems are vulnerable to climate change and adaptation is needed to maintain their functioning. Forest and community adaptation are linked: forests play a role in the adaptive capacity of local communities and the broader society by providing ecosystem services, and people either enhance or reduce adaptability of forests by their actions. The potential benefits of FLR to climate change mitigation and adaptation are detailed in Module IV, "Technical Aspects of Project Implementation" and in the report (Stanturf et al. 2015). Linkages between local communities and forests are diverse and complex, mirroring the diversity of forest ecosystems and socio-political arrangements. Generally, community adaptations to climate change can affect forests positively by reducing pressures (e.g., clearing for agriculture, charcoal production, or escaped fires), improving forest management and increasing protection by local enforcement.

Climate change mitigation and adaptation benefits of FLR:

- *Maintain/increase forest area and/or trees outside forests*
- *Maintain/increase carbon stocks*
- *Reduce vulnerability*
- *Maintain/improve biodiversity*
- *Maintain/improve hydrology*
- *Maintain/improve rural development*

Key questions:

- *Are objectives clear?*
- *Are they sustainable?*
- *Are they scientifically valid, technically feasible, and socially acceptable?*
- *Is there a solid analysis of the situation before the project?*
- *Have stakeholders (and potential stakeholders) been consulted?*
- *Do we have the conditions we want? And do we want a given condition?*

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MODULE IV.

Technical Aspects of Forest Landscape Restoration Project Implementation

This module explores the detailed steps involved in project implementation. Implementation requires restoration activities that will yield concrete results that meet targets. Necessary activities are identified and a sequenced list is developed of what will be done, where, when, by whom and at what cost. Ideally, stakeholders have reached agreement on the design of the FLR project so that project implementation can begin rapidly in order to avoid losing momentum and stakeholder interest. Realistically, however, much restoration will begin as individual or localised efforts rather than as part of a planned national or sub-national programme. Any restoration can provide benefits and the lack of a grand plan should not deter from beginning implementation. Do not succumb to analysis paralysis! Project cycle management (refer to Module III: Figure M3.2) is meant to be a flexible approach to implementation and can be applied iteratively in response to new developments, especially new stakeholders, innovations or setbacks.

Under the best circumstances, the vision of FLR has been accepted at national and sub-national levels, landscapes that need restoration have been identified, relevant stakeholders are engaged and policymakers are aware of the need for an enabling institutional and regulatory environment for restoration and sustainable land use.

Necessary pre-conditions:

- *The landscapes targeted for restoration have been selected or prioritised;*
- *All stakeholders have been identified along with the nature and scope of their interests;*
- *Restoration objectives for the target landscapes have been agreed;*
- *Tenure relationships in the landscapes are clearly understood (but not necessarily resolved);*
- *Free, Prior and Informed Consent processes have been transparently begun or completed for all vulnerable communities; and*
- *Underlying causes of deforestation or degradation have been identified and addressed.*

Specific restoration tools and techniques will be need in the selected priority landscapes. At this stage, we are now dealing with smaller elements of the landscape (and in this respect, the "basic restoration" approaches take over, without losing sight of the landscape objectives under FLR). Implementation of FLR requires a number of activities or interventions at scales below the landscape, called landscape units, sites or stands in biophysical terms, or communities or villages in socioeconomic terms. At a minimum, an FLR project realistically will have many activities running concurrently by different stakeholders that need to be coordinated in order to have an impact at scale. Larger FLR programmes may be comprised of multiple landscapes, and within each landscape, there will be multiple activities. Each activity may need to be monitored in several ways by different indicators. Continuing our Rwanda example (Ministry Natural Resources—Rwanda 2014) our implementation plan called for planting 100 ha of native species in 20 m buffers along rivers in Kigali Province in October 2016 by local farmers. The smaller landscape elements in this example are the buffer strips along rivers in the province. Someone must decide which reaches of which rivers will be treated, what native species are available and appropriate for the chosen planting sites, what planting design (density of planting and spatial arrangement) will be used and what, if any, site preparation is needed. Moreover, this is one of many sub-objectives in the implementation of forest landscape restoration in Rwanda.

Another objective in Rwanda was to restore degraded areas within reserves and parks. The baseline assessment should have identified and prioritised the reserves and parks, as well as the areas within each reserve or park, needing treatment. There should also have been an assessment of the nature of the degradation and a determination that the degradation drivers have been addressed. For example, if encroachment into the park by local people to plant crops caused degradation, this must be curtailed or restoration will be a wasted effort. Perhaps the livelihood needs of the local people will be addressed by the FLR project through intensification of their cropping outside the park. In any event, this illustrates another requirement for implementation: effectively addressing the cause of degradation, either before or as part of the FLR project.

Degraded Pamu Berekum Forest Reserve in Ghana. The forest reserve was degraded by harvesting without adequate regeneration, followed by wildfire and invasion of an exotic grass. Restoration by local farmers with native trees using the modified taungya system.

Photos © John Stanturf

Context matters

Different biophysical and social contexts affect the choice of technical approach necessary to meet restoration goals and objectives. Each situation will be unique and may require a particular mix of approaches, but some general principles apply. Furthermore, as FLR is a long-term process, over time different techniques may be necessary to achieve the same objective. For example, re-connecting forest fragments may first require planting and protection, but later late-successional species may be added in order to increase diversity or thinning may be done to alter structure.

Context is important; different ownerships may have different objectives and patterns of ownership and/or tenure may differ between landscapes or landscape units. In remote landscapes (with less than 1 person per km^2), land may be mostly publicly owned or of traditional tenure interspersed with small communities. Examples of such a landscape pattern include large protected areas such as parks and game reserves. In more populated areas (less than 10 people per km^2), wide-scale restoration opportunities occur. Most restoration opportunities outside of the boreal forest are found in mosaic landscapes of mixed land uses and population densities of between 10 and 100 people per km^2 (Minnemeyer et al. 2011). Where ownership and/or tenure relationships are mixed within a landscape, especially in mosaic landscapes, achieving success in meeting landscape-scale restoration goals and objectives will be more difficult than in a landscape dominated by one or a few owners.

Landowners or stakeholders within a landscape may have different restoration objectives. For example, a public agency may favour restoring conditions that are more natural with greater biodiversity in a protected area by using only native species. Even if the emphasis is on restoring functions, objectives may lean more toward livelihoods and provisioning functions (food, fibre and fuel) than regulating or supporting functions. Agroforestry approaches may be a good compromise in such cases; trees are restored in the landscape, along with some regulating functions as well as providing important livelihood enhancements. It is important to note that FLR does not mean the whole landscape must be planted to closed canopy forests. Open areas, early successional habitat, water bodies all provide important services. For example, restoration of migratory bird habitat includes small water bodies, suitable roosting and breeding trees, and shrubs.

Financing can also influence objectives as well as methods of implementation. Carbon financing may favour fast growing species in high-density plantings to capture carbon quickly, or management of forests under long rotations. Financing to support wildlife corridors connecting forest fragments may heighten wildlife conflicts with local farmers. Reaching consensus and accommodation among stakeholder interests is important for long-term sustainability of an FLR project and implementation must support consensus objectives.

Restoring forest functioning

The focus of FLR is on restoring functional forest ecosystems within landscapes so that forests can co-exist and subsist in a landscape mosaic with other land uses. Approaching FLR implementation through the lens of restoring functions means that many restoration methods and techniques can be used to restore multiple functions. An overview of functional restoration is given in Table M4.1 where functions targeted for restoration are hydrologic (watershed, coastal or riparian); coastal or geologic protection; carbon sequestration; species or landscape diversity; provision of wood products and non-timber forest

Table M4.1

Diverse methods for restoring forest functions in FLR begin with a clear understanding of the initial conditions

Target Function	Present Forest Condition	Methods	Initial Operations
Hydrologic (watershed, riparian, coastal)	Deforested (agricultural land use, open land, abandoned agriculture)	Native re-colonisation	Re-establish hydrologic connectivity; physical processes
		Afforestation, whole area	Site preparation; plant or direct seed natives or non-natives
			Interplant; nurse crop; fast/slow growing natives or non-natives; taungya
			Plant mixtures of natives; framework
		Afforestation, partial area	Nucleation, cluster
		Afforestation, linear planting	Site preparation; plant or direct seed natives or non-natives
		Simple mixtures	Interplant; fast/slow growing; natives or non-natives
		Complex mixtures	Plant mixtures of natives or non-natives; planting group method, framework species method; rainforestation
	Degraded forest (cleared or burned, lacking desired species)	Conversion	Clear fell and plant all desired species
			Enrichment planting; framework
			Assisted natural regeneration; farmer assisted natural regeneration
			Blowdown; with or without salvage logging; plant desired species
			Agroforestry methods
		Transformation	Partial overstory removal; underplanting; natural regeneration
		Reforestation (post-fire restoration)	Erosion control (re-seed native understory; mulching); with or without salvage logging; plant desired species
	Degraded forest (lacking desired structure)	Transformation	Partial overstory removal
		Conversion	Clear fell with residuals; variable density thinning
	Degraded forest (lacking desired fire disturbance)	Re-introduce fire	Fuel reduction by mechanical or chemical means; re-introduce prescribed fire; fire surrogates
	Deforested and disturbed site (mined land, polluted land)	Replacement	Stabilise site; plant natives or non-natives; fertilise

Diverse methods for restoring forest functions in FLR begin with a clear understanding of the initial conditions

Target Function	Present Forest Condition	Methods	Initial Operations
Coastal Protection	Deforested (agricultural land use, open land, abandoned aquaculture)	Native re-colonisation (intertidal water, mangrove)	Re-establish hydrologic connectivity; do nothing
		Afforestation (coastal barrier, dune stabilisation)	Site preparation; plant or direct seed natives or non-natives
		Transformation	Enrichment planting
			Blowdown; with or without salvage logging; plant desired species
	Deforested and disturbed site (mined land, polluted land)	Replacement	Stabilise site; plant seedlings of natives or non-natives; fertilise
Geologic Protection	Deforested and disturbed site (avalanche track, landslide, lava flow)	Replacement	Stabilise site; plant seedlings of natives or non-natives
Carbon sequestration	Deforested (agricultural land use, open land, abandoned agriculture)	Afforestation	Site preparation; plant or direct seed natives, non-natives, or naturalised non-natives
	Degraded forest (lacking desired species or stocking)	Conversion	Clear fell and plant all desired species
			Agroforestry
	Deforested, mined land, polluted land	Replacement	Stabilise site; plant seedlings of natives or non-natives; fertilise

Diverse methods for restoring forest functions in FLR begin with a clear understanding of the initial conditions

Target Function	Present Forest Condition	Methods	Initial Operations
Species or landscape diversity	Agricultural land (could be open land, abandoned agriculture)	Native re-colonisation	Remove disturbance; fencing; leave alone
		Afforestation	Site preparation; plant or direct seed natives or non-natives; enrichment planting
			Interplant; fast/slow growing natives; taungya
			Plant mixtures of natives
	Degraded forest (lacking desired species) or as second intervention	Conversion	Clear fell; plant all desired species
			Enrichment planting
			Assisted natural regeneration
			Blowdown; with or without salvage logging; plant desired species
		Transformation	Partial overstory removal; planting; natural regeneration
	Degraded forest (lacking desired structure) or as second intervention	Transformation	Partial overstory removal
		Conversion	Clear fell; with or without residuals; natural regeneration
		Legacies	Deadwood retention or creation
		Retention methods	Harvest
			Thinning
	Degraded forest (lacking desired fire disturbance)	Prescribed burning; fire surrogates	Fuel reduction by mechanical or chemical means; re-introduce prescribed fire; fire surrogates
	Degraded forest (invasive species)	Removal of invasive species	Remove invasive species (hand clearing, mechanical, chemical); enhance natives (by controlling light, planting, etc.)
	Degraded forest (climate change)	Assisted migration (managed relocation)	Expand range
			Novel ecosystems
	Deforested and disturbed site (mined land, polluted land)	Rehabilitation	Native recolonisation
	Deforested and disturbed site (mined land, polluted land)	Replacement	Stabilise site; plant seedlings of natives or non-natives; fertilise

Diverse methods for restoring forest functions in FLR begin with a clear understanding of the initial conditions

Target Function	Present Forest Condition	Methods	Initial Operations
Wood products, non-timber forest products, wildlife habitat	Agricultural land	Afforestation	Site preparation; plant or direct seed natives, non-natives, or naturalised non-natives
	Degraded forest (lacking desired species)	Conversion	Clear fell; plant all desired species
			Clear fell with enrichment planting
			Assisted natural regeneration
			Blowdown with or without salvage logging, plant desired species
		Transformation	Partial overstory removal and supple-mental planting
	Degraded forest (lacking desired structure)	Transformation	Partial overstory removals
	Deforested, mined land, polluted land	Replacement	Stabilise site; plant seedlings of natives or non-natives; fertilise

Source: adapted from Stanturf et al. 2014a

products, or wildlife habitat. Within each function, restoration methods are grouped according to the current condition of the site. The initial restoration operations are shown as a starting point for planning. More details and the science behind these techniques are given in Stanturf et al. (2014a). The success of these measures depends as much on economic attractiveness and social acceptability as on their technical aspects.

Restoration approaches, tools and techniques

The basic types of restoration activities described below are grouped according to the context in which these are often implemented. A full-fledged FLR project would include several such activities undertaken in a coordinated manner across different parts of the

Left picture: Common reclamation practise in Estonia is to level mining spoils and plant Norway spruce, a native species.

Right picture: Oil shale mining landscape in northwest Estonia after mining ceases. Pumping has been discontinued and groundwater levels rise in former pits.

Photos © John Stanturf

landscape under one overarching landscape plan. In this module, we explore the technical tools suitable for the biophysical aspects of FLR. This usually involves manipulating vegetation, for example adding trees or shrubs by planting, removing exotic plants, or altering the density or composition of forest trees.

There are essentially two broad categories of strategies for restoring desired vegetation composition and structure: passive and active restoration. Passive restoration depends upon natural dispersal and recolonisation processes while active restoration uses direct seeding or outplanting of desirable species. Even passive restoration that depends on natural regeneration arising from a seed bank or sprouting, may require interventions such as fencing to keep wild or domestic herbivores from an area. Assisted natural regeneration is more labour intensive, usually involving clearing weeds to reduce competition on desired seedlings (Figure M4.1).

Active restoration includes both adding and removing vegetation. A logical grouping of approaches begins with the condition of the overstory, the trees on a site (Figure M4.1). In many situations, such as on former mined land or abandoned agricultural lands, there is no overstory. In such instances where land use as well as land cover occur, afforestation refers to planting the entire area. When only a part of the area will be planted, dispersed planting can be in small patches (nucleation) or in groups (clusters). If there is a partial overstory on the site, then the remaining trees may be undesirable remnants, perhaps from a logged plantation of an exotic species (Figure M4.1). Depending upon objectives, removing the remnant trees and planting native species would be the chosen restoration method. Conversely, the remnants may be native species on a logged site and the desire is to keep and supplement them by planting other native species.

