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Training Handbook

Forest Landscape Restoration and the Restoration Opportunities Assessment Methodology

Village in Malawi © Mirjam Kuzee

Yale SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

IUCN

elti Environmental Leadership & Training Initiative

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This training manual was developed with support from TerrAfrica and the New Partnership for Africa's Development (NEPAD) to accompany an in-country training series introducing concepts and techniques needed to develop and implement strategies for Forest Landscape Restoration (FLR). It was designed to equip participants with the knowledge and skills needed to implement the Restoration Opportunity Assessment Methodology (ROAM) in order to generate appropriate information for improved decision-making on landscape restoration. Participants learned how FLR opportunities can be identified, analyzed and prioritized using ROAM, and discuss strategies to unlock finance and scale up FLR interventions. These trainings were held in Kenya, Malawi, Niger, Côte d'Ivoire and Uganda from January-March 2018.

This content of this manual was also translated for use in the French-language deliveries of the course in Niger and Côte d'Ivoire by: Raymond Steve Andriatahinjanahary (ELTI) and Hyacinthe Nare (ELTI).

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1 Introduction

1.1 Overview

There is a world of opportunity to restore degrade forest landscapes around the globe. According to a study commissioned by IUCN (see Atlas of Forest and Landscape Restoration Opportunities, 2009, revised 2010), there are approximately two billion hectares of degraded and deforested landscapes in mostly human-dominated mosaic landscapes. Landscape degradation directly affects 1.5 billion people, many of whom live in extreme poverty. Around half of all land used globally for agriculture is moderately or severely affected by soil degradation (GLADIS – Global Land Degradation Information System, FAO, 2015). Conversely, the restoration of 150 million hectares of degraded and deforested lands in biomes around the world – in line with the forest landscape restoration approach – is projected to create approximately US$ 84 billion per year in net benefits.

In a call to action to halt and reverse degradation, leaders from around the world launched the Bonn Challenge in 2011 during an event hosted by IUCN and the German Ministry of the Environment. The original target for the Bonn Challenge was to restore 150 million hectares by 2020, which was later increased to 350 million hectares and extended to 2030 by the New York Declaration on Forests of the 2014 United Nations (UN) Climate Summit. The Bonn Challenge is an implementation platform for international commitments, such as the UN Sustainable Development Goals, the Center for Biological Diversity, the UN Convention to Combat Desertification and the UN Framework Convention on Climate Change.

Regional implementation platforms for the Bonn Challenge are emerging around the world, including Initiative 20x20 in Latin America, AFR100 for Africa and ministerial roundtables in Latin America, East and Central Africa and the Asia-Pacific region. In recognition of the close connection between restoring forests and ensuring food and water security for vulnerable communities, African ministers declared that, “Forest landscape restoration offers multiple benefits that align directly with African nations’ economic growth and poverty reduction plans” (Kigali Declaration, 2017). Landscape restoration offers a nature-based solution to many current domestic challenges related to food security, economic growth, rural development and climate mitigation and adaptation, and many countries have made (sub)national commitments to the Bonn Challenge.

Leaders at Bonn vowed to promote a landscape approach to restoration rather than take a narrower site-based and localized approach. They highlighted landscape restoration’s importance across sectors, including in agriculture, energy, water, poverty alleviation and climate change. Forest landscape restoration (FLR) is the ongoing process of regaining ecosystem functionality and enhancing human well-being across deforested and degraded landscapes. FLR is more than just planting trees – it is restoring a whole landscape “forward” to meet present and future needs and to offer multiple benefits and land uses across landscapes and over time.

But what does FLR look like on the ground? In policies and plans? How do we go about implementing landscape restoration?

One way to do that is with the Restoration Opportunities Assessment Methodology (ROAM). ROAM can provide vital support to countries seeking to implement or accelerate landscape restoration programs and strategies that support the achievement of national objectives and international targets. It is a flexible and adaptable framework for countries interested in identifying and assessing FLR opportunities and identifying high value and priority FLR interventions at national or subnational levels. ROAM can help to inform where, when and how opportunities will bring benefits and can provide the knowledge needed by communities, governments and the private sector on where investments will generate the best return. Moreover, ROAM provides a platform where policy makers, land use planners, communities and other stakeholders can come together to negotiate and discuss the trade-offs of landscape restoration opportunities.

This training manual was developed to help meet the demand from decision-makers and practitioners to develop their capacity to implement FLR and carry out ROAM processes in their countries and communities. It combines materials on the foundational aspects of FLR with the practical application of ROAM to help participants create a Theory of Change for degraded and deforested landscapes, develop appropriate plans and policies and implement FLR on the ground. A central focus of the manual is to present the elements of ROAM needed to bring about a lasting Theory of Change for degraded and deforested landscapes, which requires participants to understand the manifestations of degradation and its drivers and how this context relates to a desired change and related objectives for doing FLR. This manual demonstrates how the steps of ROAM are connected and iterative to develop a Theory of Change.

1.2 Objective of carrying out FLR & ROAM trainings

The training manual was designed to support the implementation of comprehensive and interactive training programs on FLR and ROAM. The overall objective of that training is to equip decision-makers working at different scales with the knowledge and skills needed to implement ROAM in order to generate appropriate information for improved decision-making on FLR.

The manual includes guidelines for the following steps and tools needed to get started on ROAM: stakeholder mapping, landscape restoration degradation analysis and opportunities mapping, prioritization of restoration interventions, cost benefit analysis, ecosystem services assessments and other decision support mechanisms. It also contains information on foundational aspects of forest landscape restoration relevant to ROAM.

The specific objectives of this training manual are to:

- Present key principles on tropical forest ecology, disturbance, social and governance factors and landscape restoration actions;
- Support participants to develop a Theory of Change that will generate sustained multiple benefits of FLR by implementing a situation analysis of landscape degradation and the drivers of degradation and deforestation;
- Provide participants with knowledge to evaluate and compare an array of forest landscape restoration methodologies and how the biophysical and socio-economic conditions of a landscape influence the decision-making about which strategies to utilize;
- Facilitate the development of a shared understanding of landscape restoration opportunities and the value of multifunctional landscapes, which can lead to greater allocation of resources to restoration programs and increase engagement of key policy-makers from different sectors;
- Present ROAM as a robust and adaptable framework to analyze and develop FLR strategies, plans and supporting policies; and
- Facilitate opportunities for participants to engage in critical discussion, share expertise, and connect with other practitioners engaged in landscape restoration and ROAM-related activities in their country.

1.3 Proposed Outline of the Training

Below is a sample outline of a training accompanying using this manual.

Online Primer: A two-week online primer that participants complete prior to the in-person training.

- Week 1 – Social and Ecological Fundamentals
- Week 2 – Restoration Fundamentals and International Case Studies

The primer includes supplementary online resources on tropical forest ecology and disturbance, landscape degradation and restoration, ROAM, monitoring, finance and scaling-up FLR. Although participants should review the primer before attending the in-person training, this context should also be available to participants both during and after the in-person component.

In-Person Training: A four-day in-person training that includes key presentations on theory and on-the-ground activities, including interactive exercises, field visits, and opportunities for peer-to-peer exchange. The following outline of the in-person training can be adapted as needed:

Day 1

- Welcome and introductions
- Session 1: Introduction to FLR and ROAM
- Session 2: Fundamentals of FLR
    - Drivers of degradation
    - FLR objectives
    - Sociocultural considerations

Day 2

- Session 3: Landscape Restoration Opportunities
    - Identification of priority areas
    - Ecosystem services
    - FLR interventions
- Session 4: Peer-to-peer learning and exchange
    - Presentations by local experts
    - Group discussions

Day 3

- Session 5: Field visits to see degradation and landscape restoration activities on the ground

Day 4

- Session 6: Costs and benefits of FLR
- Session 7: Data for ROAM
- Session 8: Bringing FLR to scale
- Evaluation and wrap-up

This type of program was used in a 2018 training series carried out as part of the TerrAfrica initiative and piloted in Kenya, Malawi, Uganda, Côte d'Ivoire and Niger.

Elements of a 2018 training series which included lectures, interactive exercises, and field visits. Images taken in Côte d'Ivoire (top), Malawi (middle), Kenya (lower) © Karin Bucht

1.4 About the Developers

Yale University's Environmental Leadership and Training Initiative (ELTI)

ELTI is a capacity development initiative of the Yale School of Forestry & Environmental Studies that builds the capacity of people from all sectors and backgrounds to restore an conserve tropical forest landscapes using strategies that support biodiversity and livelihoods. The ELTI training model emphasizes the development of skill sets that participants can apply to their own restoration initiatives.

ELTI's programs include:

Field Training: Blending cutting-edge research, local wisdom and hands-on experiences, ELTI explores the natural and social sciences aspects of conservation and restoration policy and practice. Training activities are designed to frame the learning process and guide discussions at multiple scales from the global to the local. ELTI empowers people to manage land sustainably in ways that support their regions' long-term needs and interests.

Online Training: Participants connect with world-renowned scholars and professionals from a range of countries working on applied forest restoration projects in the tropics. They learn how to design and implement effective, inclusive restoration policies and initiatives in their local communities. Each course features materials developed at Yale University and by ELTI's in-country partners.

Leadership Development: The creativity and passion of trainees makes the Leadership Program a unique component of ELTI's capacity development paradigm. Rather than promote specific actions, ELTI listens to the needs and interests of each individual and work with them to make their goals a reality. ELTI provides technical assistance and guidance, but the ideas always come from the alumni themselves.

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International Union for Conservation of Nature (IUCN)

IUCN is a membership Union uniquely composed of both government and civil society organizations. It provides public, private and non-governmental organizations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together. Created in 1948, IUCN is now the world's largest and most diverse environmental network, harnessing the knowledge, resources and reach of more than 1,300 Member organizations and some 16,000 experts. It is a leading provider of conservation data, assessments and analysis. Its broad membership enables IUCN to fill the role of incubator and trusted repository of best practices, tools and international standards. IUCN provides a neutral space in which diverse stakeholders including governments, NGOs, scientists, businesses, local communities, indigenous peoples organizations and others can work together to forge and implement solutions to environmental challenges and achieve sustainable development. Working with many partners and supporters, IUCN implements a large and diverse portfolio of conservation projects worldwide. Combining the latest science with the traditional knowledge of local communities, these projects work to reverse habitat loss, restore ecosystems and improve people's well-being.

IUCN Global Forest and Climate Change Programme

iucn.org/forest
twitter.com/IUCN_forests
facebook.com/IUCNForest

A site visit in Kenya © Karin Bucht

2 Forest Landscape Restoration

2.1 Definition and principles

Forest landscape restoration (FLR) is the long-term process of regaining ecosystem functionality and enhancing human well-being across deforested or degraded landscapes. It is about "forests" because it involves increasing the number and/or health of trees on landscapes as a restorative measure. It is about "landscapes" because it involves entire watersheds, jurisdictions and biomes where many land uses interact. It is about "restoration" because it involves bringing back the biological productivity of an area in order to achieve multiple benefits for people and the planet. It is "long-term" because it requires a multi-year vision of the ecosystem functions and benefits to human well-being that restoration will produce, although tangible deliverables such as jobs, income, and ecosystem services such as carbon sequestration, may begin to flow right away.

Successful FLR is a forward-looking and dynamic approach, focusing on strengthening the resilience of landscapes and creating future options to adjust and further optimize ecosystem goods and services as societal needs change or new challenges arise. It integrates a number of guiding principles, including:

- **Focus on landscapes:** Consider and restore entire landscapes as opposed to individual sites. This approach typically entails balancing a mosaic of interdependent land uses across the landscape, such as conservation, watersheds, forests, agro-silvopastoral systems, agriculture, plantations and riparian zones.
- **Restore functionality:** Restore the functionality of the landscape, making it better able to provide a rich habitat, prevent erosion and flooding and withstand the impacts of climate change and other disturbances. This goal can be achieved in many ways, one of which is to restore the landscape back to the "original" vegetation cover, but other strategies may also be used.
- **Allow for multiple benefits:** Aim to generate a suite of ecosystem goods and services by intelligently and appropriately increasing tree cover across the landscape. In some places, trees may be added to agricultural lands in order to enhance food production, reduce erosion, provide shade and produce firewood. In other places, trees may be added to create a closed canopy forest capable of sequestering large amounts of carbon, protecting downstream water supplies and providing rich wildlife habitat.
- **Leverage suite of strategies:** Consider a wide range of eligible technical strategies for restoring trees on the landscape, ranging from natural regeneration to tree planting.
- **Involve stakeholders:** Actively engage local stakeholders in decisions regarding restoration goals, im-

plementation methods and trade-offs. It is important that the restoration process respects their rights to land and resources, is aligned with their land management practices and provides them benefits. A well-designed process will benefit from the active and voluntary involvement of local stakeholders.

- **Tailor to local conditions:** Adapt restoration strategies to fit local social, economic and ecological contexts; there is no “one size fits all.”

- **Avoid further reduction of natural forest cover:** Address ongoing loss and conversion of primary and secondary natural forest.

- **Adaptively manage:** Be prepared to adjust the restoration strategy over time as environmental conditions, human knowledge and societal values change. Leverage continuous monitoring and learning and make adjustments as the restoration process progresses.

While FLR sometimes involves the opportunity to restore large contiguous tracts of degraded or fragmented forestland (referred to as “wide-scale restoration”), particularly in less populated areas, the majority of restoration opportunities are found on or adjacent to agricultural or pastoral lands. In these contexts, restoration must complement and not displace existing land uses. This approach results in a patchwork or mosaic of different land uses, including agriculture, agroforestry systems and improved fallow systems, ecological corridors, discrete areas of forests and woodlands, rangelands and silvopastoral systems, and river or lakeside plantings to protect waterways. The Voluntary Guidelines for FLR under AFR100[1] present additional details on the cost of degradation and benefits of restoration, as well as some case studies that illustrate FLR in practice.

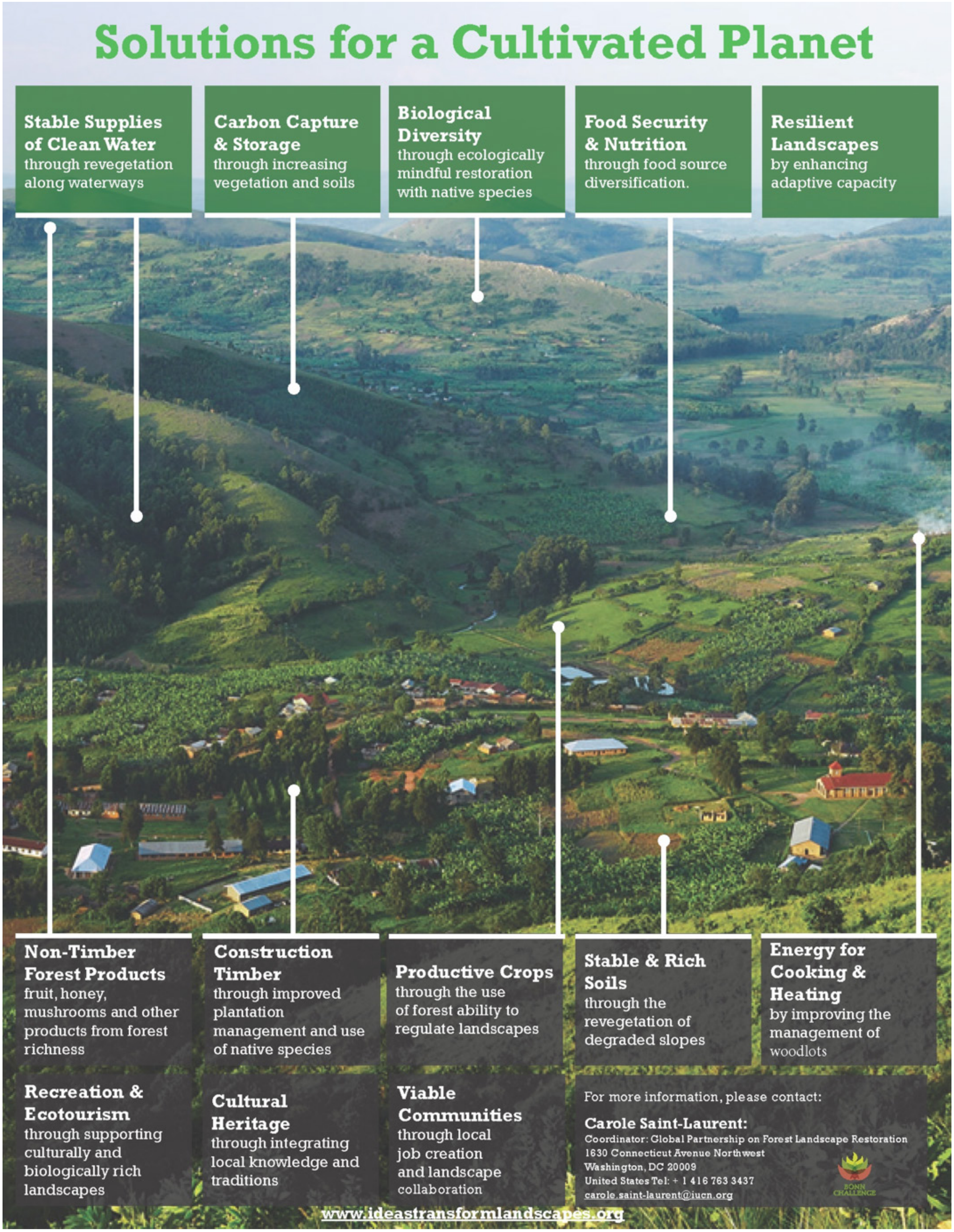
There are overlapping social, economic and ecological values and activities in any given landscape. They are multipurpose, multifunctional landscapes that provide a wide variety of goods and services to society, such a food and water, shelter, livelihoods, jobs, economic growth, climate mitigation and adaptation. All the goods and services are interlinked and dependent on each other to function sustainably as a whole. In planning and implementing FLR, there will be trade-offs to consider at the landscape level. Better yet- ways can be found to optimize goods and services for people and the planet across each landscape.

The FLR approach is centered on stakeholder engagement and human well-being. It is forward-looking to meet societal needs in the long term; without it FLR will fail. Thus, a diverse range of stakeholders with diverse perspectives are brought together to identify, negotiate and implement practices that restore an agreed upon balance of ecological, social and economic benefits across landscapes within a broad range of land uses. People and institution are an integral part of the system.

Although FLR is not a new idea- many people in different places are already doing it- the fundamental goal is to shift emphasis away from simply maximizing tree cover to truly considering landscape functions upon which people depend.

This text was adapted from: IUCN and WRI (2014). “A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level.” Working Paper (Road-test edition). Gland, Switzerland: IUCN. 125pp.

1 AFR100 (2017) Voluntary Guidelines for Forest Landscape Restoration under AFR100 .


Solutions for a Cultivated Planet
Stable Supplies of Clean Water through revegetation along waterways
Carbon Capture & Storage through increasing vegetation and soils
Biological Diversity through ecologically mindful restoration with native species
Food Security & Nutrition through food source diversification.
Resilient Landscapes by enhancing adaptive capacity
Non-Timber Forest Products fruit, honey, mushrooms and other products from forest richness
Construction Timber through improved plantation management and use of native species
Productive Crops through the use of forest ability to regulate landscapes
Stable & Rich Soils through the revegetation of degraded slopes
Energy for Cooking & Heating by improving the management of woodlots
Recreation & Ecotourism through supporting culturally and biologically rich landscapes
Cultural Heritage through integrating local knowledge and traditions
Viable Communities through local job creation and landscape collaboration
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2.2 Self-reflection

1. What is your area of jurisdiction?

2. What brings you to this training?

3. What do you hope to achieve?

4. How might FLR contribute to local, regional and national objectives?

3 Restoration Opportunities Assessment Methodology

3.1 Overview

The Restoration Opportunities Assessment Methodology (ROAM) was developed by IUCN in collaboration with WRI and published in 2014 as a "road-test" edition. ROAM combines a situation analysis of degradation and deforestation with geospatial analysis and biophysical and economic modeling, within a framework that assesses the social, political and institutional readiness to implement large-scale landscape restoration.

ROAM is not a sequence of steps or and exercise, but rather an iterative process that utilizes a Theory of Change for systematically addressing deforestation and degradation at the landscape scale. ROAM can build on successful dialogue and collaborative structures that are already in place in the assessment area. It is by definition a multi-stakeholder and participatory process.

A ROAM assessment can deliver the following products:

- Potential areas for landscape restoration;
- Opportunity areas for landscape restoration identified and prioritized;
- A shortlist of the most relevant and feasible landscape restoration intervention types across the assessment area and site-specific restoration models;
- Quantified costs and benefits of each intervention type;
- Estimated values of additional carbon sequestered by these intervention types;
- Analysis of the finance and investment options for restoration in the assessment area; and
- A diagnostic of 'restoration readiness' and strategies for addressing major policy and institutional bottlenecks.

3.2 ROAM implementation and key outputs

A ROAM process is typically structured using a three-phase approach that includes: 1. preparation, consultation and planning; 2. Data collection and analysis; and 3. Results and validation. While communicated here as *phases*, in practice they are iterative and can also occur simultaneously.

Phase 1: Preparation, consultation and planning

Phase one of ROAM involves a series of discussions, meetings and preliminary analysis to help prepare and plan the assessment, culminating in an inception workshop (at a national or sub-national level) to share the assessment plan and seek high-level endorsement of the assessment work. As ROAM begins, a primary objective is to ensure the involvement of a diverse and representative set of key partners and stakeholders in the ROAM process, from national level government partners to local community stakeholders, so that proposed interventions can be as diversified as possible and may enjoy wide support and ownership.

Phase one activities, events and expected outputs are as follows:

Stakeholder engagement and coordination: Proposed activities include finding an institutional home for the assessment, establishing a team to coordinate and lead the assessment, defining the outputs and scope of the assessment, defining the criteria to be used in identifying degradation and selecting priority areas. This can also include discussing approaches for restoration and planning the ROAM work such as identifying data and capacity needs and planning for more extensive stakeholder engagement. **Key outputs** include identification or formation and support to working groups, stakeholder engagement, and a *Stakeholder Analysis Report* identifying all key stakeholders and/or appropriate representatives.

Preparatory analysis: Includes a situational analysis on (drivers of) degradation and deforestation and developing a Theory of Change (ToC) for the assessment area based on the objectives of doing forest landscape restoration. A GIS-based analysis is used to estimate the extent and location of possible FLR opportunity area in the assessment area(s). The preparatory phase may also include a stocktaking exercise of successful landscape restoration practices in or near the assessment area so that a preliminary list of potential FLR interventions can be drawn up. **Key outputs** include *Situational analysis* where the (drivers of) degradation and FLR objectives are clearly identified, leading to a ToC for the assessment area. *Preliminary Restoration Opportunity Map(s)* identifying components and location of degradation and of restoration opportunities and a *Preliminary List of Potential FLR Interventions.* These outputs will be further refined as needed following the results of the Inception workshop and secondary data collection and analysis work in phase two.

Inception workshop(s): The suggested FLR objectives, methodology and organization of ROAM are presented to high-level and other necessary stakeholders with an overview, discussion, and revision of the proposed assessment plan. Stakeholders also identify and assess potential FLR interventions as well as validate and provide input on Preliminary Restoration Opportunity Maps. **Key outputs** include an *Inception Report* detailing agreed on Theory of Change for the assessment area, stakeholder-identified priorities for restoration, the scope of ROAM assessments, criteria for measuring impacts of restoration, data needs and gaps and findings from workshop deliberations, and an *Agreed Work Plan* detailing dates and specific outputs for the implementation of ROAM.

Phase 2: Data collection and analysis

Phase two covers the core activities of ROAM involving the collection and analysis of relevant data. The consultative, stakeholder-driven approach underlying ROAM continues throughout this phase through engagement with key stakeholders identified in phase one. Data collection to address the data needs and gaps identified in phase one of ROAM is undertaken. The Preliminary Restoration Opportunity Areas Map(s) generated in phase one are refined into a series of more useful products through the analysis of additional data or refined data proxies to include maps of functional degradation, thematic priorities, and restoration opportunity in areas that respond to FLR goals. Phase 2 also includes a cost/benefit analyses which can compare the net present values (NPVs) and costs of different restoration transitions over time for social, environmental and economic aspects, including ecosystem services. If desired, financing and return-on-investment analysis on different locally-appropriate FLR investment packages is performed. Analysis of national and sub-national policies, assessing the extent to which key success factors and enabling conditions are in place to facilitate restoration at scale is performed. Findings and recommendations are developed and presented in a comprehensive official report.

Phase two activities and expected outputs are further described as follows:

Refinement of restoration opportunity areas(s): Where needed, field data is gathered and desk surveys are undertaken to verify spatial data quality and to procure additional data as required for the successful identification of degradation and landscape restoration opportunities areas at the appropriate scale. **Key output:** *Finalized Degradation and Restoration Opportunity Area(s)* and associated spatial data and meta-data identifying extent and location of degradation and of restoration opportunities.

Multi-criteria analysis of functional degradation and restoration scenarios: Spatial data are collected, parameterized and then analyzed to create maps of functional degradation based on stakeholder inputs and user-defined criteria. Spatial data analysis can be used to help prioritize restoration intervention areas and/or to facilitate components of economic analysis. Furthermore, multi-criteria analysis (MCA) can be used to identify unique combinations of overlapping criteria to design targeted restoration intervention technical packages that directly respond to degradation or thematic input criteria. **Key output:** *Multi-criteria analysis maps and data tables* of spatial priorities for addressing degradation or FLR thematic goals.

InVEST *is a suite of free, open-source software models used to map and value ecosystem services. It can be accessed at: https://www.naturalcapitalproject.org/invest/*

ROOT *is a software tool that optimizes trade-offs among different ecosystem services to help decision-makers visualize where investments in restoration could be made that would optimize benefits for multiple landscape goals. It can be accessed at: https://www.naturalcapitalproject.org/root/*

Modeling and optimizing investment in livelihoods, ecosystem services and biodiversity impacts from different restoration transitions: Spatially-explicit analysis and optimization using data from the economic analysis and GIS-based modeling platforms such as InVEST and The Restoration Opportunities Optimization Tool (ROOT) to model anticipated impacts from different restoration transitions. **Expected outputs:** *Maps and analysis* estimating the impacts to ecosystems and livelihoods under alternative restoration scenarios. This work may feed into a cost-benefit and optimization analysis (see below).