Remove threats or obstacles

- *Remove and replace exotic or invasive species with native species*
- *Fencing to protect re-growth from ungulates and other pressures*
- *Policy changes to remove perverse incentives (such as clearing native forests for exotic plantations)*

Active restoration through uprooting of invasive species, here Lantana (*Lantana camara*) in the Sal (*Shorea robusta*) forest, Uttarakhant, India.

Photos © Michael Kleine

Several possibilities exist if there is a full overstory on the site. If the species is undesirable, the option is to clear and plant. If the species is desirable but the objective is to increase diversity, make openings of appropriate size and plant seedlings of other desired species. If the objective is to alter structure, make openings and allow them to regenerate naturally.

Choosing the species to plant combines considerations of objectives, site conditions and species' traits. Species must be adapted to site conditions, or site conditions altered to improve survival and establishment. Species must also meet objectives, whether they are to improve livelihoods by providing non-timber forest products such as honey; to control soil erosion by quickly providing a covering canopy; or to improve wildlife habitat by providing food and shelter. Besides choosing the right species, decisions must be

Figure M4.1

Decision tree for choosing the appropriate restoration method, depending upon objectives and site conditions. Decision nodes are strategy, amount of overstory present, and how much of the area will be treated.

made about how to plant, the density of planting (i.e., number of plants per hectare), and whether tending will be required in the future.

Choosing the species to plant:

- *Native species?*
- *Mixes of native and exotic species?*
- *Mixes of fast and slow-growing species?*
- *Fuelwood to reduce pressure on natural forests?*
- *Agroforestry?*

The planting design decision is made at two scales, the stand (or site, or landscape element) and the landscape (the location of plantings within the larger landscape). More details on site-level planting designs are given in Stanturf et al. (2014a) and summarised in Table M4.2.

The simplest design to implement and manage are single species, single cohort plantings. Depending on restoration objectives, plantings can have uniform spacing between rows and between trees within rows; random spacing to avoid the appearance of a

Table M4.2

Planting designs, from simple to complex

Number of species	Number of cohorts	Spacing	Variations	Future Options
Single	Single	Dispersed	Cluster	Expansion by natural regeneration
			Nucleation	Expansion by natural regeneration
		Uniform	Planted into cover crops	Thin or remove and plant other species
			Taungya	Thin or remove and plant other species
Multiple	Single	Uniform	Temporary mixture	Inter-planting or nurse crop removed earlier
			Permanent, simple mixture	Single species rows or blocks
		Random	Permanent intimate mixture	High density planting, Framework species
		Uniform	Permanent intimate mixture	Designed mixture
	Multiple	Dispersed	Permanent, intimate mixture	Cluster with multiple species
			Permanent, intimate mixture	Nucleation
		Uniform or random	Underplanting	With or without partial overstory removal
		Random	Release advanced regeneration	With or without partial overstory removal

monoculture plantation; or a clumped random spacing that provides additional space for other species to develop from dispersed seeds. Clumped random plantings with single species may be characterised as cluster or nucleation; this is also possible with multiple species.

Mixtures of two or more species require more planning and knowledge of species' traits. A temporary mixture, single cohort planting involves one or more fast growing nurse trees and a slower growing species. The slower growing species may be planted at the same time as the faster growing species or within a few years. If the faster growing species can be coppiced, multiple harvests may be available before the slower growing species fully occupies the site. Other options for simple mixture, multiple species, single cohort plantings are planting two or more species in alternating rows separating the species into single species blocks.

Intimate mixtures of multiple species are more difficult to implement successfully and requires knowledge of growth habit, shade tolerance and other characteristics of the several species. A single cohort design, with all species planted at the same time, may be random or uniform but in a designed fashion. In a random planting, multiple species are outplanted or direct seeded in a random mixture, such as high diversity plantings and "framework species" plantings. In a uniform planting, two or more species are planted together, with specific combinations based upon growth characteristics. This design usually has a specific desired outcome such as to produce a crop tree or maintain an endangered species.

At the landscape scale, patterns of planting can be visualised as "stepping stones" between forest fragments, for example for wildlife corridors; "reducing edge effects" around other land uses such as for erosion control on slopes; or providing "buffer zones" around protected areas or significant ecological features such as primary forests or water courses. Any of the stand-level planting designs can be used in any combination. Where the objective is to increase structural or age-class diversity in the landscape, for example when restoring uniform monoculture plantations, different thinning or gap-creation methods can be used with planting or natural regeneration.

Agroforestry systems have the very specific requirement that the planted trees should not significantly reduce the productivity of the agricultural crops. Species chosen for these systems usually have some intrinsic value as fodder, fuelwood, or timber, in addition to the protection they provide. Planting trees in a suitable mix with agricultural crops that enhances immediate and medium-term economic benefits to the farmers is an excellent strategy for reducing demand for woody biomass from neighbouring forests and thereby assists in the restoration of these forests. Agroforestry shade trees are common in tea, coffee, cardamom, pepper and other high value crops where shading enhances product quality. Since the shade requirement is seasonal, tall, straight-stemmed, fast growing trees that can withstand frequent leaf management and occasional pollarding are preferred.

In addition to restoring degraded land, the ramón tree (*Brosimum alicastrum*), pictured here, also is a source of food and flour, providing economic benefits to Guatemalan farmers.
Photo © Anique Hillbrand / FAO

Agroforestry windbreak belts can enhance food production in dryland farming by reducing desiccation from frequent winds. Tree planting in several parallel rows along the margins of agricultural fields and on patches of low agricultural productivity within the fields helps break the wind velocity. Silvipastoral enrichment planting of scattered trees of fodder species are used in tropical and subtropical pastoral lands. The trees reduce summer desiccation of grasses and provide fodder and shade to grazing livestock during hot days; be careful to ensure that grass productivity is not compromised by excessive shade. Controlling crown density, usually not more than 20%, is practised to avoid lowering productivity of the pasture grasses. In some places where the pasture demand is low, stakeholders may opt for more tree fodder and shade, and increase crown density.

Carrying out the activities

Next steps are developing plans for each landscape unit and activity. Alternatively, organisation can be around the activities with micro-plans for each landscape unit. To carry out the project effectively, two additional features must be addressed: needed capacity building and a coordinating body with oversight and decision-making responsibility. Since each landscape unit might have one or more dominant FLR objective, these micro-plans would centre on the dominant activities with supplementary activities integrated into the micro-plans as appropriate. For example, a component unit of a hilly landscape might consist of severely degraded forests with a few undisturbed patches or forest remnants interspersed with agriculture crops in small valleys. The dominant activities would be reforestation of degraded forests, rehabilitation of the remnants and agroforestry activities for the cultivated areas to reduce soil erosion on the slopes.

Planning

Micro-plans must provide details of the necessary activities including a sequenced list of what will be done, where, when, by whom and at what cost. Depending on the answers to these questions, further consultation with stakeholders may be needed. For example, if local communities are doing the planting, then it must be integrated into their normal work cycle. If stakeholders are farmers, then preparing their fields for planting crops will take priority over tree planting. If the tree planting is delayed beyond the optimal planting season for the seedlings because the labour is not available, seedling mortality likely will be too high to be acceptable. This occurred in Zambia in a reforestation project where the Forestry Department provided seedlings and contracted farmers to plant the seedlings but payment was not based on achieving an acceptable level of survival. Farmers waited until after their crops were planted but by then, it was too late for the trees. This illustrates the need for implementation monitoring, which is described in Module V.

Other considerations come into play in planting seedlings, including obtaining the seedlings. Are seedlings of the selected species available locally? Are they of acceptable quality? Many commercial nurseries are oriented toward horticultural plants for gardening or possibly non-native commercial tree species and obtaining good quality native species in quantity is difficult. In Central Chile, for example, local nurseries produce high quality conifer seedlings for forest industry plantations but take little care with native broadleaves. Often the seedlings are produced from wildlings dug up in the native forest and raised in a nursery bed. If seedlings must be purpose-grown for restoration, who will do it? In some FLR projects, setting up community nurseries to produce seedlings for restoration is part of providing livelihood benefits. Even so, seed must come



It takes time to acquire suitable genetic material and grow seedlings.
Left Photo © Michael Kleine, Middle and Right Photos © Louis Bernard Cheteu

from somewhere. Too often, seed sources are collected from only a few easily accessible trees, thereby limiting seedlings to very narrow genetic stock. It may be necessary to consult early on with subject matter experts knowledgeable about the best nursery practices and seed collection protocols adopted in similar situations elsewhere in the world. If seedlings must be grown for the FLR project then adequate time allowed, possibly in the order of 2-3 years in advance of the planting season.

These landscape unit micro-plans should be integrated into a comprehensive detailed activity plan for the entire landscape. Experts from the implementing agency or technical consultants can review the entire plan, or similar activities in the micro-plans. This makes it possible to develop detailed costs and possibly gain economies of scale, shared services, etc. For example, in the Atlantic Forest Restoration Pact, seedlings of native species were being grown by nurseries in some areas in excess of their local demand while in other areas; seedlings were not available (Brancalion et al. 2013). Collaboration solved two problems!

Coordination

The need for a central coordinating body should be clear from the implementation process described. In many countries, there are local forest committees, sometimes called forest development committees or something similar. Typically, membership of these local committees is comprised of local government officials from different agencies and representatives of stakeholder groups, often representing local communities. An FLR project should utilise, wherever possible, these existing resources and governance structures without duplicating their efforts. Quite possibly the stakeholder consultations will have identified motivated individuals to serve on a coordinating body. Two cautions, however, come from experience: sometimes the members of local forest committees are there for ceremonial reasons and are unlikely to commit to the hard work of managing an FLR project. Another caution is to avoid local elites capturing the committee and directing money and resources to their own ends.

One possible way (out of many) to organise a coordinating body is to have a project manager or coordinator, acting as the chief executive with a board of directors drawn from the local forest committee and local communities, with representation of all line departments (e.g., forestry, agriculture, mining, water resources, rural development etc.). The project manager could be responsible for a monitoring function (as described in Module V) and reporting to the FLR National Task Force (if it exists). In Rwanda, there is an inter-ministerial committee charged with oversight of activities under their commitment to the Bonn Challenge. Initially, focusing on implementation, the monitoring team could undertake quality control activities such as spot-checking work quality against the standards set in micro-plans in each landscape unit. Reporting to the project manager, these teams could be drawn from experienced (or trained) individuals in local communities. If work such as planting seedlings is contracted to local groups, the monitoring team could provide the project manager with data on survival, etc. before authorising payments.

Key questions:

- *Have the underlying causes of deforestation or degradation been effectively addressed?*
- *Which techniques are best suited to meet our objectives given the current condition of the site?*
- *Which techniques will best tackle existing threats to the forests?*
- *Do we have the expertise, tools and capacity to engage in these techniques (and if not, where can we get them?)*

Capacity Building

As much as possible, the FLR project should rely on local people to implement the project with technical assistance and training provided by outside experts, as needed. Time investment by local people is one way to ensure that the restoration will be sustainable over time. In addition, FLR seeks to improve livelihoods; creating local jobs and training are two ways of meeting that commitment. The nature of planned activities should decide the areas in which capacity building is to be undertaken. The target groups are the implementing agency personnel, stakeholder communities and the personnel temporarily hired for the project.

Select training contents and trainers in consultation with appropriate local and external institutions. A combination of national and international trainers often works well in such programmes but it is essential for the training contents to suit local requirements. Most developing countries have bilateral agreements with developed countries for capacity building especially in the field of environment. These agreements need to be explored for help in organising these capacity-building programmes. Such bilateral support may come in handy in accessing high quality trainers from partner countries.

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MODULE V.
Monitoring Forest Landscape Restoration Projects

This module explores in more detail monitoring needs and application in the context of FLR. Although we see monitoring as part of implementation, because of its importance, we present monitoring in more detail in a separate module.

Why Monitor?

Monitoring is often overlooked or neglected in practice, but monitoring short-term and long-term outcomes is essential for successful restoration. Because FLR is a long-term process, with true success obtainable only decades following the initial project interventions, monitoring is needed to evaluate and document successes and failures. Monitoring is also essential for long-term management of FLR; feedback from monitoring allows adaptive management and indicates when corrective or further interventions may be required. Because future land use or policy changes can occur outside of the area of the restored landscape, monitoring change over time within the project area may indicate when external forces have threatened sustainability of the FLR project. Monitoring is integral to the FLR project.

Inherent in the nature of restoration projects is that short-term perspectives dominate, to the neglect of the long-term perspective needed to assess success or failure of FLR. Too often, monitoring is limited to assessing short-term achievements or documenting that project tasks have been conducted as budgeted. Although accountability to funding sources and stakeholders is necessary, monitoring should not be limited to short-term needs. Given the typically 3-5 years lifetime of projects funded by governmental and non-governmental donors, pressure is great to allocate fixed available funding to immediate activities. Nevertheless, the need to design and implement a monitoring programme right from the start of a restoration project cannot be over-emphasised. A cost-effective monitoring programme must focus on the smallest set of indicators that relate to the project objectives. Ideally, the indicators can be measured simply, easily, and sufficiently to monitor change. Furthermore, monitoring takes place at different spatial scales: from the very specific restoration actions at the local level, aggregated to the landscape, and incorporated into the national (and global) restoration efforts. In this module, we present a coherent approach to monitoring at multiple scales oriented toward FLR objectives.

Why Monitor?

- *To gauge success of the FLR project;*
- *To determine if and when further intervention is needed;*
- *To identify unintended consequences that threaten sustainability of the restoration;*

- *To document, report and communicate FLR progress and success;*
- *To adjust plans;*
- *To learn lessons.*

Important characteristics of FLR monitoring

FLR projects occur at multiple scales, from the national level to a particular landscape, possibly defined as a watershed. Because implementation occurs on different sites or landscape units, each activity may be monitored in several ways by different indicators. These indicators may be biophysical or in the case of communities or villages, socioeconomic terms. In practice, many activities will run concurrently, conducted by different stakeholders; all will need to be coordinated in order to have an impact at the landscape scale. Large projects comprised of multiple landscapes require monitoring at both individual landscape/project level and at the overall combined level.

In addition to the multiple spatial scales of FLR projects just described, there are multiple temporal scales. Some activities, or some indicators of an activity, may need to be monitored for a short time while other indicators are to be monitored over the long-term. Long-term indicators may need to be measured at relatively short time intervals initially, and then at longer intervals. For example, planting seedlings will often be an activity in an FLR project. Survival (or conversely mortality) may need to be determined annually for 1-5 years, and combined with growth measurements at 5-year intervals until crown closure.