Economic and cost-benefit analysis: Field surveying, market and value-chain analysis and desk-based research generating an economic overview of livelihoods and potential impacts from restoration that forms a foundation for much of the ecosystem service modeling and cost benefit analysis. Cost-benefit analysis (CBA), including sensitivity analysis, assesses, compares and optimizes the NPVs of different restoration transitions, and identifying those restoration transitions that provide the largest CBA ratios and rates of return. It is important to ensure that the CBA identifies all potential *social, economic and environmental* cost and benefits of landscape restoration activity that responds to the objectives of doing FLR. CBA analysis can also create carbon abatement curves indicating the landscape restoration interventions that provide largest benefits for carbon. **Expected outputs:** *Restoration Cost-Benefit Report* detailing the findings from the CBA and broader economic analyses. In the report, NPVs are presented with confidence intervals identifying how sensitive NPVs from the different restoration transitions are to particular factors, and under what conditions identified restoration transitions are unlikely to create a benefit.

Financing analysis: Working with stakeholders including those from the private sector, a suite of investment packages is developed. Using CBA output and economic reports, “Return on Investment” metrics will be generated for potential FLR investment packages and compared. FLR investment opportunities and pathways for local and external financiers, as well as potential constraints, will be identified. Financial analysis also assesses any potential role and need for public sector finance. **Expected outputs:** *Finance Report* detailing options and constraints for financing FLR investments in the assessment area(s).

“Restoration Readiness” assessment: Analysis of national and sub-national policies and the extent to which key success factors and enabling conditions including capacity and resources for implementation of FLR are in place to facilitate restoration at scale in the assessment area(s). **Expected outputs:** *Restoration Readiness Assessment Report* detailing the findings and recommendations of the assessment of restoration readiness.

Gender assessment: The roles and responsibilities of women and girls throughout the assessment area are researched and defined. This includes an assessment of the current decision-making and institutional power of women, their representation in governance at different administrative levels, and the institutional and capacity gaps that could be addressed. **Key outcome:** G*ender in FLR Report* for the assessment area that details the potential entry points and activities for a “gender responsive” approach to FLR interventions.

Development of draft final report and recommendations: The findings and analysis described above are assessed and analyzed together with key stakeholders, to develop recommendations for FLR interventions. Findings will be presented in a comprehensive report to be validated and finalized in phase three of ROAM. **Expected outputs:** *Draft Findings and Recommendations Report* containing analysis and recommendations from all of the FLR assessment work and identifying highest-value FLR interventions.

Phase 3: Validation of results and recommendations

The final phase of ROAM plays a critical part in ensuring the credibility and impact of the ROAM process and outputs. Specific aims for this phase are to demonstrate the validity and relevance of the assessment results; discuss further with stakeholders the policy and institutional implications of the results; build support for the assessment among decision-makers; and plan for next steps, including finance and implementation. While key decision-makers will have been kept abreast of developments from the outset, it is particularly important that they be involved in this phase in order to strengthen ownership of the assessment results and help set the stage for policy uptake of the recommendations that emerge.

Activities and expected outputs are further detailed as follows:

Validation workshop: Key senior-level departmental staff, leading experts and other important stakeholders (e.g., local farmers' union, chamber of commerce, indigenous peoples' or community-based federations) are brought together to critically assess the key conclusions and recommendations. Where earlier engagement focused on methodological and process issues, here the overriding focus is on assessing whether the overarching conclusions and recommendations make technical, political and institutional sense, and whether or not specific elements of the assessment need to be further refined. **Expected outputs:** *Validation Workshop Summary Report* summarizing the findings, recommendations and action items for participants of the Validation workshop.

Finalization of findings and recommendations report: Requested revisions to the Findings and Recommendations Report agreed at the validation workshop are undertaken. **Expected outputs:** Finalized *Findings and Recommendations Report*.

Reference materials

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4 Fundamentals of Forest Landscape Restoration

4.1 Ecology of tropical forest landscapes

Tropical forest landscapes play an important role in sustaining local and global climates, human livelihoods and a large portion of the world's plant and animal biodiversity. Occurring in Asia, Africa, and the Americas, there are diverse types of tropical forest ecosystems due to complex interactions between latitude, climatic factors (i.e. temperature, precipitation, wind direction), elevation and other factors.

The variability of tropical climates (varying rainfall, in particular) impacts the vegetation and ecosystem types of different regions.

	Dry Forests	Moist Forests (seasonal and aseasonal)
Structure	Height (10-40m) and less species diversity (30-90 tree species per hectare) than moist forests. Deep root systems for water collection at lower soil levels. Higher allocation of biomass below-ground.	Height can be up to 45-55m, greater tree species richness (up to ~480 tree species/ha in the Amazon Basin) than dry forests. Shallow root systems for rapid nutrient uptake. Lower allocation of biomass below-ground.
Phenology	Fruits in wet season, seed dispersal at end of dry season, germination at beginning of next wet season.	Phenology more variable than dry forests, many species evergreen in aseasonal forests, some species deciduous in seasonally wet forests.
Seeds	Mostly dry fruits and seeds. Wind-dispersal common.	Mostly fleshy fruits and recalcitrant seeds. Animal dispersal common.
Other Adaptations	Adaptations to compete in water limiting conditions. Strong resprouting after disturbance, some fire resistance. Physical defenses (thorns, spines) more common to protect against herbivores	Adaptations to compete in light-limiting conditions. Low proportion of resprouting species. Chemical defenses more abundant to deter herbivores

The figure above illustrates how the structure, growth, and reproduction of vegetation can vary among different ecosystems due to differences in climate.

Figure by Gillian Bloomfield, incorporating concepts by Ghazoul & Sheil 2010; Carson & Schnitzer 2008.

Along with climate, the geology and topography of a landscape have a strong effect on the fertility of its soils, which influences the species composition and ecosystem structure and dynamics over time of that landscape.

Soils: The process of weathering transforms hard rocks into soil. Weathering can make nutrients available in the soil and over time, those nutrients can be leached into deeper layers by rainfall or can be washed away due to erosion. Disturbances such as flooding, landslides, volcanic activity and even dust storms can move and redistribute soils from different layers, creating areas in with more nutrient-rich soils.

Topography: Differing topography in a landscape, including gradient of slope and aspect (i.e., the direction that slopes face) leads to variation in soil moisture and nutrients across a landscape, which influences plant growth and ecosystem type.

Reference materials

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4.2 Disturbance, succession and natural regeneration

Disturbances are events that cause structural and functional changes to landscapes. The origin of a disturbance can be natural or human-caused (i.e., anthropogenic).

Natural disturbances, such as floods, naturally occurring fires, droughts, windstorms, pests, diseases and tree falls, and natural regeneration are processes that take place during the life cycle of a landscape. Anthropogenic disturbances include events such as land-clearing, logging, introduction of exotic species, fragmentation, human-driven fires and harvesting of non-timber forest products (NTFPs).

After a disturbance event, plant communities colonize and change over time in a process called succession.

Succession can be affected by the type of disturbance and the availability of plant material on or near the site. Understanding the way disturbances affect the ecosystem in a given site is key to designing a restoration strategy.

Forest disturbance

The origin, frequency and severity of disturbances can have profound effects on the structure, composition, function and regeneration potential of the ecosystem. Many sites endure multiple disturbances. For example, the combination of anthropogenic land-clearing and naturally occurring rainstorms can lead to landslides. Disturbances can be of natural or anthropogenic origin, acute or chronic in frequency, and be lethal or non-lethal to vegetation on the site.

Classifications of Forest Disturbance

ORIGIN	SEVERITY	FREQUENCY
Natural Naturally occurring events, including windfalls, hurricanes/typhoons, landslides, wildfires*, floods and droughts.	**Non-Lethal** Events that knock down or remove canopy trees, but leave the saplings, seeds, root materials, and stumps intact in the understory.	**Chronic** Recurring events, such as repeated NTFP collection, timber harvest, and grazing, which can lead to continual degradation of the forest.
Acute Single events such as hurricanes, land clearing, landslides and mining, which can alter or destroy the forest.	**Lethal** Events that destroy all the above-ground plants, such that regeneration depends any seeds that survive in the soil and/or seeds later dispersed into the site.	**Anthropogenic** Human-caused events, including land-clearing, logging, fragmentation, fires* and harvesting of non-timber forest products (NTFPs).

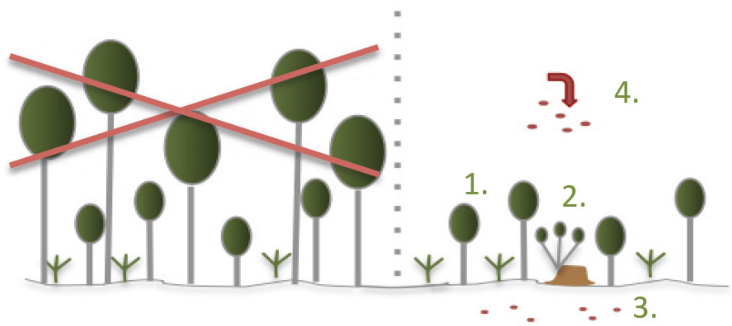
*Fires can be anthropogenic or natural, lethal or non-lethal.

Figure by Gillian Bloomfield, incorporating concepts by Smith et al. 1997; Ashton et al. 2001.

Regeneration Potential

Following a disturbance, the process of natural regeneration begins. The composition and rate of recovery depends on the regeneration potential at the site. Species regenerate after disturbance in four ways: 1) advance regeneration; 2) root and stump sprouts; 3) soil seedbank; and 4) seed rain. The site history can influence which of these catalysts for regeneration are available.

Vegetation regenerates naturally after disturbance in one of four ways



1. **Advance regeneration:** seedlings that were already in the understory before the disturbance and are able to grow quickly after the overstory has been removed;
2. **Root and Stump Sprouts:** stem that sprout from plant material remaining on the site;
3. **Soil Seedbank:** seeds preserved in the soli, which can sprout post-disturbance; and
4. **Seed Rain:** seed (or sprouting plant material) that are dispersed into the site by wind, water, gravity, or animals post- disturbance.

Figure by Gillian Bloomfield, incorporating concepts by Smith et al. 1997; Ashton et al. 2001.

Seed dispersal from seed rain depends on the presence of seed sources within the range of dispersal agents. Different species tend to have different growth habits and accompanying seed dispersal strategies. These can be grouped into "early successional" or "late successional" species.

Once dispersed, the conditions for germination, growth and competition need to be met in order for species to regenerate. Therefore, the presence of species in a landscape, therefore, is not due to dispersal only but is also due to different site conditions and patterns of resource use that offer some species competitive advantages over others. Site conditions include: topography, soil nutrients, and water and light availability.

Early successional or pioneer species: tend to begin growing on sites with higher light conditions. They often exhibit shade intolerance and rapid growth.

- These are often small-seeded species that are dispersed by wind or small animals and typically the first to colonize a site.
- They often comprise the soil seedbank and are triggered to germinate after changing light conditions or are dispersed into a site shortly after the disturbance as seed rain.

Late successional species: tend to begin growing in the understory, with lower light conditions. They often exhibit shade tolerance and slow growth.

- These are often large, animal-dispersed species that arrive on site only after forest recovery has progressed enough to attract those animals to the site.
- These species are often already on site as advance regeneration and gain dominance after the early successional species start to decline.
- These species can be generalists (adapted to a wide range of site conditions and often spaced far apart to avoid predation and disease) or specialists (adapted to specific site conditions and often found growing close together).

Succession and natural regeneration

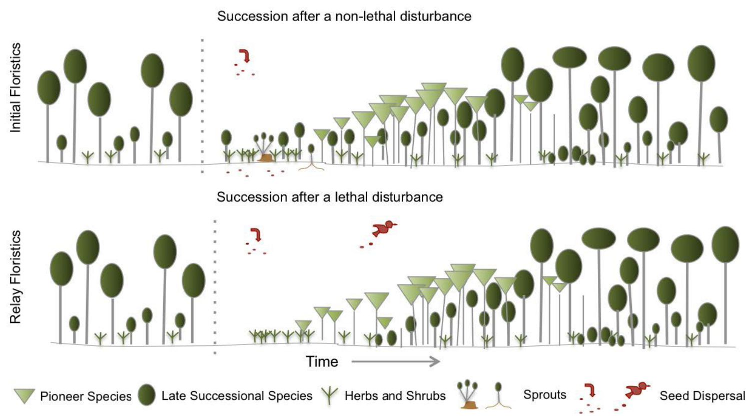
Succession is the long-term change in plant communities over time following a disturbance event. Different groups of plants gain dominance at different stages of ecosystem development.

Altered or arrested succession

In some cases, succession can become altered or arrested if degradation and competition are high enough that tree recovery is slowed or inhibited. A common case of arrested succession is found in abandoned agricultural land where degradation and competition with invasive species lead to areas dominated by grasses, low shrubs, vines or ferns. In most cases of altered or arrested succession, interventions that reduce competition, improve soil quality, and/or increase seed dispersal are necessary to enable forest recovery.

An example of arrested succession in Sri Lanka due to the presence of invasive grasses © Mark Ashton

Diagram of the process of succession after non-lethal and lethal types of disturbance



Succession after Non-Lethal Disturbance:
After most natural disturbances, the landscape begins to regenerate through a process called **initial floristics**. In this case, both early successional species (in the seedbank, seed rain) and late successional species (in advanced regeneration, stump/root sprouts, and seedbank) are present immediately following the disturbance. The pioneer species achieve dominance early during succession due to their fast growth. Midway through succession, late successional species begin to overtop early successional ones, leading to mature forests.

Succession after Lethal Disturbance:
When a lethal disturbance significantly reduces the soil quality and regeneration potential on a site, ecosystems regenerate through a different process called **relay floristics**. In this case, the early successional species arrive first, primarily by wind, water, or small animals. As they grow, they alter the light, moisture, and nutrient availability such that, eventually, the site conditions become favorable for the colonization and growth of late-successional species. The shade-tolerant, late successional species begin growing in the understory beneath the early-successional species and eventually gain dominance.