Monitoring is frequently overlooked because of its perceived cost and complexity. Yet with the right choice of indicators, monitoring need not be overly complex. Furthermore, local stakeholders need to be actively involved in monitoring to ensure its sustainability in the long term (e.g., Nagendra and Ostrom 2011).

Types of monitoring

A temporal hierarchy of monitoring types that addresses different questions (Table M5.1) was proposed by Hutto and Belote (2013), comprised of short-term implementation monitoring, short-term to long-term effectiveness monitoring, and long-term socio-ecological effects monitoring. Surveillance monitoring is outside the scope of an FLR project but useful for establishing a baseline.

Surveillance monitoring

Typically, surveillance monitoring is an ongoing programme to measure specific factors such as continuous forest inventory and population census. This type of monitoring usually measures permanently located sample points across years to uncover trends in

Plantation at Ayanagar, Delhi in 2008 (left), 2009 (upper right), und 2014 (lower right).
Photos © Haryana Forest Development Corporation (HFDC)

target response variables. Valid comparisons can be made between intervals if samples are well distributed spatially and the sampling protocol is fixed. In a biophysical context, the important question that a surveillance-monitoring programme answers is “Are ecological properties changing in some undesirable way through time, or do we perceive an association between a particular land-use activity and a negative indicator?” Socio-economic surveillance monitoring usually samples units larger than biophysical surveys or as defined by political, rather than natural boundaries. Surveillance monitoring is expensive and covers a much larger area than most FLR projects. If surveillance-monitoring programmes are available, their results are useful for establishing baselines for an FLR project and may provide important information on historical trends.

Implementation monitoring

Relatively short-term monitoring is conducted often to determine whether activities were undertaken as planned or specified by a contract. Implementation monitoring provides the information required by funding agencies or donors. In the example given above of planting seedlings, implementation monitoring would answer the questions of whether adequate stocking was achieved, as indicated in the project implementation and monitoring plans. Each planted area would have to be monitored at several stages over the initial 3-5 years, as indicated in Box M5.1.

Best practices for monitoring are to include GIS data layers that provide detailed information on how, when and where interventions (project activities) were conducted. Geo-referencing project interventions are useful in the short term for documentation (implementation monitoring) and later in the project life cycle for effectiveness monitoring. Data layers can be established in the early planning stages and then updated as activities occur. Use maps produced by the GIS system to plan monitoring activities; permanent plots established initially for implementation monitoring should be geo-referenced using field GPS systems. Additionally, initiate photo documentation of project activities at this stage and establish permanent, geo-referenced photo plots.

Effectiveness Monitoring

Effectiveness monitoring begins to answer the question "Was restoration successful?" By this, we mean were the sum of restoration activities effective in reaching the stated goals, which could include social, economic and ecological components. Effectiveness monitoring thus has both short and long timeframes, conducted at multiple spatial scales. Stratified sampling reduces costs and effort, especially as compared to surveillance monitoring, but must be targeted to address effectiveness of explicit objectives and sub-objectives as detailed in the implementation plan. Effectiveness monitoring is distinguished from implementation monitoring at both temporal and spatial scales. Monitoring long-term effects, in addition to short-term effects, requires a commitment to repeated sampling for many years. Where implementation monitoring is limited spatially to the physical features of restoration activities, effectiveness monitoring must also detect effects on important landscape features that may not have been directly manipulated by project activities. For example, sampling for plant biodiversity effects of a project includes all plants that occur over time, not just the planted ones. Developing an effectiveness monitoring protocol comes face to face with two important questions: *What to monitor and at what intensity?* The answers will be specific to the project context (the landscape and restoration objectives) and require identifying appropriate criteria and indicators.

Careful identification of the monitoring criteria and indicators to implement are challenging questions; these typically need to be addressed within the limits of available funding. Relevant parameters to monitor in the pre-restoration (baseline), as well as in the restoration process, are closely linked to the objectives and sub-objectives specified in the implementation plan. The list of potential indicators to measure can easily become exhaustively long and consume the entire restoration budget if perfectionism is allowed to rule. Therefore, sound judgement and priorities are essential.

Steps in Effectiveness Monitoring:

- *Identify what to monitor (develop criteria and indicators related to objectives);*
- *Establish threshold points where further intervention is needed;*
- *Develop a sampling design (measure indicators of the selected criteria);*
- *Collect and analyse data;*
- *Evaluate results and communicate to stakeholders;*
- *Re-evaluate the process in order to guide future efforts.*

Socio-Ecological Effects Monitoring

Socio-ecological effects monitoring seeks to determine if the restoration actions resulted in social or ecological benefits, trade-offs or unintended consequences. Just as effectiveness monitoring measures project outcomes, socio-ecological effects monitoring measures whether an FLR project actually accomplishes landscape restoration. In some ways, this form of monitoring approaches surveillance monitoring in spatial and temporal scales: it is very long-term, requires looking beyond project boundaries, and is likely beyond the resources of the FLR project. Nevertheless, an appropriate effectiveness-monitoring scheme can provide the foundation for measuring and monitoring socio-ecological effects. Forest landscape restoration projects deemed successful in the short- to medium-term may not sustain desired outcomes into the future, particularly if the FLR project is not adapted to external forces including for example population growth, land use change and altered climate.

Table M5.1

A hierarchy of monitoring types useful for FLR

Type of Monitoring	Objectives-oriented question
Surveillance	Are ecological properties changing in some undesirable way through time, or do we perceive an association between a particular land-use activity and a negative indicator?
Implementation	Was management prescription implemented according to contract specifications?
Effectiveness	Did management actions achieve the social, economic or ecological goals and objectives outlined in the prescription?
Socio-ecological effects	Did management actions result in social or ecological benefits, trade-offs or unintended consequences?

Source: adapted from Hutto and Belote 2013

Invasive species are an example of unintended consequences. Thousands of non-native species have established in new environments outside their native range because of international trade or intentional introductions. Most naturalised exotic species appear to have little negative impact; however, some non-native species are invasive with potentially very serious effects, including transforming the vegetation across entire landscapes. Grassland and low shrub communities are highly susceptible to invasion by invasive trees, which often causes substantial changes in the plant species composition or even the complete displacement of these natural or semi-natural vegetation types**.** Invasive pest insects and plant pathogens can cause a substantial decline of a variety of ecosystem services that trees provide. Despite our efforts to reduce biosecurity risks associated with international trade, more species will arrive because it is not possible to ensure imports are 100% pest free. Many of the impacts of these invaders were not predicted, in part because they only became apparent after surveillance monitoring detected significant changes (see Annex 1 for more information).

Forest landscape restoration objectives can be expected to change over time as society's perceptions and priorities change. These changes make it even more challenging or impossible to evaluate the long-term FLR efforts – particularly if there is no available scientific and quantifiable evidence of the FLR starting point (the degraded landscape), what the objectives were and how success was expected to develop. For this reason, it is important to have a well-established monitoring protocol that can be simple enough to be continued over a long period and involve local stakeholders.

Implementation Monitoring: Criteria Adequate Stocking

Box M5.1

Sampling each treated area	Timeframe
Randomly sample planting job to correct improper procedures	During planting season
Systematic sampling in treated areas for survival/mortality	Annually, 1-3 years after planting
Sample to determine herbivory or other damage	As needed, if mortality high or growth poor
Systematic sampling in treated areas against criteria of acceptable stocking level, absence of large gaps	Annually, 1-3 years after planting
Sample to determine poor planting practices (e.g., J-rooting)	As needed, 1-3 years after planting
Sampling underplanted seedlings after 2 years	As needed, 1-3 years after planting

Criteria and Indicators

Returning to practical matters, derive criteria and indicators directly from project objectives. Criteria refer to what is considered desirable, acceptable and feasible, and may have spatial and temporal characteristics. That is, a criterion may differ for different areas within a project and at different times in the project life cycle. For example, returning to the seedling survival example, the criteria for acceptable survival and stocking will not necessarily be the same for all species that are planted, or may differ for an individual species depending upon site conditions (e.g., exposed ridgetops versus protected coves), and may be lower at later stages of stand development. Legal or certification requirements may set some criteria.

Indicators are the measured parameters. They must be easy to measure, reliable and have predictive capability; remember, this is a monitoring programme not a research experiment. When resources are limited, focusing on key indicators or surrogates may be a valid compromise. Because a random sampling scheme would be too expensive, sampling for effectiveness most likely will employ a stratified design. Thus, arranging indicators within a spatial hierarchy will increase the ability to detect change and trends.

The hierarchy could include the landscape, community (stand) and population (species) levels for biophysical indicators. Socio-economic indicators could include the administrative unit in which the landscape unit occurs, the community (village) and household levels. The main message here is that a wide range of indicators is potentially relevant to monitor, and that the multiple and changing forest restoration objectives call for including a broad enough set to assess effectiveness.

Forest landscape restoration projects have multiple and interacting objectives and effectiveness monitoring should include a diverse set of indicators to provide robustness against the inevitable changes in conditions, expectations, and priorities over time. Some indicators could include:

- Extent of forest cover
- Compositional and structural diversity
- Carbon storage in various aboveground and belowground components
- Surface water yield and quality
- Groundwater recharge and quality
- Biodiversity (floral and faunal)
- Key flora and fauna habitats (e.g., closed forest, woodlands, dead wood, forest edges, trees outside forests (agroforestry and silvopastoral systems), streams, lakes, meadows
- Recreational opportunities
- Non-timber forest products
- Jobs
- Household income
- Food security

It may happen that some stakeholders already have their own monitoring protocols, in which case it will be necessary to harmonise protocols and agree on common indicators, how they are measured and at what frequency. The combined protocol includes indicators in four areas: ecological, economic, social and management. Economic indicators refer to financing mechanisms, while social indicators focus on relationships among restoration organisations, local communities and restoration workers. The protocol applies to all local activities, but it does not specify reference or criteria values, as these will be developed locally.

Establishing a baseline

It is fundamental for future project evaluations to document the initial conditions of the degraded forest landscape in terms of the criteria and indicators chosen (e.g., capture by invasive species, low level of biodiversity, continued deforestation, water scarcity, lack of income, food-insecurity, etc.). The status and characteristics of the landscape and remaining forest prior to the restoration efforts may unfortunately seem less important to fund in the early project phases, which are often loaded with enthusiasm, dedication and momentum to do all the "good on the ground". However, once this initial pre-restoration baseline is completed and the data safely stored for the future, the basis for future monitoring is established and monitoring will become much more relevant by resting on such a valuable platform.

Monitoring begins with a proper description of the degraded landscape and the conditions of local communities that is the starting point of the FLR process. It is especially

Photo © Janice Burns

important to describe current conditions relative to the objectives of the planned FLR activities. Existing long-term (>100 year-old) cases of FLR demonstrate that it may be difficult for today's observers to visualise and understand how degraded the landscape was historically based on how the restored landscape appears today. Monitoring data from the beginning of the restoration process are rare, apart from anecdotal evidence; consequently, historic FLR efforts typically are evaluated by the standards and values of today, which may differ considerably from the objectives that older projects were designed to fulfil. Even recent FLR projects may suffer from poor or no documentation of the initial status for the degraded landscape.

A good baseline is essential for evaluating successes or failures of FLR and justification for the investments made in restoration. Further consequences of a deficient baseline include few opportunities to evaluate various unintended side effects as well as an inability to adapt to future conditions and improve restoration methods.

As noted above, existing surveillance monitoring data can provide an initial, broad scale baseline. Many countries have ongoing forest inventory programmes, soil surveys and maps of some land uses such as protected areas, parks and forest reserves. Remote sensing data may be freely available, such as LANDSAT or Google Earth, and purchased higher resolution products. In some cases, interpretive maps may indicate critical areas of either high ecological value or environmental degradation. Although existing information may be too general for a monitoring baseline, it may be sufficient for stratifying the project landscape(s).

Overcome Common Weaknesses of Monitoring Efforts

There are four weaknesses common to monitoring efforts: unclear responsibility for data collection, vague objectives for collecting data, inadequate funding for monitoring, and data sitting unused. On the one hand, unless a monitoring programme has a clear purpose and the data that are collected are useful for influencing management decisions, there is little point in devoting scarce resources. On the other hand, a well-designed monitoring protocol will provide the information needed to indicate when and where to further intervene, and communicate progress and success to stakeholders. A well-designed monitoring plan will be integral to the restoration project and utilise indicators that are easy to measure, reliable and useful in models that predict development over time. The monitoring plan should begin with an explicit statement of the purpose(s) for collecting data. In addition to specifying what will be measured, where and how; the plan should include details of how the data will be managed including who is responsible, where it

Effectiveness Monitoring: Water Quality

Box M5.2

Questions to answer in local context	Possible guidelines
Starting point—before restoration treatments	Baseline from surveillance programmes or field sampling
Where should sampling be located?	Upstream and downstream of treatments
How often should samples be taken?	Likely determined by available resources (more samples needed for periodic sampling but easier to organise; episodic sampling during and after significant rain events can be fewer samples but harder to organise)
What criteria should be used?	Allowable pollutant levels can be set by regulation of recognised health thresholds
What indicators should be sampled?	Ecological: sediment, turbidity Social: faecal coliform, nitrates

Photo © Janice Burns

Photo © IFSA/BFW

will be stored and how it can be accessed. Ultimately, the data gathered should be used to make decisions.

The ability to secure adequate funding for monitoring will be aided by developing a cost-effective monitoring protocol. Measurement effort should be commensurate with the utility of the information gained. There are far too many approaches to monitoring to specify that any one approach is better than another is. Long-term monitoring is required, particularly when restoring severely degraded landscapes because progress will be slow. Generally, the short time frame (3-5 years) of many projects funded by donor agencies results in short-term or sporadic monitoring, but short-term success may not predict long-term sustainability. Even with limited funds for monitoring, incorporating

Box M5.3

Monitoring restoring natural forests in Rwanda

	Project Planning	Monitoring	
Goal	Increase forest cover	**Surveillance Monitoring**	Baseline: Maps of existing forests and/or field sampling
Objective	Restore natural forest: 3000 ha new forests		
Plan	Plant 100 ha Entandrophragma excelsum, Markhamia lutea in block mixtures in Kigali Province		
Criteria	70% stocking of Markhamia lutea at age 10 Average height 3 m at age 10 Understory diversity > 50% native species		
Indicators	Mortality, Herbivory, Disease, Height, Diameter, Understory diversity	**Implementation Monitoring**	Planting job satisfactory Mortality at 1, 3 years
		Effectiveness Monitoring	Stocking at 10 years Height at 5, 10, 20 years Diameter at 5, 10, 20 years Understory diversity at 5, 10, 20 years
	Sustainable Forest Management plans in effect, Benefit sharing scheme adopted, Non-Timber Forest Products value chain established, Local livelihoods improved	**Socio-Eco-logical Effects monitoring**	Surveys, documentation

an understanding of vegetation development patterns in the design will identify the expected trajectory of change and highlight deviation from objectives and the need for corrective action.