Figure by Gillian Bloomfield, with concepts from Ashton, M.S. & Bloomfield, G.S., 2014. Adapted from Ashton et al. 2001.

Conclusions

Disturbance and natural regeneration is an integral part of forest dynamics. The source and severity of disturbances influence:

- The regeneration potential of species on the site, related to those species' reproduction and growth strategies; and
- The rate and stages involved in succession, specifically with more disturbed sites requiring longer stages of the stand initiation phase.

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4.3 Forest degradation and deforestation

The term degradation is broadly used to describe landscapes that have experienced anthropogenic disturbances. In tropical forest landscapes, the majority of anthropogenic disturbances are divided into two types, **degradation and deforestation**.

Degradation

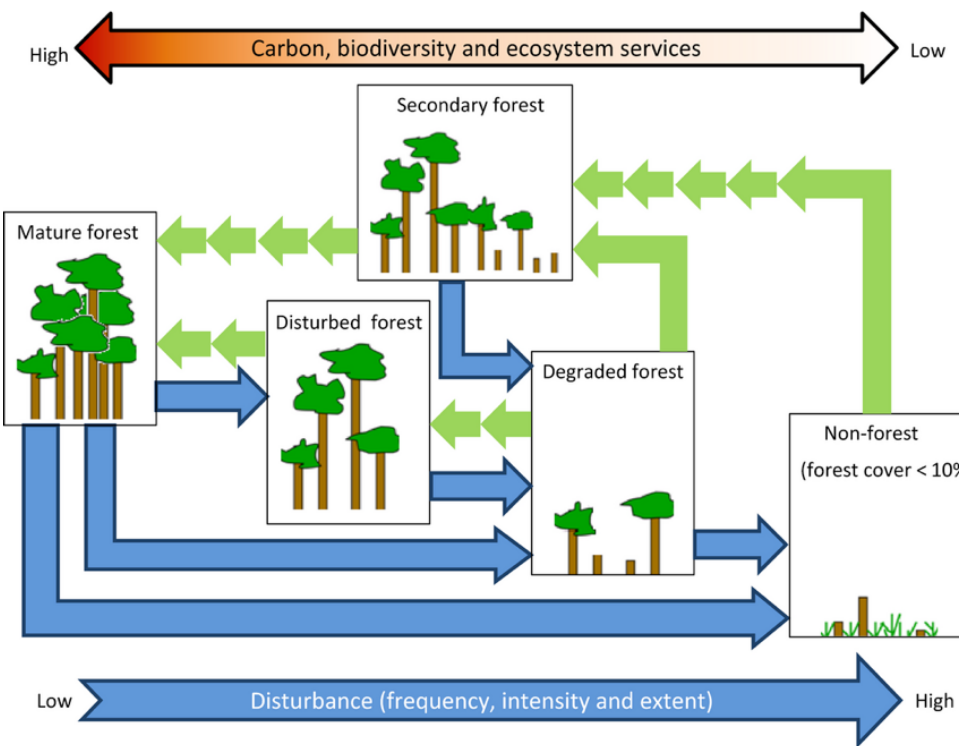
In the case of degraded forests, the land cover may still be classified as forest, but the function, structure, canopy, biodiversity or the ecosystem may all be reduced. The reduction in the physical structures (e.g., vegetation layer, wildlife, soil) and goods and services provided alter the ecosystem without changing its primary land-use. Forest degradation is often caused by chronic and non-lethal disturbances, such as selective logging, or over-harvesting of non-wood forest products (NTFP). Oftentimes degradation causes damage beyond the removal of trees or NTFPs when, over time, repeated harvest events simplify the structure and species composition of the forest.

Forest degradation diminishes reproductive processes and depletes the capacity of landscapes to provide ecosystem services, which leaves them vulnerable to fire and encroachment, and can also lead to outright deforestation.

Deforestation

Deforestation can be defined as the elimination of forest cover to less than 10% and its conversion to other land uses[2]. It is often caused by acute, lethal disturbances, which clear the land for agriculture, cattle ranching or mining. In this case, the forest canopy and understory are completely destroyed. Oftentimes, deforestation also causes soil erosion and other damage such that restoration may only proceed if the soil conditions are stabilized and improved.

Possible trajectories of forests under different levels of disturbance (intensity, frequency and extent)



Blue arrows: represent disturbances.
Green arrows: indicate regrowth of forests.
Disturbed forest, secondary forest and degraded forest:
qualify as forest degradation while no-forest indicates deforestation.

Source: Bustamante et al. 2016.

2 FAO 2010

Causes of forest degradation and deforestation

Proximate causes: Proximate or direct causes of deforestation and forest degradation are human activities or actions at the local level that originate from the land use and directly impact forest cover[3].

Underlying causes: Underlying drivers of deforestation and forest degradation can be grouped into categories of institutional policies, political-economic contexts and social settings[4]. Underlying driving forces include political processes, such as rural migration, inadequate agricultural policies, or weak institutional management. They act at multiple scales: international (markets, commodity prices, and trade agreements), national (population growth, domestic markets, national policies, governance) and local circumstances (local institutions, subsistence livelihoods and poverty)[5].

Direct and underlying causes of deforestation and forest degradation and future trends

Underlying Causes →		Demographic		Economic		Technological		Political and Institutional		
Direct Causes ↓	**Agents**	Population growth + Migration	Urbanization	Demand, Market & Competition for land	Poverty	Low productivity	Infrastructure development	Unclear land tenure and property rights	National development	Governance
Small-Scale & Swidden agriculture	Small holders	↓ View as main cause of deforestation, recent viewpoints argue that it is less severe as compared to commercial agriculture, and the use of long fallow is promoted as a sustainable management of tropical forests								
Intensive Agriculture	Commercial operators, financial institutions	↑ Cause of deforestation, it is driven by commodity market and price—the impact has increased causing loss of millions ha of forests mostly in Asia and Latin America. Recently, palm oil and rubber plantations are being developed in Africa.								
Conventional Cattle Ranching	Commercial operators, financial institutions	↑ Since mid-to-late 20th century, many governments policies have encouraged rural development to incentivize settlement and land-clearing in forested areas.								
Overharvest of NFTPs	Smallholders and hunters	↑ Cause of degradation, shift from subsistence-based cultivation to larger markets for NTFP extraction can lead to unsustainable harvesting practices in the future								
Fuel Wood harvesting	Small holders	↑ Common cause of degradation in Africa, wood for charcoal production has destroyed habitat and threatened wildlife populations.								
Small-Scale logging	Small holders, and commercial operators	↑ Main driver of degradation, known as selective logging, likely to increase for income generation, market demand and weak governance								
Industrial Timber & Pulp	Commercial operators, financial institutions	↑ Tropical timber wood production remains a small portion of global production, but the demand for tropical woods is expected in increase in coming years.								
Mining & Petroleum Extraction	Investors, government	↑ Large-scale mining and petroleum extraction requires large capital inputs and national government support. Loss of forest is driven by markets of precious resources that serve as incentive for governments to offer profitable concessions.								

Figure by Peter Umunay, adapted from Umunay et al. 2016.

3 Geist, 2002
4 Carodenuto et al. 2015
5 Kissinger, 2012

Assessing forest degradation and deforestation

Technology available today allows people to make reliable estimates of deforestation using high-definition satellite images, where the land is clearly visible from space. However, assessing degradation is more difficult[6]. There is currently no single remote sensing tool that can assess ecosystem dynamics due to degradation. The most common approach to assess degradation uses a combination of remote sensing data and field surveys to analyze and assess direct indicators.

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6 Zhuravleva et al. 2013

4.4 Self-reflection

1. What are the natural disturbances that occur in the region where you work? Describe their frequency and severity.

2. What are the anthropogenic disturbances that occur in the region where you work? Describe their frequency and severity.

3. How will the disturbances mentioned above affect the potential for regeneration and the succession process?

4.5 Activity: degradation drivers and FLR benefits

Part one: degradation and disturbance

In groups of 5-6 people groups, please respond to the following (write one response per piece of paper or post-it note).

Degradation:

1. What does degradation look like to you? *(For example: loss of food productivity, drought, etc.)*
2. What is the spatial and temporal scale of this degradation?
(Is it present across the landscape or in specific areas? Does it occur only sometimes or all the time?)

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Disturbance:

1. What disturbances cause degradation on the landscape? Describe what might be the origin (natural or anthropogenic) frequency (chronic or acute) and severity (lethal or non-lethal) of each type of disturbance.
2. Select two of your possible disturbances/degradation drivers. Describe how they might impact cover type, regeneration potential and vegetative succession in the ecosystem if no restoration actions are implemented.

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Part Two: Identified FLR objectives and benefits

In groups, please discuss then list **three primary reasons or objectives for doing FLR** and identify who the beneficiaries of these objectives are.

As you discuss, please consider the following:

1. What challenges can FLR help address in your country / assessment area?

2. What are the objectives and reasons for beginning FLR?

3. How does FLR fit in with the targets of your department/jurisdiction/etc.?

Groups will then report back on the three primary reasons for FLR they identified and why, also discussing who are the beneficiaries or interest groups for these objectives.

Based on the discussion, each group will then select or be assigned a primary FLR objective to focus on for the upcoming activities. In your group, please discuss and decide at what scale ROAM and FLR planning should take place, in order to best achieve your objective. (National? Subnational?)

1 FLR Objective:

2 Scale:

4.6 Socio-economic and governance factors relating to landscape restoration

Socio-political Objectives

The outcomes of FLR are strongly influenced by a range of complex social, economic and political factors. Because every country, region and community has a unique set of socio-political conditions, the main objective of this section is to highlight a number of factors that should be considered when determining whether FLR is feasible in a particular situation and how those factors should be addressed in the project's design and implementation.

Stakeholders

FLR initiatives can involve any of a number of stakeholders, which we define as individuals, groups, agencies or organizations that have a vested interest in a given process or result. Common stakeholders within the context of restoration include:

- Governments
- Local and international NGOs
- Individuals in participating communities
- Private sector actors
- Landholders and cooperatives
- Universities and research institutes

The involvement of different stakeholder groups will vary depending upon the scope and scale of the restoration initiative. A large-scale restoration project, for example, might include all of the previously mentioned stakeholder groups, whereas a restoration initiative focused on restoring lands with a select group of farmers might only include one or two stakeholder groups. Regardless of the scope and scale, there needs to be explicit and deliberate efforts in stakeholder engagement processes to ensure that they are wide reaching, while ensuring active presence, participation, and equitable engagement of women, men and youth from various stakeholder groups in all phases.

It is rare to find land where it is possible to conduct restoration without taking into account local community wishes. It is, therefore, essential to understand local community dynamics and interests when developing a restoration initiative. Local communities can also be an important pool of labor for landscape restoration, either on their farms or on communal areas.

However, while the term "community" is often used as representing an integrated union of people, they are often split along ethnic, economic, political and gender lines. Many successful forest restoration projects, therefore, rely on a community organizer to understand the dynamics within the communities and organize efforts.

Socio-Political Factors That Affect Restoration

Socio-political factors that influence FLR projects and initiatives

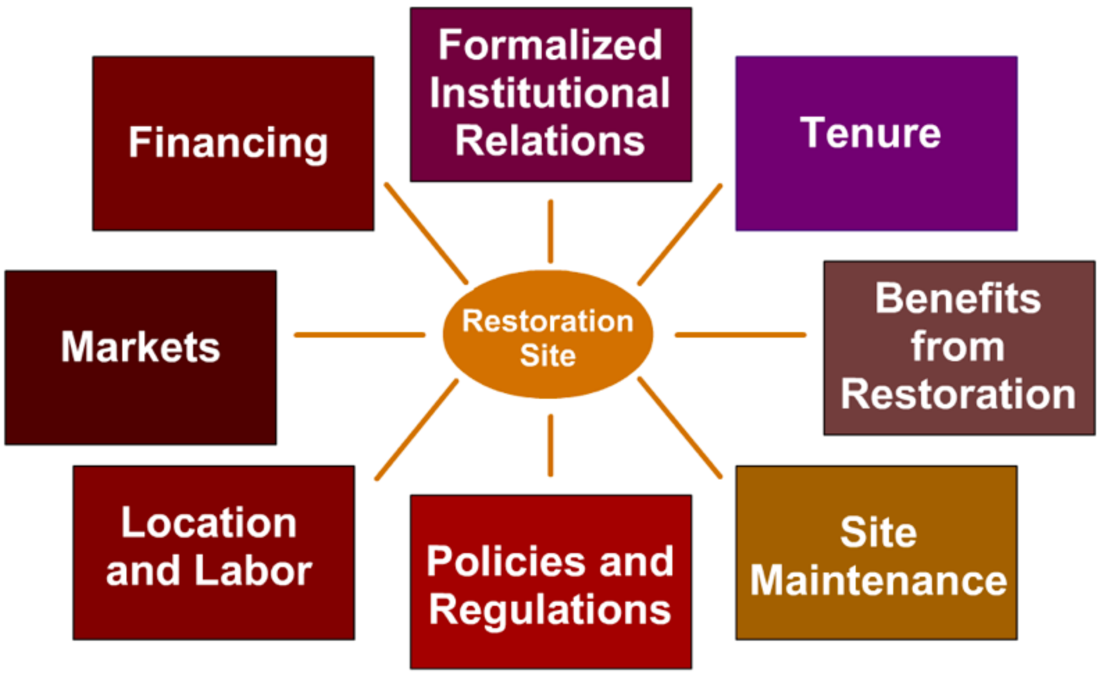

Figure by Gillian Bloomfield, featured in Garen & Neidel 2014.