Involving local communities in monitoring may provide for long-term monitoring needs. So-called citizen science can have additional spinoffs including investing local people in the restoration project, developing local capacity, and possibly providing some employment. Community-based monitoring may be the only feasible approach to long-term sustainability in developing countries.

Key points:

- *Explicitly state the objectives of monitoring;*
- *Provide adequate funding;*
- *Manage data and make them available for analysis;*
- *Use the data to influence management decisions.*

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MODULE VI.
Climate Change Mitigation and Adaptation in Forest Landscape Restoration

Climate change mitigation and adaptation are intimately linked in practice but separated in international negotiations and programmes. Mitigation takes aim at the causes of climate change, the emission of greenhouse gases (GHG) and their accumulation in the atmosphere. Adaptation focuses on the effects of climate change and is local in nature, with short-term effects on vulnerability of natural and social systems. Optimising mitigation and adaptation strategies in FLR means recognising diverse ecological conditions as well as challenging governance and complex socio-cultural contexts. Forest landscape restoration can contribute to climate change mitigation and adaptation by increasing productivity of landscapes, enhancing the resilience of forest ecosystems and reducing the vulnerability of forest-dependent communities. Explicitly focusing on linkages between mitigation and adaptation, and integrating them into FLR, provides opportunities to address climate change risks while at the same time providing sustainable flows of environmental goods and services from forests.

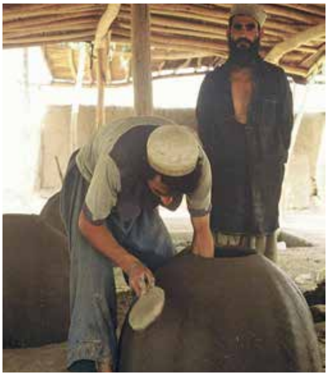
Climate change mitigation and adaptation benefits of FLR

- *Maintain/increase forest area and/or trees outside forests*
- *Maintain/increase carbon stocks*
- *Reduce vulnerability*
- *Maintain/improve biodiversity*
- *Maintain/improve hydrology*
- *Maintain/improve rural development*

Mitigation

Climate change mitigation has two general objectives: sequester carbon in long-term storage and reduce the amount of carbon and other greenhouse gases released to the atmosphere (Table M6.1). Mitigation interventions either reduce the sources of, or enhance the sinks for, GHG (IPCC 2003). Emissions from fossil fuel combustion, biomass burning (including wildfire) and land use change all contribute to the increases in GHG emissions. Fossil fuel emissions can be mitigated by substitution: replacing fossil fuels with bioenergy, for example community fuelwood lots or bioenergy plants, or using wood instead of other materials with a greater carbon footprint such as steel and aluminium in construction. Minimising carbon emissions from biomass burning includes increasing the efficiency of biofuel production (e.g., better charcoal kilns). An FLR programme can reduce carbon emissions by including a livelihood scheme that substitutes wood for fossil fuels. This can be achieved by producing biofuels in a community fuelwood plantation or by increasing efficiency of wood-processing technology and biofuel utilisation (e.g., fuel-efficient cook stoves or charcoal kilns). In India, for


Alternatives to traditional wood heat can increase the efficiency of burning biomass for energy.
Photos © IFSA/BFW

Ovens made from clay and straw increase the energy (firewood) efficiency of heating for baking local flatbread (naan), Pakistan.
Photos © Michael Kleine

example, introduction of fuel-efficient stoves reduced pressures on natural forests. The more efficient stoves reduced the need for large-scale fuelwood collection, thus enabling natural regeneration of forests. Additionally, wood products themselves provide long-term storage of carbon.

Wildland fires are another source of GHG emissions. Prescribed burning and holistic fire management can reduce overall emissions in fire-adapted wildlands by reducing the risk of high intensity fires. Altering timing of agricultural burning to earlier in the season, in order to produce a cooler fire also may reduce emissions. A key action to reduce carbon emissions is reducing rates of forest loss and degradation, i.e., from land use change. There are many ways of reducing deforestation drivers from policy reforms to promote increasing trees in the landscape (e.g., secure tenure) or improving native forest management, to increasing agriculture, agroforestry or pasture productivity and profitability (Table M6.1).

Forest landscape restoration can counteract emissions by avoiding deforestation and change to other land uses, and by increasing the carbon sequestered in soil and biomass (Table M6.1). Carbon sequestration involves increasing forest area or the amount of carbon stocks per unit area. Activities include afforestation (conversion of non-forest areas to forest), reforestation (artificially regenerating forests after disturbance such as logging), and restoration aimed at increasing productivity and diversity of degraded forests. Introducing longer-lived species or extending the cutting cycle both increase the amount of carbon in existing forests. Soil carbon can be increased by implementing soil

A prescribed burn in Guanacaste's dry forest (pictured right) to remove the invasive African grass jaragua (*Hyparrhenia rufa*), Costa Rica.

Left Photo © Janice Burns
Right Photo © Stephanie Mansourian

conservation measures that reduce wind and water erosion or by adding carbon to soil in the form of biochar.

Adaptation

Adaptive strategies for coping with climate change may be incremental, anticipatory or transformational (Joyce et al. 2013; Kates et al. 2012; Stanturf 2015). Incremental adaptations are comprised of extensions of current practices instituted to respond to variations in climate and extreme events could reduce vulnerability or avoid loss under current conditions. This is often characterised as a *no regrets* approach where the benefits are realised under current climatic conditions, as well as providing adaptation to future conditions (Table M6.2). Projects that attempt to restore forests to some measure of historical fidelity or past systems or within a presumed range of natural variability are incremental approaches and generally are reacting to climate change effects.

Guiding principles for adaptation

- *Maintain or improve ecosystem processes*
- *Promote species, genetic, structural and age-class diversity*

Anticipatory approaches may use many of the same techniques as incremental approaches but with an eye toward adaptation to future climate (Alfaro et al. 2014) thereby tolerating more ecological novelty. This can be seen in the choice of species used, or in the approach to novel community assemblages. Where the incremental strategy would focus in using only native species and resisting novel or emergent communities, the anticipatory strategy would tolerate using non-native species that are functional equivalents of natives, if the non-natives are better adapted to future climate. Restoration focused on resilient forests under future climate conditions aims to maintain ecological function and capacity for change, rather than specific species composition or current habitat conditions for particular animals (Table M6.2).

Transformational adaptations are attempts to proactively respond to or anticipate climate change, are larger in scale or more intense than incremental adaptations, or they are novel by their nature or new to a region or resource system (Joyce et al. 2013; Kates et al. 2012). Transformational approaches anticipate larger shifts in climate that may require significant changes to management objectives or production systems in the longer term.

Erosion control measures in Haryana, India.

Photos © Haryana Forest Development Corporation (HFDC)

Transformational adaptation arises spontaneously as novel ecosystems emerge or it may be intentionally planned. It includes assisted migration of species well beyond their native range (Williams and Dumroese 2013), introduction of non-native species (Davis et al. 2011), or genetic modification to restore keystone species (Jacobs et al. 2013).

Similar objectives of adaptation strategies

- *Maintain vigour at stand level;*
- *Favour genotypes adapted to local conditions;*
- *Resist pathogens;*
- *Manage herbivory to ensure adequate regeneration;*
- *Encourage species and structural diversity at the stand-level, landscape-level, or both;*
- *Provide connectivity and reduce landscape fragmentation.*

What differentiates these strategies is their tolerance of novel conditions or approaches (Table M6.2). By novel, we mean "a degree of dissimilarity to historical or current conditions in one or more dimensions" (Radeloff et al. 2015). Moving plant species in response to climate change is one adaptation technique that has acquired a new vocabulary, termed "assisted migration", "assisted colonisation", or "managed relocation" (Dumroese et al. 2015). The scale of movement defines the process. Assisted population migration refers to movement within a species' historic range and is primarily incremental adaptation to reintroduce an extirpated species or to expand the population to new areas within the range. Assisted range expansion, just beyond the historic range, mimics natural migration but intentionally anticipates changed climatic conditions. Creating new refugial areas to maintain species' presence in the landscape, by identifying microsites where the species may persist, is another technique of anticipatory adaptation (Keppel et al. 2012). Relocating species far beyond their historic range is a transformational approach that could include intracontinental movement. Less dramatic transformational approaches are the use of more genetically diverse

Table M6.1

Mitigation opportunities relevant to forest landscape restoration in terms of objectives, mechanisms and potential restoration activities

		Mitigation[1]	
Objective	**Mechanism**	**Restoration Activity**	**Level[2]**
Sequester carbon	Increase forest area	Recolonization	TL
		Farmer-assisted natural regeneration	STL
		Agroforestry (agroforestation)	ST
		Afforestation	STL
	Increase biomass/ unit area	Increase productivity	ST
		Introduce longer-lived species	ST
		Lengthen rotation or cutting cycle	STL
	Increase soil carbon	Introduce species with greater rooting depth	S
		Implement soil conservation measures that reduce erosion	TL
		Establish windbreaks to reduce wind erosion	TL
		Add biochar	T
Reduce fossil fuel emissions	Bioenergy	Firewood, charcoal, and forest residues	TN
		Bioenergy plantations	TLN
	Substitute materials with greater carbon footprint	Producing wood-based bioproducts (e.g. construction materials, bioplastics)	N
Reduce emissions from biomass burning	Control GHG emissions from wildfire	Prescribed burning and holistic fire management	TLN
		Convert to fire resistant species	STL
	Increase biofuel use efficiency	More efficient stoves, power plants, and conversion technology	N
		Improve charcoal production	TLN

Mitigation opportunities relevant to forest landscape restoration in terms of objectives, mechanisms and potential restoration activities

		Mitigation[1]	
Objective	**Mechanism**	**Restoration Activity**	**Level[2]**
Reduce emissions from land use change	Reduce deforestation drivers	Policy reforms to promote increasing trees in the landscape (e.g., secure tenure)	TLN
		Effective protection (e.g., conservation easements, improved enforcement)	TLN
		Improve native forest management employing sustainable forest management principles	TLN
		Utilize existing programs for local forest management (community forests, joint forest management, participatory forest management, etc.)	TLN
		Reduce illegal logging	TLN
		Reduce escaped fire	TLN
		Manage or exclude grazing	TLN
		Prevent agricultural encroachment	TLN
		Increase agriculture, agroforestry, pasture productivity and profitability	STLN
		Improve smallholder access to climate-adapted inputs and markets	STLN
		Promote forest-based value chains (especially for non-timber forest products)	SLN

[1] Based on Stanturf (2015) with additions from other sources
[2] Spatial hierarchy of activities: S=species, T=stand, L=landscape, N=national or international

seed sources with more systematic deployment of mixed systems, and promoting assemblages of tree species that are differently adapted to climate (Prabhu et al. 2015).

Table M6.2

Comparison of the features of incremental, anticipatory, and transformation adaptation strategies

	Adaptation Strategies*		
Features	**Incremental**	**Anticipatory**	**Transformational**
Vulnerability Target	Reduce vulnerability to current stressors	Reduce vulnerability to current and future stressors	Reduce vulnerability to current and future stressors
Restoration Paradigm	Ecological restoration: historic fidelity	Functional restoration	Intervention ecology
Species	Native	Native, or exotic with functional equivalencies	Native, exotic, or designer species
Genetics	Local sources, natural evolution	Conventional breeding or biotechnology for clones or provenances with adaptive traits More deliberate management and use (deployment) of species as well as intra specific diversity	Transgenic for keystone species, cloning extinct species
Invasive Species	Prevent or remove	Accept those that are functional analogs to extirpated natives	Accept as novel
Novel Ecosystems	Prevent or avoid	Accept and manage neo-native (emergent) assemblages	Manage novel and emergent ecosystems (exotics dominate)

**Adapted from Stanturf (2015)*

The adaptation activities directly relevant to FLR mostly fall into the categories of practice and behaviour, green infrastructure and technology, while FLR often benefits from policy changes and improvements in national management and planning. Practice and behaviour refer to revised or expanded practices that relate directly to building resilience, such as thinning stands to reduce transpiration loss as an adaptation to drought or by introducing genetically diverse planting material to improve adaptive capacity (Alfaro et al. 2014). Green infrastructure describes new or improved natural infrastructure that provides direct or indirect protection from climate hazards. An example of green infrastructure is planting coastal mangroves to adapt to rising sea levels and protect

Table M6.3

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	Mechanism	Restoration Activity	I[2]	A[2]	Levels[3]
Maintain forest area	Reduce deforestation drivers	Policy reforms to promote increasing trees in the landscape (e.g., secure tenure)	×		TLN
		Effective protection (e.g., conservation easements, improved enforcement)	×		TLN
		Improve native forest management employing sustainable forest management principles	×		TLN
		Prevent agricultural encroachment	×		TLN
		Reduce escaped fire	×	×	TL
		Manage or exclude grazing	×	×	TLN
		Reduce or avoid fragmentation	×		TLN
		Reduce illegal logging	×		TLN
		Promote forest-based value chains (especially non-timber forest products)	×		SLN
		Improve smallholder access to climate-adapted inputs and markets	×	×	STLN
		Increase agriculture, agroforestry, pasture productivity and profitability	×	×	STLN
Maintain carbon stocks	Reduce or avoid degradation	Policy reforms to avoid clearing native forests (e.g., functioning secondary forests cleared for oil palm)	×		LN
		Policy reforms to promote increasing trees in the landscape (e.g., secure tenure)	×	×	TLN
		Utilize existing local participatory forest management programs (e.g., community forests, joint forest management)	×		TLN
		Implement sustainable forest landscape management	×	×	TLN

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	**Mechanism**	**Restoration Activity**	**I[2]**	**A[2]**	**Levels[3]**
		Improve native forest management employing sustainable forest management principle	×		TLN
		Effective protection (e.g., conservation easements, improved enforcement)	×		TLN
		Protect native forests to enable local adaptation to climate change	×		TLN
		Use low-impact logging	×	×	TL
		Adjust harvesting levels to accommodate lowered productivity	×	×	TLN
		Protect soil from erosion or compaction	×	×	TL
		Reduce illegal logging	×		TLN
		Reduce or avoid fragmentation	×		TLN
		Prevent agricultural encroachment	×	×	TLN
		Manage or exclude grazing	×	×	TLN
		Reduce escaped fire	×	×	TLN
		Alter season of field burning	×	×	TL
		Manage fuel loads to avoid severe wildfire	×	×	TL
		Maintain or restore native fire regimes	×	×	TL
		Establish windbreaks to reduce wind erosion	×	×	TL
		Rehabilitate degraded stand structure		×	T
		Rehabilitate degraded stand composition	×	×	ST
		Restore natural disturbance processes (e.g., fire, flooding)	×	×	STL
		Favor species in native forests adapted to new and anticipated conditions	×		STL
		Manage vegetation to reduce water use and drought stress	×	×	ST