There are number of different socio-political factors that influence the planning and outcomes of FLR and ROAM. Some of these include:

- **Formalized Institutional Relations:** FLR initiatives inherently involve multiple stakeholders. Creating formalized agreements between stakeholders (i.e. Memorandum of Agreement) can be an important aspect of ensuring restoration project success.
- **Land Tenure:** Tenure refers to the rights that different groups or individuals have to access and benefit from land and other related resources. Tenure conflicts can play out in many ways. Offering or receiving security of tenure, in terms of both state and local community recognition of land rights, therefore, is often regarded as an important prerequisite for a successful restoration initiative.
- **Benefits from Restoration:** Restoration will not be successful if the people who are engaged in the activities do not receive adequate benefits. In FLR projects where community needs are not adequately addressed, community members may plant the trees but not be invested enough to maintain them, or might even deliberately return the land to the previous land use.
- **Site Maintenance:** Many forest restoration projects fail to meet project goals because after the tree seedlings are planted they are not adequately maintained and succumb to disturbance or competition from other vegetation. Because of this trend, the leaders of FLR initiatives must emphasize continued site maintenance and the importance of "growing trees" and not just "planting trees."
- **Policies and Regulations:** Restoration goals must be aligned with local, subnational, or national spatial planning and other regulations that determine what can and cannot be done in certain areas. For example, FLR projects based on the presumption that people will be able to gain economic benefits from harvesting trees need to explore whether there are permits or other types of licenses that can be signed to ensure that (native) timber trees that are planted will be able to be harvested in the future.
- **Location and Labor:** Restoration efforts require significant amounts of labor. If the labor pool is small it is difficult to monitor and maintain trees in the field and protect the site from disturbance. A project far from a local community can also reduce the benefits that community members could gain from the site.
- **Markets:** Markets for the tree species used in FLR can center on timber and non-timber forest products (NTFPs). Both household demand and broader market conditions can influence how different products are valued locally, as can location, distance to market, the quality of roads and availability of transportation. Trees for which there are valued uses and strong markets will be more easily accepted in FLR projects than those trees that are relatively unknown.
- **Financing:** Many funders (especially donors) are interested in funding the initial establishment costs of restoration projects. In areas where the economic benefits of restoration are clear, this could suffice since the local population may see it in their own best interest to maintain the site. In other locations, where the local benefits are less clear, the lack of sustainable financing can cause problems and longer-term funding sources must be secured. Other funders, such as investors looking for long-term returns from timber production, may be focused on different timeframes and require long-term cost-benefit projections to ensure these expectations are met.

Land-use planning exercise at a training in Malawi © Karin Bucht

Gender

Another important socio-political factor to consider when planning for restoration is gender.

Women and men's dependence on landscapes is different. They tend to have different knowledge, access and control of forests and NTFPs, resulting in different collection, use and benefits from the landscape. As such, men and women contribute in different manners to forest conservation, landscape restoration and management. Men typically are involved in income-earning activities, and women often engage in more-subsistence actions for their households. When it comes to projects, men and women are involved in different ways, with women often being excluded.

Data and case studies have shown, however, that women are important forest stakeholders. For example, women play a key role in the use and management of natural resources, particularly in agriculture and forest value chains. FLR initiatives should recognize the important role women have as users, managers, and knowledge-holders on forests in communities. Initiatives should critically address gender inequalities and integrate women's engagement and empowerment to promote the advancement of women's rights and gender equality. A failure to integrate women and gender considerations into restoration projects may result in less knowledge, innovation, livelihood impacts or even less effective or efficient outcomes.

Achieving gender-sensitive and gender-responsive results in FLR and ROAM activities requires more than just the participation of girls, boys, men and women in events or workshops. Transformational change occurs when gender-sensitive (recognizing and accounting for the constraints, needs and opportunities of different groups) and gender-responsive (recognizing and responding to the strengths and weaknesses of different groups) approaches target and positively transform structural causes of gender inequality. To better achieve gender equality and gender equity, IUCN's gender-responsive restoration guidelines[7] provide guidance on setting out objectives, developing a road map, identifying stakeholders and resources that may be required for gender analysis.

7 IUCN 2017a.

Youth

Another important but often overlooked stakeholder group is youth. In many countries, youth are one of the fastest growing demographics, often with very high unemployment rates. In Africa, the majority of youth live in rural areas and are mostly employed in the agriculture sector, accounting for 65% of total agricultural employment. Around the world, rural youth are the future of food security, yet few young people see a future for themselves in the agriculture and forestry sectors. It is, therefore, important to involve youth in the planning and implementation of FLR since they have enormous potential to help conserve and restore tree and forest cover in degraded landscapes.

Youth who participate in FLR and ROAM can develop expertise and help contribute towards a better understanding of the value of natural resources[8].

Challenges with incorporating youth into FLR include:

- Lack of access to, and control over, productive resources (e.g., land and capital);
- Inadequate skills (e.g. lack of indigenous farming knowledge due to a generational gap);
- Discrimination, often resulting in higher unemployment rates for young girls;
- Poor access to information and education, especially for young rural women who tend to have particularly poor access to both general education and education on ways to integrate agricultural and forest sector knowledge into what?;
- Lack of engagement of youth as a stakeholder in development strategies.

During the ROAM process, the assessment team can ensure identifying the challenges and opportunities for youth's engagement. For example,

- Are youth's needs and priorities considered in prioritizing FLR opportunities?
- Are youth's organizations identified as a major stakeholder?
- Do the FLR opportunities have recognized differentiated benefits for youth?
- Are there specific opportunities to improve youth's engagement in FLR implementation?
- What are the roles played by youth in forest use, management and agriculture?
- Which resources do youth obtain from the forest and agriculture sector?
- Are there gender differences within youth in access to and control over resources?

Culture

Culture can have a critical role in the way land is either degraded or restored. For instance, culture can generate outcomes such as restoration around 're-sanctified' sacred groves or forest restitution on indigenous land[9]. Two categories of culture that are particularly relevant to restoration are:

1. **Societal or Ethnic Culture:** the culture of a particular society or ethnic group with its own beliefs, ways of life, art, etc.
2. **Group Culture:** the culture of groups, including standards or a way of thinking, behaving, or working that exist in a place or organization (such as a government institution or business).

8 IUCN 2017b
9 Wild, R.G. 2016.

The following set of questions, developed by Rob Wild (2016) allows users to deepen their understanding of culture related to forested, or once forested, landscapes as part of ROAM:

1. To what extent does societal culture influence FLR in the area?
2. What are the main themes or domains where societal culture influences FLR?
    a. Land, land tenure, governance and rights
    b. Specific landscapes, features in the landscape, specific sites (e.g. sacred natural sites)
    c. Specific plant and animal species (e.g. food, taboos and beliefs, medicines, construction)
    d. Arts and crafts
    e. Institutions and cultural leadership
    f. Spirituality and religion
3. Are there cultures that could be described as forest cultures? (Societies whose culture tends to protect or restore forests.) What is their status in the area?
4. Is culture an opportunity or barrier to FLR in the area? Or both? How?
5. How does culture influence other key social elements, gender, youth, ethnicity, politics, arts and economics with regard to restoration?
6. Does the overarching group culture of the area predominantly lead to restoration or degradation?
7. Are there 'centers of excellence' or specific cultural events that can be consulted for a deeper understanding of cultural dimensions of forests, landscapes and FLR?
8. Are there cultural or religious institutions that could make commitments to the Bonn Challenge?
9. Are any relevant culture or cultural services recognized in existing national laws, conservation or science programs? (e.g. National cultural laws, World Heritage Convention, National Biodiversity Strategy)
10. In what way should the FLR program that is currently being designed take into account culture? Can a restoration culture be developed? If yes, how?

Conclusions

International interest in tropical restoration has never been higher. There is increasing recognition of the many benefits that restoration projects can provide, not only combating climate change and maintaining species diversity but also improving human livelihoods. Therefore, restoration initiatives are increasingly included as avenues to reach international environmental and sustainable development objectives.

While this support for restoration initiatives is positive from a restoration management perspective, many restoration projects still fail. Failure is not always from a lack of effective restoration methods or financial support, but due to overlooking sociopolitical factors that can influence the success of a restoration project. Thus, it is vital to take into account these sociopolitical factors when implementing a restoration project.

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4.7 Self-reflection

1. What is the social, political and cultural context related to land and forest use in the area where you work? Who lives and has lived there (presently and historically)? What types of activities are they involved in on the land? Do you foresee any future drivers of change that may influence land use at the landscape scale in the region?

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2. What considerations might you have related to gender, youth and culture as it pertains to FLR in your area?

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3. What other socio-political and economic factors need to be considered beyond stakeholders themselves?

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4. What are they main governance issues in your landscape that will be relevant for the FLR interventions and successful implementation of restoration projects?

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4.8 Activity: stakeholder mapping

Participants will work together in groups of five or six to identify stakeholders that should be involved with FLR assessments and activities, keeping in mind the scale (national or sub-national) they identified to be best for achieving their objective. Participants should take care to think about all the people and processes that are directly and indirectly related to productive landscapes. These considerations include the physical, social, economic and ecological factors that influence landscapes and people.

Part One:
Groups will have 20-30 minutes to use the paper or post-its provided to write down all stakeholders that may be directly or indirectly involved with, or impacted by, FLR activities.

1. Please write out one stakeholder per piece of paper or post-it. *Please be as specific as possible – which branches of government/at what level, which NGO's, who in the community, etc.*

Questions to consider during this deliberation may include:

- Who benefits from landscape restoration?
- Who bears the costs of landscape restoration?
- What landscape processes might be impacted by restoration activities?
- How might an initiative for restoration change social and economic dynamics throughout landscapes?
- Are women and men affected differently by these initiatives and/or the projected outcomes?

Part Two:

1. Which of the stakeholders listed have the most direct influence (positive or negative) on the outcomes of the FLR initiative? Which stakeholders will have the least influence?
2. Which stakeholders will have the highest interest or see the greatest benefits from FLR initiatives?
3, Classify the stakeholders listed in part one into the matrix (right).

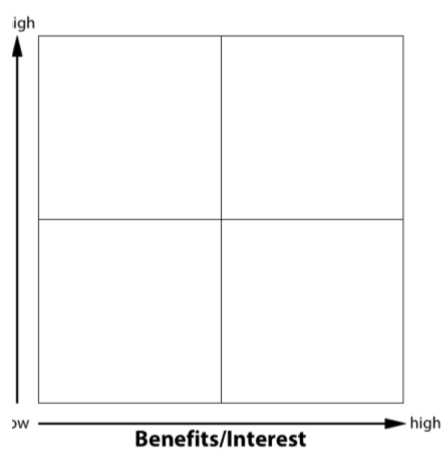

Figure by ELTI and IUCN.

Part Three:
During ROAM and FLR planning, you may face limitations in the number of stakeholders you can include due to timing, budget or other constraints. Imagine that your budget has been cut and the number of stakeholders you can incorporate into your planning has been cut in half.

1. Please prioritize your stakeholders accordingly, selecting no more than half to involve in your ROAM and FLR process.
2. Groups then report back on the stakeholders they prioritized.

Notes:

5 Identification and prioritization of Forest Landscape Restoration opportunities

5.1 Overview

In order to identify FLR opportunities, it is critical to engage a wide range of stakeholders to discuss and better understand the context and trade-offs that need to be considered. It is important to look at the whole landscape because some benefits of landscape restoration are in the public domain, including carbon sequestration, water quality and quantity and other services. Biophysical information on the **level of degradation** (high levels of degradation may be costlier and need more time to restore) and the **ability of the landscape to recover** from disturbances (are there seed sources nearby, is the site devoid of seeds, seedlings or coppicing species, etc.) are important variables for identifying FLR opportunities.

Additionally, once landscape restoration opportunities have been identified, the next step is to prioritize which benefits and areas to restore first or develop a short, medium and long-term plan for the entire assessment area. ROAM utilizes landscape-scale information on a range of social, biophysical and economic factors to identify and prioritize areas for landscape restoration.

The process of prioritization can take many forms and also depends on the will and ambition of people to undertake restoration. Spatial data can help identify the most degraded areas, as well as areas that might provide the most ecosystem service benefits. However, prioritization may consider additional factors, such as desired outcomes of the assessment team, land tenure rights, labor and how restoration can address systemic drivers of degradation.

In practice, prioritization of restoration areas and site-based interventions is a collaborative process among stakeholders. The process of prioritization is extremely valuable for the different stakeholders to voice their considerations for priority areas and eventually build consensus.

The following activity will allow you to experience this negotiation process by identifying FLR opportunities and prioritizing landscape restoration within a given landscape, and context for FLR objectives.

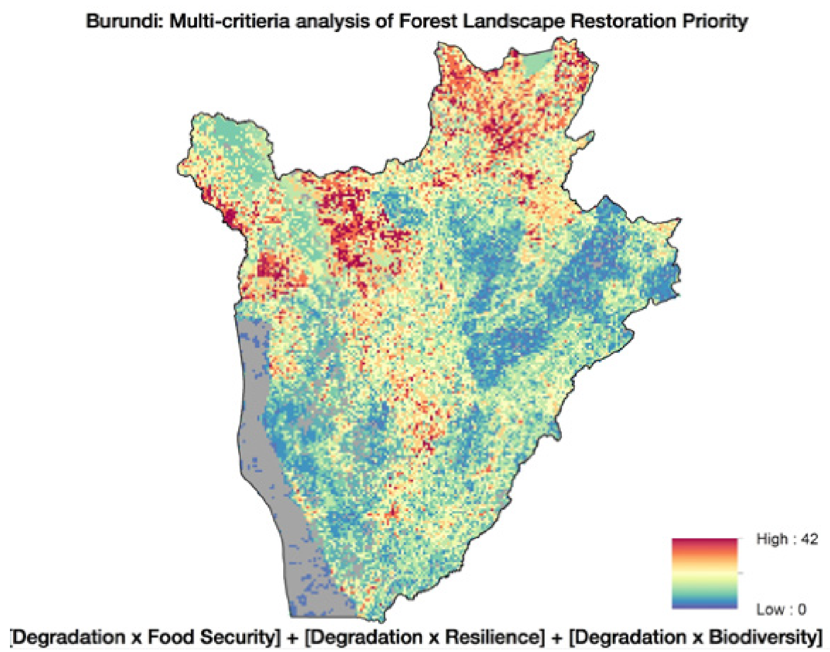

Figure by IUCN

5.2 Activity: identifying and prioritizing opportunities for landscape restoration

The Minister of the Environment has heard about the Bonn Challenge and is interested in FLR as a strategy to use nature-based solutions for restoring degraded landscapes. The Minister has already identified a focal region for an initial ROAM assessment. S/He is interested in restoring the degraded landscapes to achieve the following objectives:

To be filled in from Training Day 1 results

1. ....

2. ....

3. ....

The Minister needs your help to identify and prioritize where FLR should be implemented to achieve these objectives. The ROAM team has already collected several geospatial datasets characterizing land cover and use for the assessment area (see below). This landscape exhibits widespread degradation, except for the closed natural forest.

Using maps (layers) of the provided datasets (see below), your task is to provide the Minister with answers to the following questions

1. What are the landscape restoration opportunities of the given landscape?
2. Where are the areas of highest restoration priority, taking into account the social, economic and ecological feasibility of restoration in targeted landscapes?
3. What are the trade-offs that need to be considered to identify the areas of highest priority?

Make your case to the Minister, as s/he will need to present these results during an upcoming ministerial meeting

DIRECTIONS: Identify someone to represent the Minister of the Environment in your group – s/he will be able to answer any questions about identifying and prioritizing landscape restoration opportunities that are not mentioned above or are explicit from the data given. If the group has any questions or issues to resolve, you can turn to your Minister for answers. The Minister also participates in the group exercise. Identify who will present the results to the other groups at the end of the exercise.

Please take a look at the target landscape and discuss the potential opportunities for landscape restoration using the layers describing the landscape features (transparencies). Keep in mind the characteristics of the landscape described above and the FLR objectives. Then select only 10 squares that represent the highest restoration priority based on input from group members. If you need any clarification, the Minister will provide landscape definitions or other information that you might need to complete this task.

Record any questions here that you asked the Minister:

1 ....

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2 ....

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3 ....

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4 ....

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5 ....

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Explain the reasons why you selected the 10 squares. What opportunities did you consider? Reflect on biophysical, economic, social and political aspects of the landscape.

1 ....

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2 ....

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3 ....

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4 ....

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5 ....

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What were the trade-offs that you considered when selecting the 10 squares?

1 ....

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Target landscape for the assessment of FLR opportunities and prioritization

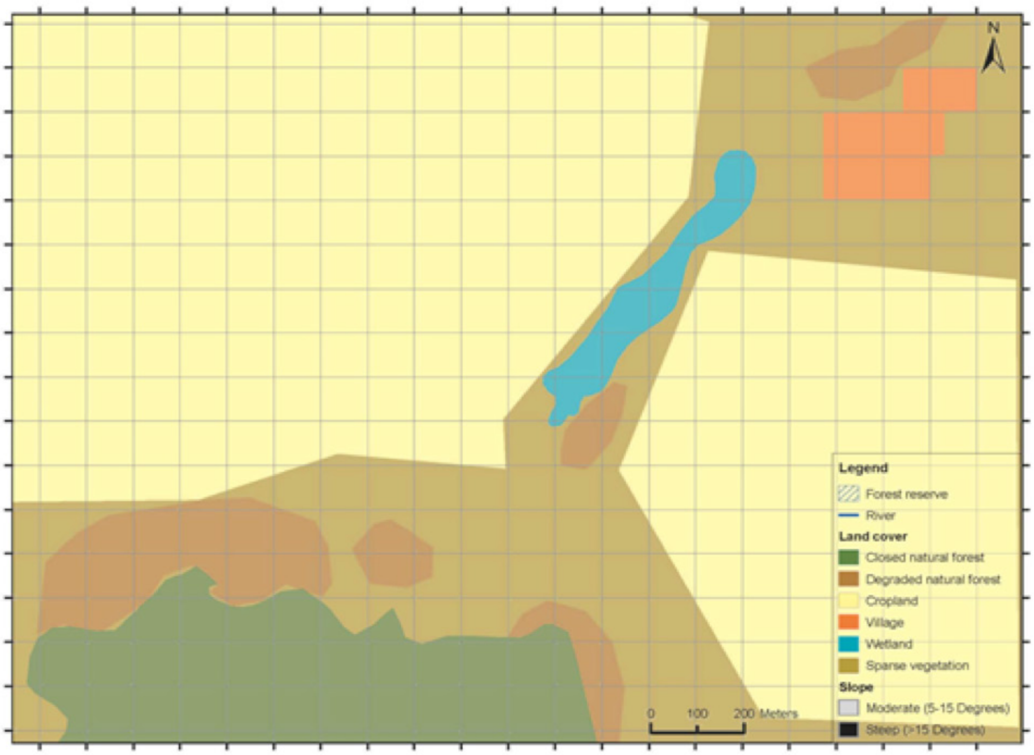


Figure by IUCN

Features of the target landscape for the assessment of FLR opportunities and prioritization

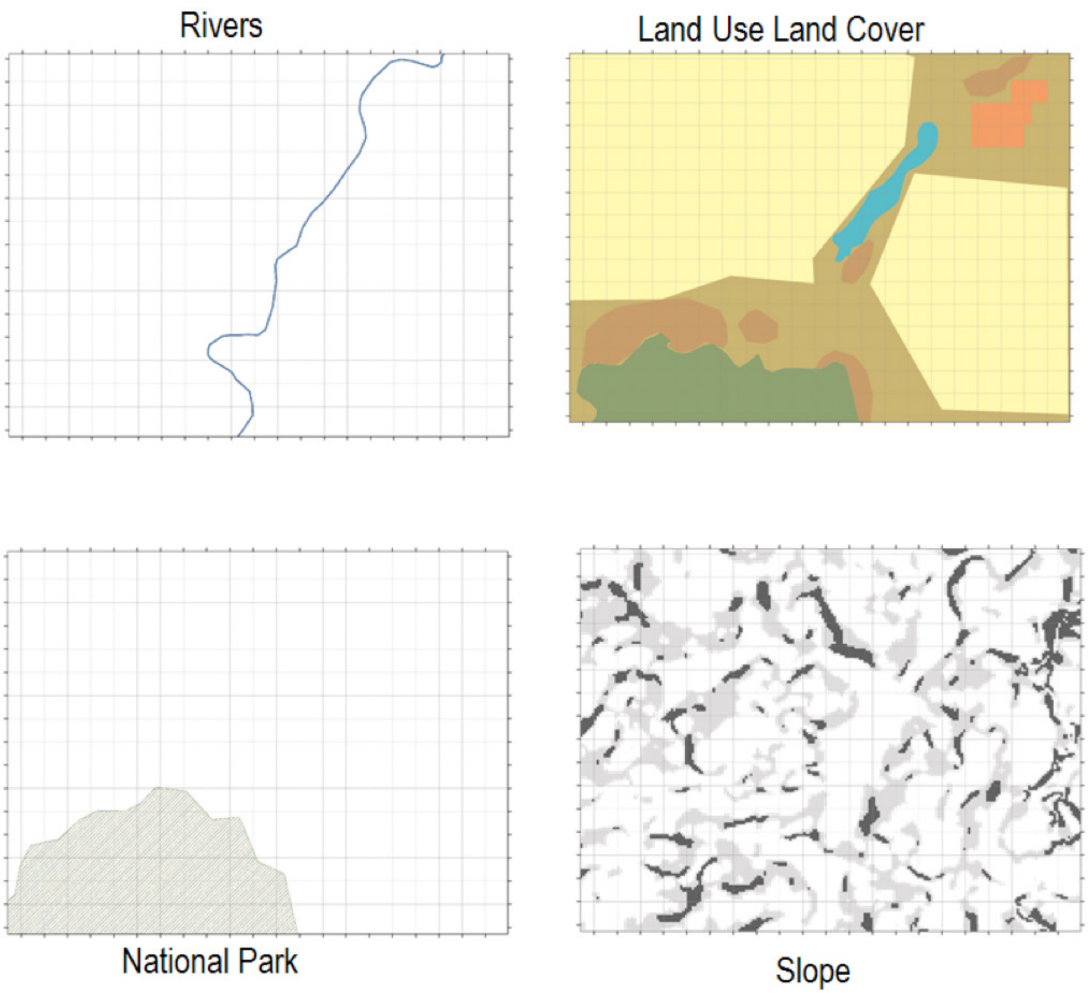


Figure by IUCN

5.3 Ecosystem services and landscape restoration

When effectively managed, ecosystems provide a variety of benefits and services. Over the last few decades, there has been increasing recognition of the importance of ecosystem services (ES), which has placed them at the core of discussions on the role that nature plays in supporting human well-being.

"Ecosystem Services" are the goods and other benefits that populations derive, directly or indirectly, from ecosystem functions.

These services can be classified into:

- **Provisioning Services:** production of goods and resources from ecosystems. This includes food, water, medicines, timber, and energy (hydroelectricity, biofuels, wood fuel).
- **Supporting and Regulating Services**: processes that are part of ecosystem functions, including maintenance of biodiversity, carbon storage and sequestration, soil and nutrient cycling, water quality and regulation.
- **Cultural Services:** landscapes also provide important social values, for spiritual, cultural and recreational reasons.

Assessing ecosystem services goes beyond measuring ecosystem functions and requires linking those functions to supply and demand of services people value. The value that emerges from this supply-and-demand relationship can then be measured and compared to help decision-makers understand the trade-offs that exist between different development, restoration, and conservation opportunities. By incorporating information on these trade-offs into decision-making, an ES approach can inform planning processes, mediate stakeholder engagements, and help to establish policies that can improve, support, and expand the delivery of ES to people.

5.4 Range of landscape restoration strategies

The objective of the landscape restoration approach is not to return tree cover to a site *per se.* Rather, the objective is to improve the health, integrity, and sustainability of the landscape as a whole. Landscape restoration seeks to regain the landscapes capacity to self-perpetuate.

Landscape restoration activities may range from assisted natural regeneration to reforestation plantations to improved silvopastoral and agroforestry systems, among others, all of which are included within a broad view of FLR.

The restoration staircase to the right can be a useful way to distinguish various actions for landscape restoration. In reality, many of these actions will take place simultaneously in a landscape under restoration, depending on the availability of seeds and seed sources and the level of degradation.

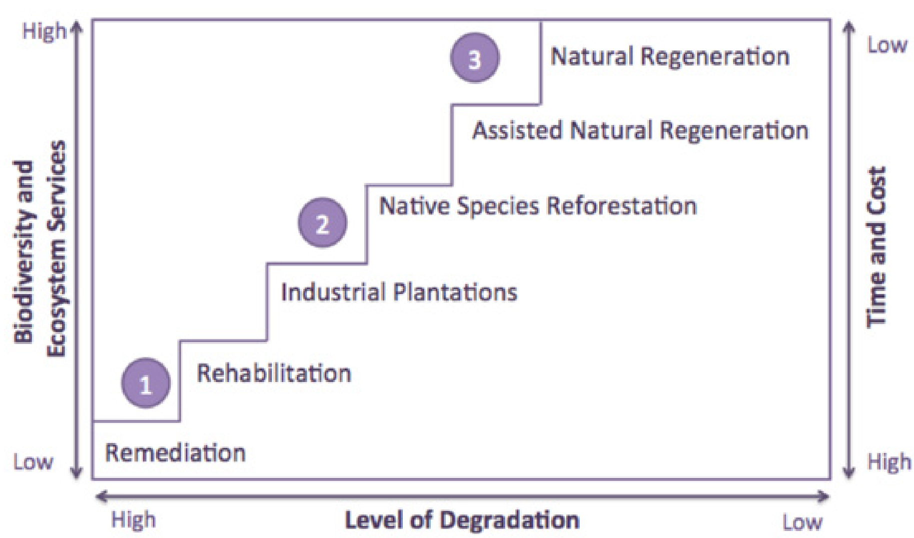
Depending on the level of degradation, there are various restoration actions with different focuses. For example:

1. Restoration of soil fertility;
2. Production of timber and non-timber products; and
3. Recovery of biodiversity and environmental services.

The actions necessary for successful restoration depend on how disturbances affect site conditions and re-generation potential. The following should be considered to evaluate the biophysical context of a site:

- Type of disturbance on the site;
- Land use history of the site.

Restoration Staircase



Adapted from Chazdon 2008

Natural Regeneration

Natural regeneration, also known as regrowth or secondary forest recovery, can occur on sites that have not been heavily degraded over a prolonged period of time and have access to seed sources, such as seedbanks and nearby forests. Vegetation sprouts from plant matter on site (e.g., stems, stumps, roots, or the seedbank) or recolonizes from seed rain to form a secondary forest over time. In humid climates, land abandonment after uses such as agriculture or ranching can result in vegetative cover resembling secondary forest in less than 15 years. In dryer regions, forest recovery advances more slowly. In many cases, the factors causing degradation, competition with invasive species, and the presence of recurring forest fires results in the regeneration of a system that does not resemble the pre-disturbance forest but can regain its ecological function.