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	**Mechanism**	**Restoration Activity**	**I[2]**	**A[2]**	**Levels[3]**
		Increase connectivity between forested patches	×	×	TL
		Increase structural and age diversity in the landscape	×	×	TL
		Increase species diversity in the landscape	×	×	STL
		Plant species or provenances adapted to new and anticipated conditions (plantations, enrichment plantings in native forests)	×	×	STL
		Modify seed transfer zones, relax rules governing movement of planting stock	×	×	STLN
		Increase agriculture, agroforestry, and pasture productivity and profitability	×	×	STLN
		Improve smallholder access to climate-adapted inputs and markets	×	×	STLN
Maintain or improve other forest functions	Biodiversity	Expand reserves	×		LN
		Manage hunting (protect seed disperser or control herbivory)	×	×	TLN
		Manage for threatened, endangered, and species of concern	×	×	TLN
		Remove invasive species	×	×	TLN
		Protect species at edge of their ranges that may be better adapted to new climatic conditions	×	×	STL
		Silvicultural interventions to increase species diversity	×	×	STL
		Afforest, reforest, or agroforest with mixed species	×	×	STL

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	Mechanism	Restoration Activity	I[2]	A[2]	Levels[3]
	Hydrology	Protect catchment areas, riparian areas to benefit downstream users	×	×	LN
		Maintain or establish ridge top forests to intercept mist and fog	×	×	TLN
		Design dams to allow sediment transfer to coastal wetlands	×	×	TLN
		Restore stream hydroperiod	×	×	LN
		Maintain or increase shade in riparian zones to counteract increased temperatures that risk aquatic species	×	×	TL
		Plant stream buffers	×	×	TL
		Protect soil from erosion or compaction	×	×	TL
		Install or repair check dams and contour trenches	×	×	TL
		Plant coastal margins to buffer storm surges	×	×	TLN
		Maintain salinity levels and adjust to increased sedimentation in mangroves	×	×	TL
		Design shore structures to allow longshore sediment drift	×	×	TLN
	Rural economy	Promote forest-based value chains (especially for non-timber forest products)	×		SLN
		Improve timber productivity	×	×	STL
		Improve production of non-timber forest products	×	×	STL
		Improve recreational and subsistence hunting	×		SLN
		Improve aesthetics to promote eco-tourism	×		SLN

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	Mechanism	Restoration Activity	I[2]	A[2]	Levels[3]
Reduce vulnera-bility	Increase re-sistance and resilience to stressors	Thin to increase drought resistance	x	x	STL
		Integrated pest management	x	x	STL
		Design dams to allow sediment transfer to coastal wetlands	x	x	LN
		Maintain salinity levels and adjust to increased sedimentation in mangroves	x	x	LN
		Design shore structures to allow longshore sediment drift	x	x	LN
		Introduce new species or more climate-adapt-ed provenances of existing species	x	x	STL
	Overcome regenera-tion barriers	Control herbivory	x	x	TL
		Enhance dispersal by removing barriers and creating connectivity	x	x	TL
		Genetically diverse seed sources available in the landscape for natural regeneration, colonization, or agroforestry planting	x	x	SN
		Modify seed transfer zones, relax rules governing movement of planting stock	x	x	SN
		Plant species or provenances adapted to new and anticipated conditions (plan-tations, enrichment plantings in native forests)	x	x	STL
		Develop genetically diverse germplasm that is climate-adapted (e.g., seed sources, provenances, or functionally equivalent non-native species)	x	x	SN
		Introduce genetically diverse germplasm that is climate-adapted	x	x	
	Assisted population migration	Reintroduce species within historic range that have become extirpated	x		STL

Adaptation activities relevant to forest landscape restoration in terms of climate change benefits, restoration mechanisms and activities

		ADAPTATION (Incremental and Anticipatory)[1]			
Objective	Mechanism	Restoration Activity	I[2]	A[2]	Levels[3]
		Expand population within the historic range	×		STL
	Assisted range expansion	Expand just beyond historic range, mimicking natural range expansion		×	STL
	Create refugia	Identify and create microclimate refugia for in situ conservation of climate-threatened species		×	SLN

[1] Based on Stanturf (2015) with additions from other sources

[2] Adaptation activity: I=Incremental, A=Anticipatory

[3] Spatial hierarchy of activities: S=species, T=stand, L=landscape, N=national or international

from storm surges (Alongi 2008). For example, studies from Sri Lanka highlight the real value of mangroves in protecting communities from tsunamis. New or increased adoption of climate resilient technology includes improved cook stoves to reduce GHG emissions (e.g., India). Many FLR projects also include capacity building, management and planning, and information components, and may require policy revisions to be effective. Nevertheless, in most cases core activities of FLR projects involve manipulating vegetation.

Adaptation benefits come from maintaining forest area, carbon stocks and reducing or avoiding degradation (Table M6.3). Other benefits come from maintaining or improving other forest functions such as biodiversity and hydrology or by improving rural economy. Benefits from anticipatory activities include a reduction in vulnerability and an increase in resistance or resilience to climate-related stressors. Natural and social systems are vulnerable to climate change and adaptation can maintain their functioning. Forest and community adaptation are linked: forests play a role in the adaptive capacity of local communities and the broader society by providing ecosystem services, and actions of people enhance or reduce adaptability of forests (Locatelli et al. 2011).

Planting species or provenances adapted to new and anticipated conditions is a widely discussed form of adaptation to climate change. In landscapes where planting is necessary for restoration or reforestation, rigid rules governing movement of planting stock or seed transfer zones that do not account for changing climate may need to be relaxed to allow for adaptation. Developing climate-adapted germplasm can take advantage of existing breeding programmes and techniques in order to introduce new provenances

Co-operative tree nursery in Rwanda.
Photo © Janice Burns

of native species or functionally equivalent non-native species to replace maladapted provenances.

Informed deployment (movement) of the genetic resources of trees requires that we know what the appropriate material for a given climate envelope may be and that such material is available. Suitability maps are needed for a greater range of species than are currently available (Kindt et al. 2014; 2015) and the incorporation in breeding programmes of climate-related traits (such as pest and disease resistance, drought resistance, fire tolerance, cyclone resistance, salt tolerance and phenotypic plasticity) needs to be done more actively (Alfaro et al. 2014).

Transformational adaptations encompass novel ecosystems that arise spontaneously or are created by design (Table M6.4). Managing spontaneous novel ecosystems entails managing new assemblages that arise by the arrival of new species or the altered dominance of existing species. Warming climate has already caused large-scale insect outbreaks (Bentz et al. 2010) that are changing landscapes but it remains to be seen whether novel ecosystems will arise. Techniques for intentional creation of novel ecosystems range from policy changes that allow non-native or transgenic trees to be planted in areas where previously they were prohibited, to assisted species migration (long-distance movement outside historic range for the purposes of avoiding extinction) (Dumroese et al. 2015; Williams and Dumroese 2013).

Neo-native ecosystems could arise by intentionally moving communities of native species to a new location in anticipation of climate change. Lunt et al. (2013) distinguished between push migrations to maintain taxa (e.g., assisted migration of a species far beyond its historical range (McLachlan et al. 2007; Williams and Dumroese 2013) versus pull migrations used to restore a degraded site by adding a species (e.g., introducing a non-native species; Davis et al. 2011). Creating a truly novel (or designer) ecosystem would require establishing an assemblage of native and non-native species adapted to future climate (Hobbs et al. 2009).

There are innate social limits to adaptation that are rooted in a society's cultural values, its ethics and belief, its traditional values in the face of fast-paced technological developments, its attitude toward risk taking, its education levels, economic status and

Table M6.4

Transformational adaptation activities[1]

Objective	Mechanism	Restoration Activity	Levels[2]
Manage novel eco-systems	Manage spontaneous ecosystems	Manage new species combinations that emerge (e.g., non-natives, altered dominance of natives)	STLN
	Create ecosystems	Policy that allows planting non-native species or transgenic trees	SN
		Assisted long distance species migration (well outside historic range)	STLN
		Create and plant new species that are climate-adapted (using synthetic biology) with desired functional traits	STLN
		Rewilding (re-introduce extirpated or extinct species)	STLN
		Ecosystem with novelty (replace native species with non-natives having desired functional traits)	STLN
		Neo-native ecosystems (moving communities of native species)	STLN
		Novel ecosystems (combinations of native and non-native species with desired functional traits; designer ecosystems)	STLN

[1] Based on Stanturf, 2015

[2] Spatial hierarchy of activities: S=species, T=stand, L=landscape, N=national or international

quality of leadership (Adger 2000). Many societies have value systems rooted in their sense of kinship to land and forests and may find technological interventions needed for adaptation - like creation of genetic variants for adaptation - that are sharply at variance with their belief systems, unacceptable (Kant and Wu 2012). However, many adaptation measures likely will require significant technological leaps and it will be necessary to instil in communities confidence in the use of modern technologies through regular interactions between them and scientists in order to enhance their understanding.

The greatest opportunities for incremental adaptation exist where active forest management already occurs (Guldin 2013; Spittlehouse and Stewart 2004). Establishing new forests or restoring degraded forests must balance sustainability under current climate conditions and adaptability to future climates, thus choice of species, seed source, stand structure and management regime may require trade-offs. Landscape position and site characteristics influence stand-level adaptation; existing forest conditions may narrow alternatives. In general, striving for quick site capture will maximise carbon benefits and avoid invasion by grasses and herbaceous species that could increase fire risk (D'Antonio and Vitousek 1992).

Other mitigation activities include favouring multiple species over single species plantings at the stand level and developing structure/age diversity at the landscape level (Millar et al. 2007). Landscape level restoration in Brazil's Atlantic forest is an example of such large-scale and diverse restoration actions. In this case, they include policy-level actions – a new Forest Code (Law # 12651/2012) passed in 2012, to restore six million hectares – with on the ground actions such as the reintroduction of native species by seedling planting or the removal of ecological barriers to support the establishment of new species through seed dispersal from neighbouring forests.

Considerable planning, experimentation, and adaptive management will be required to be successful. Windows for transformational adaptation likely will be associated with extreme events, which are expected to increase in frequency and intensity under climate change (Rummukainen 2012). Prolonged drought, insect outbreaks, wildfire and wind disturbances that reach the level of a "natural disaster", whether associated with climate change or not, all provide impetus for restoration. The window for transformative approaches will likely be narrow, as the general tendency following a severe disturbance is to restore to what was there before the event (Cruz et al. 2012). Extreme events can create a window of opportunity for transformative activity, by temporarily lowering institutional and social barriers to change that allow for "directed transformation" by institutions (Nelson et al. 2007).

Linkages, Synergies and Trade-Offs

Narrowly focused mitigation actions potentially can increase the vulnerability of forests and forest-dependent communities but this can be avoided by incorporating adaptation practices into mitigation (Ravindranath 2007). For example, planting indigenous fruit trees can be a component of an FLR process, sequestering carbon and providing a source of vitamin-rich foods to rural communities, reducing their vulnerability to malnutrition and possibly increasing their income (Jamnadass et al. 2015). In the same way, some actions undertaken in the name of adaptation, such as protecting mangroves from fuelwood collection by supporting small community fuelwood plantations under agroforestry, can also contribute to FLR.

Linkages between local communities and forests are diverse and complex, mirroring the diversity of forest ecosystems and socio-political arrangements. Community adaptations to climate change could affect forests positively by reducing pressures (e.g., clearing for agriculture, charcoal production or escaped fires), improving forest management and increasing protection by local enforcement. In Ghana for example, local communities were trained in fire prevention and management, and were given fire-fighting equipment and support in post-fire restoration efforts. Alternatively, communities might adapt to a changing climate that lowers crop yields by clearing more land and increasing pressure on forests.

Adapting forests to altered climate will benefit local, regional and global communities by maintaining provisioning of ecosystem goods and services such as soil protection, provision of construction material, food etc. Local communities may benefit specifically through the roles that forest plays in food security and meeting energy needs. For example, in Indonesia local communities were involved in restoration inside the Gunung Halimun Salak Park using notably, fruit trees such as rambutan (*Nephelium lappaceum*), durian (*Durio* sp.), mangosteen (*Garcinia mangostana*) and nutmeg (*Myristica* sp.).

Mitigation activities such as afforestation may be situated in the landscape to improve connectivity between patches of intact forests, aiding dispersal, migration and gene flow among populations of plants and animals. New forest areas including high-productive forests and plantations of native and/or non-native species around intact forests - especially protected areas - may act as buffers and reduce pressure on native forests as long as introduction of invasive species is avoided. Forest adaptation measures are crucial to ensuring permanence of carbon fixed in forests established for mitigation purposes and improved forest management may increase carbon sequestration in native forests. Similarly, community adaptation activity such as conservation agriculture that increases crop yields may benefit carbon permanence in mitigation forests by reducing the need to expand cropped land to maintain sufficient food and in the process, increase carbon sequestered in cropland soil. Mitigation forests may provide ecosystem services to communities as well as carbon payments under the Clean Development Mechanism (CDM) or REDD+, and the afforestation programme may provide local jobs in nurseries, planting and tending the restoring forest. For example, in Lake Victoria smallholder farmers were trained in agroforestry techniques that contribute to carbon sequestration. As an incentive, they were given free seeds and seedlings. Bioenergy plantations established on depleted cropland may provide income to landowners as well as creating jobs to establish, tend and process the crop (Campbell et al. 2008).

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MODULE VII.

Communicating Forest Landscape Restoration Results

Adequate and intensive interaction and communication are required at all stages of an FLR project in order to achieve measurable changes in the landscape. By their nature, FLR projects are complex as they cover larger landscapes involving a multitude of landowners and different stakeholders with differing interests, objectives and aspirations.

Successful development and implementation of FLR projects depends on many motivated actors at different levels doing the right things, and communication among everyone involved or interested in FLR is critical. This module focuses on best practices to communicate effectively the FLR vision, goals, objectives, implementation plan and outcomes to multiple audiences at different stages of the FLR process. The module is divided into three parts as follows:

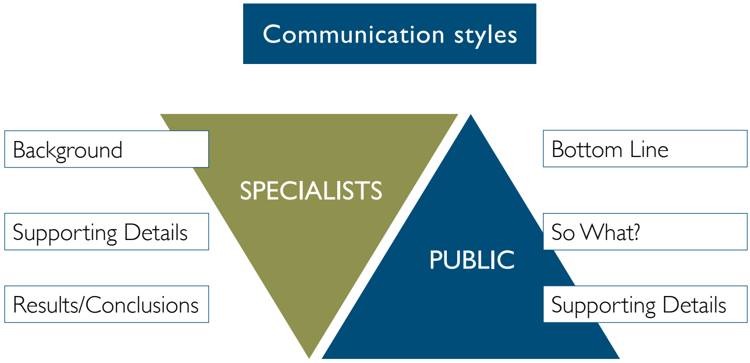
- *General principles of communication that apply at all stages;*
- *Communicating and interacting with different target groups, explaining key benefits of FLR in concrete terms that are relevant and attractive to specific stakeholder groups; and*
- *Using a simple communication product, the "Stoplight Tool", to tell the story at different stages.*

The general thrust of this module is how to communicate both the overall FLR concept and technical issues to non-technical, or non-specialist, audiences.