Assisted Natural Regeneration (ANR)

Assisted natural regeneration (ANR) is a technique used to accelerate the natural recovery of a landscape by removing or reducing barriers to forest succession. For this handbook, we have divided the range of interventions for ANR into four steps, listed in the figure to the right.

In areas where seeds and seedlings remain or can be easily dispersed from nearby forests, it is possible that only the first one or two steps of ANR will be necessary. These actions can advance forest restoration using less costly and less intensive methods than those in steps three and four.

Nevertheless, when a restoration site is very isolated from natural forest or is highly degraded, it is likely that natural seed dispersal is limited. It is here that steps three and four can be necessary to catalyze regeneration.

Four Steps of Assisted Natural Regeneration

1. Reduction of external pressures such as anthropogenic disturbance
2. Reduction of competition with herbaceous species
3. Facilitation of desired species; and
4. Enrichment planting by means of introducing seeds or seedlings to complement natural regrowth

Source: Bloomfield & Calle 2014

Farmer Managed Natural Regeneration

A method called "Farmer Managed Natural Regeneration" (FMNR) is used in many different countries in Africa. The technique consists of facilitating the sprouting of new stems from the trunks and roots of felled trees. The farmer then chooses the best and manages them by pruning and removing unwanted branches and stems. More involved techniques include using sprouting trunks as a source of seedlings in which the thinned cuttings are transplanted elsewhere.

http://fmnrhub.com.au

FMNR
Farmer Managed Natural Regeneration

The presences of seed sources on the landscape is integral to the utility of ANR as a restoration technique. Seeds can come from forest patches, remnant trees on farms, living fences, and other nearby sources.

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Reforestation

In landscapes where the desired tree species do not regenerate naturally or through assisted natural regeneration, the best catalyst for restoration can be reforestation- the planting of tree seeds or seedlings where they had been removed by disturbance. Many government agencies, businesses and NGOs in the tropics have carried out reforestation programs to reverse the clearing of forests and to restore degraded lands.

In many cases, the term "reforestation" is used to describe plantations established with monocultures of exotic trees (e.g., acacia, pine, eucalyptus and teak species) in a short rotation. Although reforestation with exotic species can rehabilitate some characteristics of a site, these species do little to restore the biodiversity, structure and function of forest ecosystems.

Native Species Reforestation is the establishment of forest on cleared land by planting seeds or seedlings, most of which come from the area or region to be restored.

There may be hundreds of thousands of native tree species a specific region that have the potential to provide economic and ecological benefits if they are used for reforestation and landscape restoration. These species are increasingly being used and tested in reforestation projects with native species across the tropics.

Restoration in Secondary, Degraded, or Planted Forests

Chronic disturbances and isolation of forest fragments and riparian zones can reduce the species, structural, and genetic diversity and productivity in forests. To facilitate the regeneration of desirable species in degraded, secondary and planted forests, silvicultural treatments with methods similar to ANR are used.

Techniques such as pruning, thinning or enrichment planting can increase the species richness, presence of desirable species and structural complexity of that forest.

Native species nursery for reforestation in the Philippines

Restoration in Agricultural Systems

Most degraded and deforested landscapes are human-dominated mosaics with multiple land uses. Agricultural landscapes are the dominant form, with only 6.1% of land surfaces under protection.

- **Forest restoration within agricultural landscapes:** The techniques for ANR, reforestation, and silviculture can be done in agroecosystems, specifically in those located in riparian areas, steep areas, and areas of low production. With a focus on landscape restoration in these areas, it is possible to improve water quality, reduce erosion and surface runoff and increase forest and ecosystem connectivity, while maintaining productive activities in the more fertile areas of the landscape.

- **Integration of trees and shrubs into production zones:** Conservation and restoration of trees distributed throughout productive areas has an important role in increasing ecological value and sustainability of agroecosystems. Trees can be used for living fences and wind breaks, shade trees and fodder banks, and agroforestry or silvopastoral systems.

Reference materials

This section includes text and figures adapted from: Bloomfield, G., Bare, M. and D. Lopes, 2014. "Ecology and Ecosystem Services of Tropical Forests." Course Materials. Environmental Leadership and Training Initiative. Yale University, New Haven, Connecticut and Bloomfield, G.S. & A. Calle. 2014. "Introduction to the Range of Restoration Strategies for Human-Dominated Landscapes" Course Materials. Environmental Leadership and Training Initiative. Yale University, New Haven, Connecticut.

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6 Restoration Interventions

6.1 Getting in-depth on restoration interventions

There are diverse restoration methods, which can be seen on a continuum of approaches from more passive (natural regeneration) to more active (reforestation). Which intervention is appropriate will depend on the individual landscape, flow of ecosystem services and goods, as well as the needs and objectives of the people dependent on these landscapes. A landscape approach is necessary to ensure the appropriate level of data-gathering and analysis, to identify FLR actions at the site level.

If natural regeneration is insufficient, ANR activities to ongoing disturbance and reduce competition with weedy species should be considered first. These may be the only action steps needed if the site is less degraded and close enough to natural seed sources. For instance, in some cases, exclude livestock grazing from a site may be enough to facilitate regeneration.

In areas that are more degraded, fertilization can help species to grow faster. In areas that are more isolated, action steps such as wildlife recruitment, direct seeding and supplementing with planted seedlings can enhance the species diversity and number of trees, and achieve the desired FLR benefits.

In some cases, such as heavily degraded mining sites or abandoned agricultural land that is highly isolated from natural forests, tree planting may be the only way to catalyze forest regeneration. However, there are many circumstances in which ANR actions can advance restoration with less cost and labor by

Restoration site in Malawi © Karin Bucht

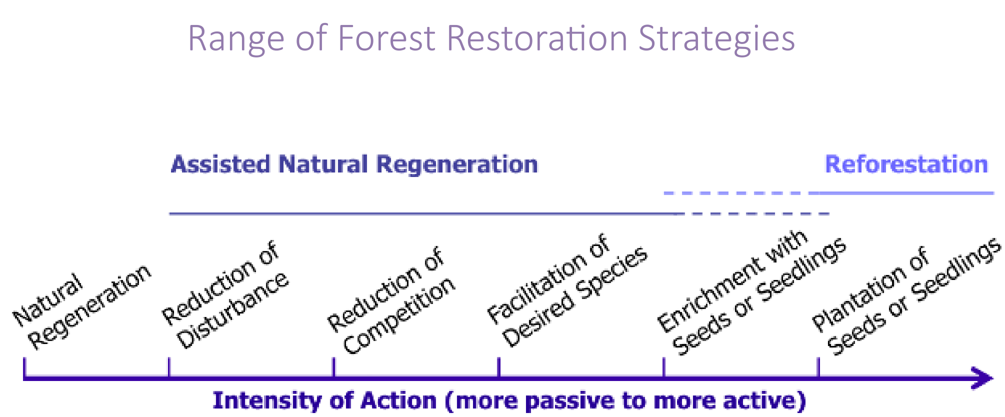


Figure by Gillian Bloomfield, incorporating concepts from Chazdon 2008 and Lamb 2011

helping naturally dispersing trees grow faster and survive more often than they would by the natural processes of succession.

Although the concepts are discussed below as distinct topics, there is overlap between ANR and reforestation with respect to the introduction of vegetative material.

Assisted Natural Regeneration (ANR)

Assisted Natural Regeneration (ANR) is a technique for accelerating the natural processes of landscape restoration by removing or reducing barriers to vegetative succession. It comprises of four steps:

Step 1: Reduce disturbances

Remove destructive grazing: The regeneration potential of a site can be tested by constructing a fence to exclude animals and protect plant regeneration. Other actions can also be taken to protect seedlings from large and small herbivores. If it is not possible to do this over the entire area, establishing “islands” where vegetation is allowed to regenerate will create a valuable seed source for FLR over time.

Control and prevent fires: Fire is one of the most common causes of failure for forest restoration projects. Controlling fire is an important action to protect the regeneration on a site, especially in areas with long dry seasons and those dominated by fire-prone grasses and shrubs. In many cases, once fire is excluded from areas dominated by fire-prone grasses, woody species will eventually establish, grow, and shade out the grasses. Actions to control and prevent fires include:

- Increasing awareness and response;
- Establishing firebreaks; and
- Storing firefighting tools on site.

If a fire does occur, some trees might resprout. For example, 25% of trees resprouted after a large fire at a reforestation site in West Kalimantan, Indonesia. When such accidents occur, it is important to collect data on which species of trees resprout.

©ASRI

© Jacob Slusser

Step 2: Reduce competition

Until woody species grow and naturally shade out grasses and other competing vegetation, weeding treatments might be necessary to reduce above and below-ground competition.

An important first step is to identify the species desired for natural regeneration and mark them with stakes or reflective tape to avoid accidentally harming them during weeding operations. Weeding should be done more frequently during rainy seasons. During months of low precipitation herbaceous cover can actually benefit some tree species by preventing loss of soil moisture. Both manual and chemical methods can be used for weeding. In areas where productive grasslands are desired, weeding invasive species and promoting the growth of desired grasses may be needed until they can outcompete undesirable species.

Step 3: Facilitate desired species

Fertilize desired species: If nutrients are limiting on a site, fertilizer can be added to the soil around naturally occurring regeneration. Some species will grow faster if given fertilizer, but others will not. Before spending money and time on fertilization, it is important to test the effects on a few of the species planted in the site. Natural fertilization in productive systems is possible through planting tree species that produce nutrient rich leaf litter.

Thinning or transplant seedlings: When there are two or more trees growing close to each other, they will compete for light, water and nutrients. To reduce competition, choose the more vigorous tree and remove the surrounding individuals – a process called thinning. If desired, healthy seedlings removed from thinning operations can be transplanted to another site that does not have sufficient regeneration.

Step 4: Introduce of desired seeds or seedlings

Create or leave structures for seed-dispersing animals: In some cases, structures that attract seed-dispersing bats and birds can increase the seed rain of forest tree species. Examples include live fences, fodder-banks or built structures (such as bat root boxes).

Direct seeding: People can serve as seed dispersers by bringing seeds into restoration sites through a process called direct seeding. If seeds survive and germinate, this method can save on the costs of raising seedlings in a nursery before planting in the field. However, for some tree species, seed predation and desiccation of seeds planted in the field can limit the survival and germination abilities of directly planted seeds.
Supplement with planted species: Enriching the site with nursery-produced seedlings can play an important role in restoration where regeneration or the presence of important species is lacking or does not meet project goals. Because of the high cost and intensive labor involved in enrichment planting, introducing nursery seedlings is only recommended for cases when steps 1-3 of ANR have already been considered.

Before investing time and money into nursery establishment, consulting local communities and conducting species selection trials can help ensure that the species are appropriate to plant on the site. When deciding which species to plant, consider:

- Species present in nearby forests but not naturally regenerating on the site;
- Species that can close the canopy and create shade;
- Nitrogen-fixing species;
- Species with wildlife value, especially those desirable to seed-dispersing animals; and
- Economically and culturally valuable species.

It is also important to consider the spacing and placement of enrichment planting trees, to avoid competing with the naturally occurring regeneration.

Silvicultural Techniques in Secondary, Degraded, or Planted Forests

Silvicultural techniques can help advance the restoration of secondary, degraded or planted forests by increasing species richness, presence of desirable species and structural complexity.

Pruning or Thinning Canopy Trees: To regenerate certain species naturally or to encourage the growth of enrichment plantings, pruning or thinning canopy trees may be necessary to increase light reaching the understory. For all pruning and thinning treatments, it is important to be careful not to shock shade-tolerant species and not to thin so much that weedy species such as grasses, ferns, and vines take over.

- If overstory trees are economically valuable and feasible to extract, they can be harvested and removed from the site to be sold or used elsewhere.
- If overstory trees are not economically valuable or feasible to extract, a common method of thinning, called girdling, can be used. This method kills the tree but leaves it standing, providing structure for wildlife, while creating less damage than the felling and transportation of trees.
- Some species require larger canopy gaps to successfully establish. For example, many timber species are long-lived pioneer species, which require larger strips or patches so that the light transmission is high enough for growth.

Enrichment Planting: The process of planting seedlings in the understory of a forest to enhance species composition is called enrichment planting. Species can be selected for a variety of goals, including for economic and ecologic values. The light requirements of planted trees should match the overstory conditions. For example, if the canopy is closed, then the species undergoing enrichment planting must be shade-tolerant. Otherwise, the canopy will need spaces for light to come in or thinning treatments.