Need to Communicate!!

- *Translating global FLR objectives into the national context*
- *Demonstrating the need for an enabling regulatory and institutional environment for FLR implementation*

Left Photo © Wolfgang Simlinger; Right Photo © Mokhammad Edliadi/CIFOR



Communication styles differ between scientists and the public
Source: American Association for the Advancement of Science, https://www.aaas.org/page/communicating-engage

Figure M7.1

- *Explaining FLR to funding agencies/private sector*
- *Motivating local stakeholders to participate in FLR*

General Principles

The most basic principle of communication is to ***Know Your Audience***; specifically, to understand why a listener needs your information. This potential user of knowledge, or the policymaker, need not only be at the highest level of governance, s/he could be at the community level, district level, provincial and national level, and even the global level; decide to whom the information generated could be useful and then act accordingly.

Your job is to construct a message that meets that listener's need to know about your FLR project. Not everyone needs to know the same main points and almost no one needs to know all the details or the full process of how you reached conclusions. Your message should be clear, concise and compelling. Conciseness confers credibility. As Albert Einstein reportedly said, "If you can't explain it simply, you don't understand it well enough." The acronym KISS embodies this admonition—Keep It Simple Stupid. If you are a technical specialist, you are used to communicating with other specialists in a certain way. You probably begin with background and build your argument to a result or conclusion. Be advised! This is not how non-technical communication happens. The differences between communication styles of scientists and technical specialists versus the public are illustrated in Figure M7.1.

Effectively communicating with the public begins by delivering the conclusions first, then providing detail as necessary. This is more complicated than simply stating the results of your analysis; it requires winnowing down a lot of technical jargon into a headline and three main supporting points. If your audience is hearing about your FLR project for the first time, you will need to provide some context as well by presenting briefly the problem first, and then giving the solutions. Regardless of whether or not the audience is familiar with your specific FLR project, try to connect to what they already know about the environment and similar projects.

Communicating forest landscape restoration to all sectors of society is essential for implementation success, Kuala Selangor, Malaysia.
Photo © Alexander Buck

Deciding how much detail to include answers the question, "So what?" Begin by asking yourself, "How much does the audience already know?" That sets a baseline for the next question, "What do they need to know?" If the audience is non-technical (and in some instances illiterate), you may need to provide background on the problems in order for them to appreciate the significance of the information you are providing. Finally, you should understand what you think the audience will do with the information, or at least what you want them to do with it. Is it strictly informational, such as briefing a sister government agency on the FLR project? Alternatively, maybe the desired outcome is to mobilise a community group to support the FLR project with their time and labour.

Two techniques that speakers use to communicate technical information to non-technical (or even technical) audiences are telling stories and using analogies to establish a connection with the audience. Analogies should not be too involved and should always relate to general experience; you should not have to explain your analogy to make your point. For example, people (and the media) often conflate weather and climate. An analogy that points out the difference between them is "Weather is mood, climate is personality." Finally, try to anticipate and answer "Why?" questions before they are asked. For example, in describing a monitoring indicator such as stream turbidity, you might present this as "We measured stream turbidity because it is the most sensitive measure of soil erosion in the watershed and the easiest to measure."

Communicating/Interacting with specific target groups

Generally, interacting with society in a strategic and thoughtful way has the potential to create interest in FLR so that it will lead to improved outcomes. By interacting with different target groups and identifying key issues and interests from their perspective, national and sub-national FLR implementation facilitators (whatever their title, let us call them FLR facilitators) can identify opportunities for stakeholders to contribute to long-term national and global FLR. Moreover, they can inspire individuals and help them to achieve their personal goals, which will cumulatively contribute to restoring degraded lands and maintaining and improving sustainable land management practices. For each target group, consider the purpose and method of delivery of the message. Identifying issues important to a particular target group and listening to feedback will allow FLR facilitators to better understand the local situation and enable them to provide feedback that is more useful. Besides answering stakeholder questions, the FLR facilitator can more clearly illustrate how existing actions or alternative actions could contribute to the successful implementation of FLR locally.

Targeting your audience

This section offers examples of the types of messages, method of delivery and important points to consider when interacting with major target groups. Interacting with society in this way has the potential to create interest so that target groups will seek the tools, means and knowledge required to participate in a much larger purpose, while primarily serving their own interests. The target groups discussed in this section are:

- *Industry*
- *Science community*
- *Farmers and subsistence agriculturists*
- *Extension agents*
- *Governments*
- *NGOs*
- *Youth and educators*
- *Civil society (including consumers and urban dwellers)*

For each target group, address these three main questions:

- ***Why interact with this target group?*** *Why are they important for FLR within a defined local context? What can they contribute to the big picture?*
- ***What main messages should be conveyed to this group?*** *How might you approach them? Which media, means of communication could be suitable? Which type of language (formal/complicated/simple), scope and conceptualisation are relevant for engaging with them about issues relevant to their day-to-day life?*
- ***How could their actions contribute to FLR?*** *How might their individual goals be integrated with social goals? How might they be equipped with tools that help them reach their goals?*

Photos © Michael Kleine

Key points:

- *Actively engage key target groups*
- *Know to whom you're talking*
- *Tailor your interaction specifically to them and their situation*
- *Listen and learn*
- *Contribute relevant and missing information*
- *Highlight opportunities, benefits and tools which may help to overcome expected obstacles*

Industry

Here is an example of how to communicate with one group, industry.

Why interact with industry?

Private sector companies play an important role in land management because of their involvement in forest and agriculture plantations, mining, or infrastructure development. Their operations can have a significant impact and may contribute to land degradation. As improvements of private sector operations in the landscape have the potential to positively contribute to FLR, it is important to integrate such companies into FLR activities.

What main messages should be conveyed to this group?

As economic entities, private sector companies are set up to earn money through cost-effective operations. Therefore, any requirement for a company to contribute to restoring ecosystem functions needs to take into account the company's interest and the financial implications. One main message to the private sector is that changes can be low-cost. For example, the enhancement of biodiversity within a plantation forest area could be accomplished by re-establishing natural vegetation along streams, plantation fringes and roads. To encourage industry to implement these practices, messages should emphasise the very small timber production area that is lost. Another message is to appeal to their corporate social responsibility and image as means to increase their client base and comply with legal requirements or commitments made under different sustainability initiatives (e.g. the UN Global Compact).

How could their actions contribute to FLR?

Re-establishing natural vegetation elements in landscapes, particularly to diversify areas where large-scale monocultures (e.g. fast-growing tree plantations) have replaced diverse tropical forests, can help reverse the decline in biodiversity. This is important for improving habitat quality for many species including pollinators, bird populations and others.

Engaging with different groups

Science community

- *Broadly discuss all issues, scales, complexities – from primary forest biodiversity to herbicide application*
- *Encourage cross-sectoral cooperation, information sharing, collaborative thinking*

Farmers and subsistence agriculturalists

- *Utilise existing farm schools*
- *Partner with extension and land use planning agencies*

Extension agents

- *Explain how FLR fits into the picture of what they have already been doing for 30 years*
- *Train them on FLR and how to incorporate it into their ongoing work*

Government/NGOs

- *Categorise existing activities and achievements in terms of their goals/objectives/targets*
- *Indicate direction of progress relative to their goals*

Youth and educators

- *Capture the interest of the youth so that they demand education on FLR*
- *Support youth by approaching educators and proposing FLR modules to include in elementary and tertiary education*

Civil society

- *Present potential benefits or losses that are directly related to their actions and habits*
- *Impress the importance of their decision making on global land management practices*

Potential donors or sponsors are intentionally excluded from this list of target groups because all of the above groups will be the ones who finally invest the time, knowledge, expertise and resources to making meaningful long-term differences. They will be the ones who develop the capacity and skill sets to capture opportunities when they arise, in an environment where markets, funding, constraints and challenges are constantly evolving. They are the ones who will seek solutions that serve their own personal interests and the greater good of society as a whole.

Successful interactions with different target groups will prompt individuals to take action by clarifying the specific benefits that they will receive if they choose to implement certain practices. Moreover, it will help them to connect with the tools needed to implement their projects and reach their goals, and overall this will lead to the scale of participation necessary to implement globally sustainable land management.

Essential skills for national and sub-national FLR implementation facilitators

- *Listening - communication is a two way process and listening, learning and utilising feedback are essential components of capturing the interest of a target audience. People like to talk about themselves, so let them tell you about their situation, issues, challenges, successes and failures, then integrate what you learn from them when targeting further avenues of discussion or presenting potential FLR benefits so that you are discussing something relevant to them.*
- *Filling in the gaps – if you do a good job of listening to your target group, then you have a great opportunity to identify points of interest for the person with whom you are speaking. Focus your dialogue on issues that are relevant to the person or group that you are talking to, and draw on your own knowledge and contextual understanding to fill in the gaps for them and point out relevant issues that they may not have considered. This will help to avoid wasting time by boring them with things they already know or do not care about.*

Stoplight Tool

Communicating the results and benefits of FLR is important at every stage within the FLR process. National decision-makers need to be informed about the range of

Educating youth about the value and functions of forest ecosystems can help to ensure a sustainable future, pictured here, National Nature Camping program, Haryana, India.
Photo © Promode Kant

restoration options that could be considered and applied in their country. Results of the Restoration Opportunity Assessment Methodology (ROAM) (IUCN/WRI 2014) and consultations with national agriculture and forest research institutions could aid in this process. Experience has shown that one of the biggest challenges in putting FLR into practice is reaching consensus among stakeholders on necessary measures to achieve a desired set of objectives.

The stoplight tool is a simple communication product modelled on a traffic or stop light that can be used to promote the understanding of FLR with policymakers. It also can be modified for use in participatory planning and joint evaluation of concrete FLR initiatives in a given local context. The tool is meant to complement the Rapid Restoration Diagnostic Tool developed by IUCN and WRI (Hanson et al. 2014) and add resolution to the enabling conditions and key success factors identified in the ROAM developed by IUCN and WRI (2014). The added resolution will bring the user (whether planner, evaluator or implementer) closer to the requirements of the actual field operations of FLR, including the many complex technical problems that need to be dealt with following the participatory planning process involving both governance and implementation structures and institutions.

Multiple Uses of the Stoplight Tool

- *To promote understanding of FLR among decision-makers and stakeholders*
- *For participatory planning involving different stakeholders*
- *To evaluate FLR projects against pre-defined criteria and implementation standards*
- *To communicate potential benefits of a project to decision-makers*

- *To facilitate involvement of many stakeholders in participatory planning of a project*
- *To evaluate different FLR project formulations*
- *To evaluate a single project formulation against pre-defined criteria or implementation standards*

The stoplight tool can be used in two different ways. It can be used to answer the question of where we are in terms of (i) the status of implementing an activity (current implementation level), or it can be used to answer the question of (ii) where we want to go with a certain activity (prioritisation). Ideally, one would always try to answer question (i) first and from there decide on question (ii). Nevertheless, in some cases there may be a need to answer question (ii) without having the answers to question (i). The stoplight tool does not perform evaluations, rather it summarises status and communicates progress. Evaluations can be done simply (by consensus or voting) or through complex computer-aided ranking algorithms. The stoplight tool presents the results of the evaluation or rating process in a simple table that communicates the results.

Status of implementation of an FLR project

Table M7.1 highlights an example of a stoplight tool used to present a hypothetical FLR project in a medium-sized landscape to decision-makers. The question addressed in the table is "Where are we?" Each activity is rated with a colour: in this table, green indicates an activity is in place, red indicates not in place and yellow means an activity is partly in place or in progress.

Table M7.1 Status of implementation of an FLR project. Implementation level indicated by green=in place; yellow=partly in place; red=not in place.

Communicating during the design phase

The involvement of a wide range of stakeholders is essential for any FLR project to be successful. To this end, using the stoplight tool can facilitate participatory planning and designing of projects with stakeholders. At an early stage, the full array of potential restoration activities could be developed by a design team, possibly resulting from an assessment such as ROAM. A stoplight matrix can communicate the design and facilitate modifications (an example is shown in Table M7.2). Groups of stakeholders can use the tool to assign consensus ratings to each activity: green for fully appropriate or desirable, red for not appropriate or undesirable, and yellow for possibly appropriate (perhaps not enough information is available to evaluate the activity or there is not a consensus among the stakeholders). The tool is used here to begin to answer the question, "Where do we want to go?" Initially, the stoplight summarises priorities without assessing the feasibility in advance. As more information on feasibility and costs become available, the stoplight summarises final objectives. Larger FLR projects may involve multiple stakeholder groups. These may be geographically defined (for example, in different parts of a watershed) or by interest/livelihood sector (for example, smallholders, large landowners, conservation NGOs). Multiple columns represent rankings of a stakeholder group (Table M7.3) with a final column representing an overall rating for an activity.

Communicating alternative project formulations

The stoplight tool can be used to communicate evaluations of alternative FLR project formulations utilising multiple columns (Table M7.4). A design team or a stakeholder group then ranks each cell in a fashion similar to that used in Table M7.2: green for fully appropriate or desirable, red for not appropriate or undesirable, and yellow for when there is no consensus. For example, project alternatives might be different landscapes or each alternative might be a package of activities proposed by a stakeholder group. Another application of the stoplight tool in this formulation might be desirability of specific activities in different locations or different areas within the landscape. For example, afforestation might be desirable in all areas within a watershed except in recharge areas (column 1). These examples illustrate the multiple applications and flexibility of the stoplight tool. Importantly, give the groups using the tool clear instructions on what they are evaluating, in terms of both the meaning of "project alternatives" and the colour-coded rating.

Communicating FLR project evaluations against goal-based criteria

The stoplight tool may also be useful to summarise and communicate predetermined evaluation criteria. Using the stoplight tool in this way, each activity could be rated as to whether it provided a positive (green), negative (red), or neutral (yellow) effect on general sustainability criteria such as ecological, social and financial benefits (Table M7.5) or the "triple win" of mitigation, adaptation and development co-benefits (Suckall et al. 2015). The criteria might be more specific, for example using programme or donor agency criteria such as carbon sequestration, water supply, food security, cost feasibility, etc. In the same way, a third-party auditing team could use the stoplight tool to evaluate an FLR project against predetermined audit criteria.

Key questions:

- *Do I know my audience?*
- *How much does the audience know?*
- *How much does the audience need to know?*
- *How can I keep my message simple?*
- *What is my story?*

Table M7.2

Communicating progress and promoting a hypothetical FLR project in a medium-sized landscape

	Objective	Mechanism	Restoration Activity	Priority Level
Mitigation	Sequester carbon	Increase forest area	Afforestation	🟢
		Increase biomass/unit area	Increase productivity	🟠
			Longer – lived species	🟢
		Increase soil carbon	Increase rooting depth	🟢
	Reduce emissions	Bioenergy	Bioenergy plantations	🟠
Adaptation	Maintain forest area	Reduce deforestation drivers	Policy reform – wetlands drainage regulations	🟢
			Conservation easements	🟢
			Improve silviculture	🟠
	Maintain carbon stocks	Reduce degradation	Sustainable forest management (improve regeneration)	🟢
	Maintain other forest functions	Improve biodiversity	Afforest with mixed species	🟢
			Recover endangered species (Louisiana black bear, pondberry)	🟠
			Manage for species of concern (Neotropical migratory songbirds)	🟠
		Improve hydrology	Restore microsites	🔴
			Plant stream buffers	🟠
	Manage for resistance	Reduce vulnerability to stressors	Integrated pest management of *Populus deltoides* only	🟠
		Overcome regeneration barriers	Secure advance *Quercus* regeneration	🟢
		Reduce vulnerability by breeding, introduce new provenances, genetic modification		🔴
	Manage for resilience	Expand population (within range)	Emphasize *Quercus* spp. in afforestation	🟠
		Expand range		🔴
		Create refugia		🔴

Priority levels are indicated by 🟢 desirable, 🔴 undesirable, 🟠 not enough information is available to evaluate the activity or there is not a consensus among the stakeholders

Communicating progress and promoting a hypothetical FLR project in a medium-sized landscape

	Objective	Mechanism	Restoration Activity	Priority Level
Transformation	Novel ecosystems	Manage spontaneous ecosystems	Management of mixed plantings	Green
		Create ecosystems	Translocate species	Red
			Replace species within assemblages with desired functional traits	Orange
			Introduce exotics (non-native species) with desired functional traits	Red

Table M7.3

Multiple stakeholders use the stoplight tool to plan and communicate potential FLR activities

	Objective	Mechanism	Restoration Activity	Priority assigned by different stakeholder groups				
				1	2	3	4	Overall Rating
Mitigation	Sequester carbon	Increase forest area	Afforestation	Orange	Green	Green	Green	Green
		Increase biomass/ unit area	Increase productivity	Green	Orange	Orange	Green	Orange
			Longer – lived species	Orange	Green	Green	Green	Green
		Increase soil carbon	Increase rooting depth	Green	Green	Green	Green	Green
	Reduce emissions	Bioenergy	Bioenergy plantations	Orange	Red	Red	Green	Orange
Adaptation	Maintain forest area	Reduce deforestation drivers	Policy reform – wetlands drainage regulations	Green	Green	Green	Orange	Green
			Conservation easements	Red	Green	Green	Red	Orange
			Improve silviculture	Green	Orange	Orange	Green	Orange
	Maintain carbon stocks	Reduce degradation	Sustainable forest management (improve regeneration)	Green	Orange	Orange	Green	Orange
	Maintain other forest functions	Improve biodiversity	Afforest with mixed species	Green	Orange	Green	Green	Green

Multiple stakeholders use the stoplight tool to plan and communicate potential FLR activities

	Objective	Mechanism	Restoration Activity	Priority assigned by different stakeholder groups				
				1	2	3	4	Overall Rating
Adaptation			Recover endangered species (Louisiana black bear, pondberry)	🔴	🟢	🟢	🟡	🟡
			Manage for species of concern (Neotropical migratory songbirds)	🟡	🟢	🟢	🟡	🟡
		Improve hydrology	Restore microsites	🔴	🟢	🟢	🟡	🟡
			Plant stream buffers	🔴	🟢	🟢	🟡	🟡
	Manage for resistance	Reduce vulnerability to stressors	Integrated pest management of *Populus deltoides* only	🟡	🔴	🔴	🟡	🟡
		Overcome regeneration barriers	Secure advance *Quercus* regeneration	🟡	🟡	🟢	🟡	🟡
		Reduce vulnerability by breeding, introduce new provenances, genetic modification		🔴	🔴	🟡	🔴	🔴
	Manage for resilience	Expand population (within range)	Emphasize *Quercus* spp. in afforestation	🟢	🟢	🟡	🟡	🟡
		Expand range		🔴	🟢	🟡	🔴	🟡
		Create refugia		🔴	🟢	🟡	🔴	🟡
Transformation	Novel ecosystems	Manage spontaneous ecosystems	Management of mixed plantings	🔴	🟡	🟡	🟢	🟡
		Create ecosystems	Translocate species	🔴	🔴	🟡	🟢	🟡
			Replace species within assemblages with desired functional traits	🔴	🔴	🟡	🟢	🟡
			Introduce exotics (non-native species) with desired functional traits	🔴	🔴	🟡	🟢	🟡

Priority levels are indicated by 🟢 desirable, 🔴 undesirable, 🟡 not enough information is available to evaluate the activity or there is no consensus among the stakeholders. The overall rating is obtained by consensus or voting.

Table M7.4

Communicating evaluations of desirability of alternative project formulations

	Objective	Mechanism	Restoration Activity	Project Alternatives 1	2	3	4	5
Mitigation	Sequester carbon	Increase forest area	Afforestation	🔴	🟢	🟢	🟢	🟢
		Increase biomass/ unit area	Increase productivity	🔴	🟢	🟢	🟢	🟠
			Longer – lived species	🔴	🟢	🟢	🟠	🟢
		Increase soil carbon	Increase rooting depth	🔴	🟢	🟢	🟠	🟢
	Reduce emissions	Bioenergy	Bioenergy plantations	🔴	🟠	🟢	🟢	🟠
Adaptation	Maintain forest area	Reduce deforestation drivers	Policy reform – wetlands drainage regulations	🟢	🟢	🟠	🔴	🟢
			Conservation easements	🟢	🟢	🟠	🔴	🟢
			Improve silviculture	🟠	🟢	🟢	🟢	🟠
	Maintain carbon stocks	Reduce degradation	Sustainable forest management (improve regeneration)	🟠	🟢	🟢	🟢	🟠
	Maintain other forest functions	Improve biodiversity	Afforest with mixed species	🔴	🟢	🟢	🟢	🟠
			Recover endangered species (Louisiana black bear, pondberry)	🟢	🟢	🔴	🔴	🟠
			Manage for species of concern (Neotropical migratory songbirds)	🟢	🟠	🟠	🟠	🟠
		Improve hydrology	Restore microsites	🟢	🟢	🔴	🔴	🔴
			Plant stream buffers	🔴	🟢	🔴	🔴	🔴
	Manage for resistance	Reduce vulnerability to stressors	Integrated pest management of *Populus deltoides* only	🔴	🔴	🟠	🟢	🟠
		Overcome regeneration barriers	Secure advance *Quercus* regeneration	🔴	🟠	🟠	🟢	🟠
		Reduce vulnerability by breeding, introduce new provenances, genetic modification		🔴	🔴	🟠	🟢	🔴
	Manage for resilience	Expand population (within range)	Emphasize *Quercus* spp. in afforestation	🟠	🟠	🟠	🟢	🟠
		Expand range		🔴	🟢	🔴	🔴	🔴
		Create refugia		🔴	🟢	🔴	🔴	🔴

🟢 In place 🟠 Partly in place 🔴 Not in place

Communicating evaluations of desirability of alternative project formulations

	Objective	Mechanism	Restoration Activity	Project Alternatives 1	2	3	4	5
Transformation	Novel ecosystems	Manage spontaneous ecosystems	Management of mixed plantings	🔴	🔴	🟠	🟢	🔴
		Create ecosystems	Translocate species	🔴	🔴	🟠	🟢	🔴
			Replace species within assemblages with desired functional traits	🔴	🔴	🟠	🟢	🔴
			Introduce exotics (non-native species) with desired functional traits	🔴	🔴	🟠	🟢	🔴

Table **M7.5**

Communicating evaluations of FLR project benefits using goal-based criteria

	Objective	Mechanism	Restoration Activity	Benefit Criteria* M	A	D	F	W
Mitigation	Sequester carbon	Increase forest area	Afforestation	🟢	🟢	🟠	🟢	🟢
		Increase biomass/ unit area	Increase productivity	🟢	🟠	🔴	🟠	🟠
			Longer – lived species	🟢	🟠	🔴	🟢	🟠
		Increase soil carbon	Increase rooting depth	🟢	🟠	🔴	🟢	🟠
	Reduce emissions	Bioenergy	Bioenergy plantations	🟢	🔴	🔴	🟠	🔴
Adaptation	Maintain forest area	Reduce deforestation drivers	Policy reform – wetlands drainage regulations	🟠	🟠	🔴	🟢	🟢
			Conservation easements	🟠	🟠	🔴	🟢	🟢
			Improve silviculture	🟢	🟢	🟠	🟠	🟠
	Maintain carbon stocks	Reduce degradation	Sustainable forest management (improve regeneration)	🟢	🟢	🟠	🟠	🟠
	Maintain other forest functions	Improve biodiversity	Afforest with mixed species	🟢	🟢	🟠	🟠	🟠
			Recover endangered species (Louisiana black bear, pondberry)	🔴	🟠	🔴	🟠	🟠

Communicating evaluations of FLR project benefits using goal-based criteria

Adaptation			Manage for species of concern (Neotropical migratory songbirds)	Not in place	Partly in place	Not in place	Partly in place	Partly in place
		Improve hydrology	Restore microsites	Not in place	Partly in place	Not in place	Not in place	Not in place
			Plant stream buffers	Partly in place	Partly in place	Not in place	Not in place	In place
	Manage for resistance	Reduce vulnerability to stressors	Integrated pest management of *Populus deltoides* only	In place	Partly in place	Partly in place	Partly in place	Partly in place
		Overcome regeneration barriers	Secure advance *Quercus* regeneration	In place	In place	Partly in place	Partly in place	Partly in place
		Reduce vulnerability by breeding, introduce new provenances, genetic modification		In place	Partly in place	Partly in place	Not in place	Not in place
	Manage for resilience	Expand population (within range)	Emphasize *Quercus* spp. in afforestation	In place	In place	Partly in place	Partly in place	Partly in place
		Expand range		Not in place	In place	Not in place	Not in place	Not in place
		Create refugia		Not in place	In place	Not in place	Not in place	Not in place
Transformation	**Novel ecosystems**	Manage spontaneous ecosystems	Management of mixed plantings	Partly in place	Partly in place	Partly in place	Not in place	Partly in place
		Create ecosystems	Translocate species	Partly in place	Partly in place	Partly in place	Not in place	Partly in place
			Replace species within assemblages with desired functional traits	Partly in place	Partly in place	Partly in place	Not in place	Partly in place
			Introduce exotics (non-native species) with desired functional traits	Partly in place	Partly in place	Partly in place	Not in place	Partly in place

* Benefit criteria indicated as M=mitigation, A=adaptation, D=development, F=food security, w=water supply

● In place ● Partly in place ● Not in place

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Outlook

The Bonn Challenge and associated regional initiatives present great political will to restore degraded landscapes globally. The challenge is to capitalise on that momentum and turn grand ambition into actual accomplishments on the ground. Nevertheless, it is important to understand that forest landscape restoration is a long-term process. There is hope that early successes with implementation will motivate local people to stay committed to FLR even after the political attention (and maybe funding) has waned. The short-term viability and long-term sustainability of any FLR project depends on local involvement and commitment.

In many landscapes, indeed where opportunities for FLR are the greatest, unclear or insecure tenure frequently leads to deforestation and/or poor restoration choices. This insecurity can affect the choice of species used for restoration, the place where trees are restored in a landscape, and who gets involved in the restoration effort. Ultimately, insecure tenure can affect sustainability. Key questions at the outset of designing an FLR include who are the stakeholders? Do we understand where they are coming from? How do we engage them? What sort of governance structure can we rely on? Have issues of free, prior and informed consent been taken into account? Do we have the skills in our team to negotiate with stakeholders? Do stakeholders have the capacity to engage in FLR? Are there institutions to support stakeholder participation? How can we address potential conflicts?

We have presented in this guide an approach to implementation that has been tried and tested in development projects for many years, "Project Cycle Management". It is a systematic development path "from the project idea to measurable results." It provides a structure that can guide FLR implementation in a process that is both hierarchical and

Bhutan.
Photo © Janice Burns

iterative. That is to say, there is a linear process for moving from one phase to another, from a grand vision of FLR in a country, region or landscape to the detailed planning of what will be done where, when, by whom and at what cost. At the same time, the process also allows for looping back to an earlier phase if something changes, for example, new stakeholders join the project with new interests, or some external driver changes conditions in the landscape. The key questions are is there a clear and agreed vision? Have priority landscapes been identified and assessments made for each landscape? What are the objectives and are they measurable relative to clearly defined baselines? The process can begin at the national or regional level by prioritizing landscapes for restoration and identifying ecological and social goals, or begin with a smaller, defined landscape and design an FLR project. The design phase turns often broad or even vague goals into concrete, ideally measurable objectives with defined starting and ending conditions. Much consultation and stakeholder involvement is required to reach agreement on objectives and trade-offs and compromises may be necessary before moving to the implementation phase where detailed plans are made for sub-units of the landscape.

The notion of "landscape" as a scale is a bit vague but generally taken to mean thousands, rather than hundreds of hectares. A common notion is that a landscape should encompass one or several watersheds and will be context-specific. Some key features of landscapes are that both they and their components have multiple uses and purposes, and they provide a diverse range of values, goods and services. Each component of a landscape, what we have called sub-units, is valued in different ways by different stakeholders. If that trade-offs exist among the differing landscape uses and benefits, they will need to be reconciled through collaboration and consultation. Achieving success in FLR

United States (left), India (right).
Photos © Janice Burns

means identifying clear goals and turning them into measurable objectives. Stakeholders should agree on objectives; if there are disagreements, objectives can be prioritised, or different sub-units designated to meet different objectives. The landscape scale is particularly important as it enables a balancing among ecological, social and economic priorities. The emphasis on the landscape also indicates that tree cover is not needed throughout the landscape, but rather the focus of FLR is on restoring functional forest ecosystems within landscapes so that forests can co-exist and subsist in a landscape mosaic with other land uses.

Deciding on objectives begins with a shared understanding of the initial conditions (a baseline) in terms of both ecosystem and social characteristics. From this common foundation, four general questions arise: Has the underlying cause of degradation been addressed? What needs to be repaired or improved? What needs to be maintained or preserved? What are feasible interventions? Some necessary pre-conditions must be in place before addressing these questions:

- *The landscapes targeted for restoration have been selected or prioritised;*
- *All stakeholders have been identified along with the nature and scope of their interests;*
- *Restoration objectives for the target landscapes have been agreed to;*
- *Tenure relationships in the landscapes are clearly understood (but not necessarily resolved); and*
- *Free, Prior and Informed Consent (FPIC) processes have begun or completed for all vulnerable communities.*

If these pre-conditions are met, planning for each landscape sub-unit can proceed. Generally, restoration treatments will remove threats or obstacles (e.g., policy changes to remove perverse incentives such as clearing native forests for exotic plantations; removing and replacing exotic or invasive species with natives; or fencing to protect re-growth from ungulates and other pressures). Often project activities will alter vegetation by passive or active means. Active means require many decisions, including which species to plant, at what density, in what pattern. Will it be only native species or a mix of native and exotic species? Will it be a mixture of fast-growing species, possibly to produce fuelwood to reduce pressure on natural forests, with slow-growing species to increase

Pakistan.
Photo © Michael Kleine

biodiversity or high value timber? Alternatively, is it trees on farms in various forms of agroforestry? The key considerations are which techniques are best suited to meet our objectives and given the current condition of the site? Which techniques will best tackle existing threats to the forests? Do we have the expertise, tools and capacity to engage in these techniques (and if not, where can we get them?).

The current motivation for FLR is to address past deforestation and degradation of forests and landscapes but we should also be looking toward the future. Climate change may degrade some landscapes by altering the conditions necessary for species that have adapted in the past but are no longer able to, thereby increasing the amount of land to be restored globally. Altered climate may impact whole vegetation assemblages or some keystone or rare species. Additionally, we should consider whether the restoration we plan today will be adapted to future conditions.

In this practitioners' guide, we have shown how FLR can contribute to climate change mitigation and adaptation by maintaining or improving ecosystem processes and promoting species, genetic, structural and age-class diversity. Specifically, FLR can:

- *Maintain/increase forest area and/or trees outside forests;*
- *Maintain/increase carbon stocks;*
- *Reduce vulnerability;*
- *Maintain/improve biodiversity;*
- *Maintain/improve hydrology;*
- *Maintain/improve rural development.*

Adaptation actions can address climate change through incremental improvements to current practices, by anticipating future conditions and altering current practices, or by drastically transforming landscapes to be more adapted to future conditions. These three adaptation strategies have similar objectives of maintaining vigour at the stand level; favouring genotypes adapted to local conditions; resisting pathogens; managing herbivory to ensure adequate regeneration; encouraging species and structural diversity at the stand-level, landscape-level, or both; and by providing connectivity and reducing landscape fragmentation.

Atlas Mountains.
Photo © Alexander Buck

Iguaçu falls.
Photo © PJ Stephenson

Monitoring the progress of an FLR project toward clearly stated objectives is needed to gauge its success and to determine if, and when, further intervention is needed. Monitoring is often overlooked or neglected in practice, but monitoring short-term and long-term outcomes is essential for successful restoration. Because FLR is a long-term process, with true success obtainable only decades following the initial project interventions, monitoring is needed to evaluate and document successes and failures. Future land use or policy changes that occur outside of the area of the restored landscape may influence it; therefore, monitoring change over time within the project area may indicate when external forces have threatened sustainability of the FLR project.

Monitoring should be considered integral to the FLR project, rather than viewed as an add-on that can be delayed until the project is well underway. To be effective and provide value and a return on the investment made, the objectives of monitoring must be explicitly stated. This will likely include both implementation and effectiveness monitoring that answer different questions. Implementation monitoring is designed to ask whether management prescriptions were implemented according to contract specifications. Effectiveness monitoring attempts to evaluate whether management actions achieved the social, economic or ecological goals and objectives outlined in the prescription. There are four weaknesses common to monitoring efforts (in addition to the already mentioned deficiency of vague objectives). These are unclear responsibility for data collection, inadequate funding for monitoring, and the data go unused and do not influence management decisions.

If done correctly, monitoring will identify unintended consequences that threaten sustainability of the restoration efforts. In addition to providing the basis for adjusting plans or further interventions, monitoring is a tool for documenting and communicating FLR progress and success. Collecting, analysing and interpreting data are necessary steps in an FLR project becoming a learning organisation that understands what worked, what did not work and why. Early detection of altered conditions or even failures provided by a monitoring programme focused on key criteria and indicators enables a learning organisation to react and adapt. A learning organisation maintains critical memory and can survive and maintain continuity when key personnel move on. In addition to having a good understanding of the progress being made to restore the landscape, a learning organisation can effectively communicate to diverse audiences.

The final module in this guide addressed the need to communicate, in both top-down and bottom-up directions. Successful development and implementation of FLR projects depend on many motivated actors at different levels doing the right things, and communication among everyone involved or interested in FLR is critical. Top-down communication may require translating global FLR objectives into the national context at multiple scales, for example communicating a Bonn Challenge commitment at the national level to various affected agencies. An enabling regulatory and institutional environment for FLR implementation may require policy changes in several agencies such as removing perverse incentives in agricultural policy that encourage deforestation; effectively communicating that need may require showing how the FLR project will introduce agroforestry practices that benefit farmers' livelihoods as well as providing environmental benefits. Communicating a national restoration commitment to regional or local agencies and stakeholders may be couched in terms that motivate local stakeholders to participate in FLR.

The "Communicating Results" module focuses on best practices to communicate effectively the FLR vision, goals, objectives, implementation plan and outcomes to multiple audiences at different stages of the FLR process. The module moves from general principles of communication that apply at all stages of an FLR project to explaining key benefits of FLR in concrete terms relevant and attractive to specific stakeholder groups. We introduced a simple communication product, the Stoplight Tool, to tell the story at different stages. The Stoplight Tool is flexible and can be modified for multiple uses:

- *Promoting understanding of FLR among decision-makers and stakeholders;*
- *Participatory planning involving different stakeholders;*
- *Evaluating FLR projects against pre-defined criteria and implementation standards;*
- *Communicating potential benefits of a project to decision-makers;*
- *Facilitating involvement of many stakeholders in participatory planning of a project;*
- *Evaluating different FLR project formulations;*
- *Evaluating a single project formulation against pre-defined criteria or implementation standards.*

No single guide or manual can address all of the complexity of forest landscape restoration in different social and ecological settings but we hope that this guide provides enough generality to serve as an overview of what is possible; and enough specificity to enable a practitioner to begin to restore a degraded forest ecosystem.

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ANNEXES
ANNEX 1

Biological invasion in the context of forest landscape restoration

Eckehard G. Brockerhoff

Background

Biological invasions are an important aspect of globalisation. Thousands of non-native species have become established in new environments outside their native range, mainly as a result of international trade or intentional introductions (Mack et al. 2000). For example, in New Zealand there are more than 2,100 naturalised exotic vascular plant species (Wilton and Breitwieser 2000) and approximately 1,600 known exotic insects (Gordon 2010). Although most naturalised exotic species appear to have little negative impact, some non-native species are invasive and can have a variety of potentially very serious effects on recipient environments (Mack et al. 2000). Biological invasions are a major cause of declines of species and the modification of natural communities and landscapes (Lockwood et al. 2013). In fact, some invasive pests or pathogens of trees, such as emerald ash borer (*Agrilus planipennis*) and Dutch elm disease (caused by the pathogens *Ophiostoma ulmi* and *O. novo-ulmi* in conjunction with their bark beetle vectors) can drive their host trees to virtual extinction in invaded areas. Invasive species are now also recognised for their adverse effects on the provisioning of ecosystem services (Boyd et al. 2013). For example, invasive pest insects and plant pathogens have been shown to cause a substantial decline of a variety of ecosystem services that are provided by trees (Boyd et al. 2013). Invasive plants can also have major impacts on local plant communities or, by transforming the vegetation, even across entire landscapes. Conversely, under certain conditions, exotic trees and shrubs can contribute to the restoration of natural or semi-natural vegetation, and thereby facilitate the restoration of forest landscapes.

Forest landscape restoration (FLR) is considered a process that "*aims to improve the landscape for people and for biodiversity, through several approaches – agroforestry, tree planting, natural regeneration, connecting forest fragments, etc. – so that it can better provide ecosystem services, support biodiversity and withstand threats such as climate change*" (Stanturf et al. 2015). While aspects of FLR are shared with 'ecological restoration', there are important differences between these concepts, especially in terms of the larger scale of FLR, its focus on the restoration of ecological processes and function, and the consideration of linkages with human well-being (Mansourian et al. 2005).

The objectives of this paper are to consider the effects of biological invasions in the context of forest landscape restoration and to highlight opportunities and risks in managing "invasive" species (fauna and/or flora), in order to generate benefits from the landscape for society, including the long-term effects of such measures on ecological integrity and their feasibility for application. For the purpose of this short paper, I will focus on the role of exotic trees in terms of (i) their potential benefits for FLR as well as (ii) their potential negative effects on the natural vegetation and on FLR where they are planted or spread and regenerate naturally. I will also (iii) address the effects of non-native tree pests on FLR and touch on the role of biodiversity (here the diversity of tree species planted) with regard to resistance and resilience of forests.

Benefits of planted exotic trees for forest landscape restoration

It has been recognised for some time that tree plantations can facilitate the restoration of forest vegetation. This case is made, for example, by the paper entitled '*The apparent paradox of reestablishing species richness on degraded lands with tree monocultures*' (Lugo 1997). Even plantations of exotic trees can have the effect of facilitating natural succession of forest vegetation (e.g., Allen et al. 1995; Brockerhoff et al. 2003; Brockerhoff et al. 2008). For example, in New Zealand a chronosequence study of exotic Monterey pine (*Pinus radiata*) stands about 5, 16 and 27 years since planting was undertaken to assess successional patterns in the understorey vegetation of these non-native pine forests (Brockerhoff et al. 2003). Despite the intense site preparation and management and the fact that the canopy trees are not native, a total of 202 native vascular understorey plant species were recorded in that study, with an increasing number and proportion of forest species including shade-tolerant ferns, herbs and shrubs, as well as some native tree species. Although in operational plantation forests, this succession is re-set with harvesting and site preparation (which is typically followed by an invasion of open-habitat species, including many non-native plants), the increasing dominance, over time, of native forest species clearly indicates the potential of such plantings of exotic trees to facilitate the regeneration of native forest vegetation (Fig. 1). As this process is driven by natural processes including the creation of a shady environment (conditions that can be suitable for the germination of seeds), the provision of perches for seed-dispersing birds, etc., no human input is needed such as seeding or planting, as long as seed sources are present in the vicinity in the form of remnants of natural forest vegetation, and

Fig. 1
Understorey of native shrubs and trees underneath a canopy of 20-year old non-native Monterey pine (*Pinus radiata*) in a plantation forest on the Canterbury Plains (New Zealand), a region where most natural forest vegetation has given way to agricultural land uses.

provided there is sufficient rain fall and the canopy is not too dense (as a very dense canopy of conifer plantations may shade out and prevent the development of an understory vegetation) (Brockerhoff et al. 2003). Therefore, such plantations of exotic trees have the potential to facilitate the restoration of forest landscapes, provided the conditions are suitable, similar to the processes described, for example, by Lugo (1997) and Parrotta et al. (1997).

Negative effects of planted exotic trees on forest landscape restoration

Despite the potential benefits of planted exotic trees for forest landscape restoration, there are many instances around the world where such trees have invaded natural vegetation causing various detrimental effects. In New Zealand, the spread of non-native pines (*Pinus* species) and Douglas fir (*Pseudotsuga menziesii*) from plantation forests, wind breaks and other plantings into natural vegetation is a major concern (e.g., Ledgard 2001). Especially grassland and low shrub communities are highly susceptible to invasion by such trees, which is often causing substantial changes in the plant species composition or even the complete displacement of these natural or semi-natural vegetation types (Ledgard and Paul 2008). The main mechanisms are the lowering of light levels beneath the trees which shades out open-habitat plants that are not shade tolerant. In areas with limited precipitation, invasive trees can also cause a reduction in soil moisture that may reduce the viability of other plants (Simberloff et al. 2010), due to the trees' interception of rain and evapotranspiration. In addition, such tree invasions can also lead to an ongoing modification of below-ground microbial communities (Dickie et al. 2014) as well as changes in fire regime (e.g., Nuñez and Raffaele 2007), potentially increasing fire frequency or severity. These impacts of invasive non-native trees are common across many different regions (Fig. 2), especially in the southern hemisphere where the planting of exotic trees is particularly prevalent (e.g., Taylor et al. 2016). Most of these effects of non-native tree invasions can be detrimental for forest landscape restoration, both in areas where these trees are planted and elsewhere. Consequently, if the planting of native trees can meet the desired outcomes, then this may be preferable, compared with the use of non-native trees. However, in many parts of the world, non-native tree species are planted on a large scale because of their desirable properties in terms of growth rate or market demand for certain forest products. These plantations of non-native trees can contribute to FLR (as discussed in previous section); however, it is critical to manage the potential for tree invasions.

Fig. 2
Douglas fir and pines invading southern beech (*Nothofagus*) forest near Bariloche, Argentina (during the field trip of the joint conference of IUFRO Working Parties 7.03.05 "Ecology and Management of Bark and Wood Boring Insects" and 7.03.12 "Alien Invasive Species and Global Trade".

Effects of invasive non-native tree pests on forest landscape restoration, and the role of tree species diversity in resistance and resilience of forests

Some examples are given above of invasive pests and pathogens that have major impacts on their host tree species. Emerald ash borer, hemlock wooly adelgid, several Phytophthora species, and the pathogens and beetle vectors responsible for Dutch elm disease, laurel wilt, and pine wilt disease cause large-scale mortality of trees in invaded areas (e.g., Wingfield et al. 2015; Ramsfield et al. 2016). A common theme with these species is that they are known as only minor pests that are benign because their natural host trees, with which they have co-evolved, are more or less resistant to these species. By contrast, in the invaded range, these 'pests' encountered new host species that are highly susceptible and show no resistance. These and thousands of other species have been transported unintentionally to new regions, primarily by international trade. Despite our efforts to reduce biosecurity risks associated with international trade (e.g., Haack et al. 2014), more such species will arrive because it is not possible to ensure imports are 100% pest free. Many of these impacts of invaders were not predicted, in part because they are unpredictable. In the context of FLR, this is relevant because if forest restoration projects focus on only one or a few tree species, they could become the next unfortunate species that is affected by a serious invader. Therefore, it is recommended that plantings and restoration activities involve a variety of tree species, as a kind of 'insurance'. This would increase the likelihood that, should a new serious pest arrive, at least some trees would remain and allow for successful forest landscape restoration.

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ANNEX 2
Selected Guidance

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