Restoration of native species under pine plantations in Sri Lanka

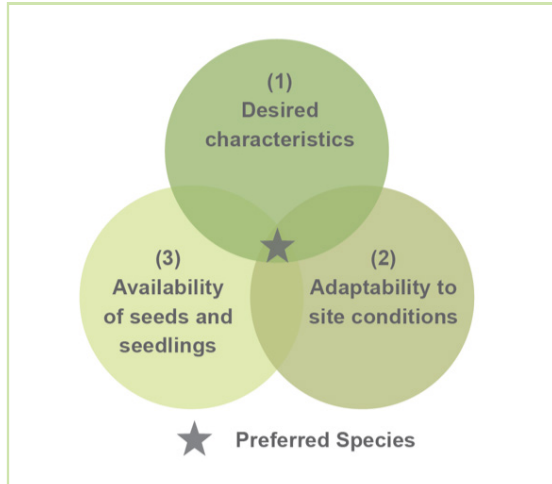
In the Sinharaja Man Biological Reserve, in Sri Lanka, reserchers tested the survival of five native Dipterocarp species used in enrichment plantings under 13 year old pine (Pinus caribea) plantations. Their survival was evaluated in areas with treatments where the pine overstory had been cut in strips of different widths. The highest survival was in the areas cut with 8 meter-wide strips. These images show the growth of the native enrichment plantings within the cut strips at planting (left), 2 years post-planting (middle) and 6 years post-planting (right). © Mark Ashton

Reforestation or Tree Planting

In sites where desired tree species do not regenerate naturally or through ANR, planting mixed, native trees and shrubs (hereafter referred to as “native species”) may be the most effective way to catalyze recovery of biodiversity and ecosystem services.

There are a variety of tools, strategies and informational resources that can be used to evaluate which species to select for a reforestation project.

After the goals of the reforestation project are identified, there are three species-level factors that can help narrow down the possible species for a given project:



1. Desired characteristics: First, the project objectives influence the types and arrangement of trees that might be desired.

Is the project aimed at forest restoration, the provisioning of desired products and/or ecosystem services?

Different trees may be more or less useful for the following objectives:

- Timber production
- Source of fuelwood and non-timber forest products (NTFPs)
- Soil enhancement and nitrogen-fixation
- Rapid canopy closure
- Wildlife attraction
- Building soil
- Fixing nitrogen
- Sequestering carbon
- Preventing erosion

Additionally, some FLR initiatives may rely on **nurse trees**, fast-growing species that can survive in a hostile environment and facilitate the establishment of other species by changing local conditions. These trees are often used in reforestation to improve microclimates by quickly closing the canopy, reducing competition with grasses and creating shadier and cooler conditions for other species. Nurse trees that are fire-adapted are particularly useful in fire-prone restoration sites.

2. Adaptability to site conditions: Another important factor for is species' adaptability to the site's light, humidity and soil conditions. The following resources can help identify species that match a project's site conditions:

- Local knowledge of species
- Species selection trials
- Documented information on species for restoration
- Reference ecosystem

3. Availability of seeds and seedlings: Finally, the species selected for reforestation projects are highly influenced by the availability and accessibility of their seeds or seedlings. The seeds must be able to germinate and thrive in nursery conditions and the seedlings must be able to survive.

Why reforest with mixtures of native species?

With any FLR project, there will be tradeoffs between the extent of ecological enhancement and product provisioning. However, in comparison with exotic monocultures, planting native species in mixtures can lead to the following benefits:

- Sustaining biodiversity
- Regulating water
- Increasing productivity
- Providing multiple culturally and economically valuable benefits

In addition to the points above, diversity within a system can reduce the risks from disease, pests and/or weather-related events. This is particularly important, given the predicted intensification of such events due to climate change.

The greater the number of species in the system, the greater likelihood that there is an overlap in the functions they serve within their ecosystem; therefore, there is less risk that ecosystem function is completely lost, if one or more species are no longer able to thrive due to the environmental changes. Similarly, a greater variety of genetic diversity within a species may increase the chances for adaptation or evolution of a species.

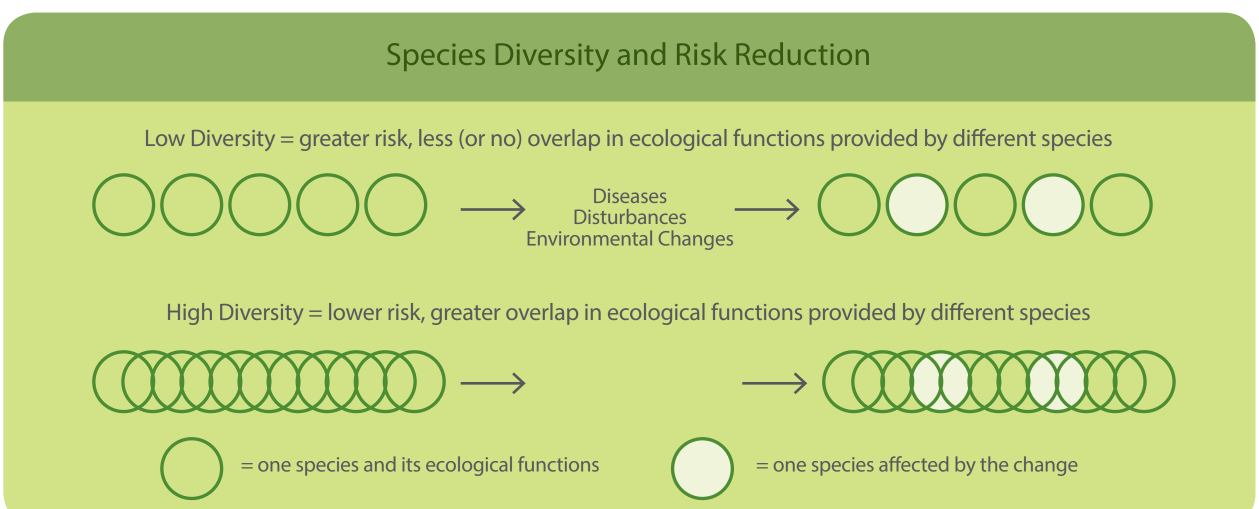


Figure by Gillian Bloomfield, incorporating concepts Lamb 2011

Is there a role for exotic species?

When no native tree is suitable for a management goal, there are cases when exotic species can be the most appropriate restoration choice, such as:

- When conditions severely limit the potential for native species to regenerate naturally or survive in plantations, exotic species can catalyze restoration efforts by serving as nurse trees. Exotic species that are used for this purpose are commonly pioneer species that are adapted to a broad range of site conditions.

- Trees from which people harvest fruit, edible nuts, resins and other types of non-timber forest products are often exotic to many areas of the tropics. These culturally and economically valuable species can also be planted among mixtures of native species.

- In areas in which the management goal is industrial production of timber and pulp, the use of fast-growing, short rotation exotic species is likely to remain common. However, there are some cases in which exotic species could be replaced with pioneer species native to a given region.

Before choosing an exotic species, one needs to investigate the potential impacts of its introduction. For example, *Acacia mangium* planted outside of its natural range has demonstrated the ability to be highly invasive and may cause long-term ecological problems.

Mixed species secondary forest (left)
and monoculture Eucalyptus plantation (right) in Colombia.

Prioritization of restoration within agricultural land

Within a mosaic of agricultural landscapes, techniques for forest restoration (ANR, enrichment planting, reforestation and silviculture) can be conducted in and around land actively managed to produce food. Priority areas for restoration include riparian corridors, steep slopes and areas of low production where restoration can improve water quality, reduce erosion and surface runoff and increase production. Crop and grazing systems are maintained on the more fertile areas of the landscape.

Additionally, **improved fallows** and intensified **agroforestry and silvopastoral systems** are strategies that integrate restoration with sustainable agriculture or livestock.

Improved fallows

Natural fallows are land that is left for grazing or to naturally regenerate following traditional shifting, slash and burn cultivation practices that deplete soil fertility over time. Natural fallows are traditionally left for longer periods of time (10 years) to allow soil fertility to build. However, decreased availability of land for cultivation has also decreased the natural fallow times (2-3 years), decreasing soil fertility available for agricultural production.

The term **"improved fallows"** refers to areas undergoing management to establish trees and to improve fallow productivity. This method replenishes and shortens the time needed to build soil fertility for subsequent agricultural cultivation. Actions can include:

- Protecting the area from fire and other disturbances;
- Planting specific species, such as nitrogen-fixing leguminous trees; and
- Extending the fallow period to facilitate longer processes of regeneration and the recovery of ecosystem services.

Agroforestry and Silvopastoral Systems:

"Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately integrated with agricultural crops and/or animals in the same land management unit, in some form of spatial arrangement or temporal sequence." (Lundgren and Raintree 1982)

Agroforestry involves the careful selection of multi-purpose plants or trees that complementarity grow together with crops or animals. Agroforestry systems can take on multiple forms.

Linear systems: Lines of trees or shrubs as living fences, windbreaks and alley cropping strips have been widely promoted to integrate easily into existing conventional agricultural systems.

Home gardens: Traditional agroforestry homegardens are grown in most regions of the tropics and subtropics, especially in lowland humid tropics. They are characterized by high species diversity (including both indigenous and exotic species), with multiple layers of tree crops (3-5 vertical strata) that have multiple uses (food, medicine, fiber, etc.).

Shade crops: One of the oldest systems of agroforestry is the successional clearing of forest undergrowth to select for shade trees that agricultural subsistence or cash crops can be grown beneath. In addition to planting in the understory of forests, this system can be established on deforested land by growing shade trees among crops.

Shade-grown Coffee and Cacao

Coffee and cacao are important cash crops that are commonly grown under forests or planted shade trees. Studies have shown that coffee plantations with a diversity of shade strata offer a greater variety of food and market products (such as flowers, fruits, nectaries for pollinators, etc.), and the diverse structure provides habitat that supports a diverse range of fauna that can control weeds (Perfecto et al. 1996), and/or suppress pests (Huxley 1999).

Taungya systems: In taungya systems, the land is cleared and planted initially with food crops. Then, seedlings of valuable hardwood timber species are planted on the same plot with the staple crops such as maize, beans, etc. This can either occur in combination with the food crops or following several years of cultivation.

Successional agroforestry systems: Similar to taungya systems, successional agroforestry systems are designed to mimic the stages of forest succession, but using annual crops or short-lived tree crops instead of early successional pioneer trees. In this case, the species grow and become ready for harvest at different stages (annual crops, short-lived tree crops, longer lived forest species), while also facilitating the dispersal of additional late successional species.

Silvopastoral systems: The integration of trees and grazing of domesticated animals is one of many agroforestry practices. Silvopastoral systems may range from introducing grazing animals into established forests, to planting trees in established pasturelands. Two specific techniques include:

- **Cut and carry systems** where fodder banks are established with dense plantings of forage materials. During times of year when pasture grass is low, dry or otherwise of poor quality, these fodder banks can be "cut and carried" to the cattle and provide all the nutrients required to supplement the livestock.
- **Intensive silvopastoral systems** where forage trees and shrubs are planted in high densities among improved pasture grasses. This strategy reduces erosion, improves microclimatic conditions for cattle and can provide a more constant source of protein and nutrients. Cattle are rotated through different sections of the system in order to allow the forage plants the opportunity to resprout.

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6.2 Activity: developing landscape-level FLR interventions

Considering your primary FLR objective, please discuss the following in groups:

Part 1:

Consider the entire assessment area in the in the previous exercise (target landscape) as your FLR intervention area. What different zones you can distinguish in the landscape? Divide your assessment area into zones and write them on the flip chart with space under each. Consider the FLR objectives for your group.

Notes:

Part 2:

What FLR interventions could you implement to achieve your objectives and why? Which interventions should be done in which zones? Please also consider the chronological order of treatments and spatial arrangement within or across zones. Write down your selected intervention activities on post-it notes and place it under the appropriate zone on the flip chart.

Please be as specific as possible- Will you be planting trees or using ANR? What kinds of species (characteristics e.g. nutrient rich leaf litter, deep or surface roots?) Will you conduct maintenance activities? If using agroforestry, what type of agroforestry systems might you use?

Notes:

Part 3:

Please discuss the following:

- How might your restoration interventions interact with each other and with the landscape?
- What are possible options for facilitating or ensuring local acceptance of the intervention?
- Are there knowledge or infrastructure gaps that would need to be addressed? (nurseries, seeds, access to sites or equipment, training on techniques, other)
- Which interventions will be least/most expensive?
- What are possible options for financing these interventions?

Based on the constraints and considerations discussed above, are there any changes you would make to your selected restoration interventions?

Notes:

Part 4:

Based on your discussion in Part 3, would you change any of the priority areas identified in the mapping exercise previously? If so, please update your map accordingly.

Notes:

7 Cost-benefit analysis for landscape restoration decision-making

7.1 Costs and benefits of FLR

Implementing forest landscape restoration interventions requires land, labor, input materials and time, with both direct costs from the physical process of restoring degraded land and indirect costs from foregone production (opportunity costs) and transaction costs (i.e. negotiating and planning). Restoration interventions impact the functionality of landscapes and the production of ecosystem services and commodities over time. These changes need to be quantified to understand the value of various interventions.

To facilitate the analysis of costs and benefits from restoration interventions, it is necessary to have accurate, localized data on the costs of production inputs (e.g., labor, seeds, fertilizer, land) and the benefits from production of related outputs (e.g., crop yields, timber yields, fuel wood, charcoal, carbon). This is usually gathered through a combination of field surveys and value-chain and market analysis.

Landscapes can provide multiple services and benefits. For example, a landscape can provide water purification, flood control, habitat for biodiversity, food, beauty for tourism and other services. The decision of smallholders and resource managers to adopt FLR interventions is driven by their perception of the benefits that each FLR intervention is likely to produce. Some benefits of restoration can be sold directly, such as timber and food crops, whereas others are derived from services provided by the restored ecosystems such as water, carbon, biodiversity and soil nutrients (ecosystem services). Usually, costs and the benefits accrue differently to different stakeholders and can be differentiated at local, district, provincial, national or global levels. They can also be split according to gender or property rights.

As part of a cost-benefit analysis (CBA), monetary value is typically assigned to all relevant inputs and outputs, which are then combined with modeling by InVEST[10] and ROOT[11] to arrive at estimates for the annual costs and benefits of different landscape restoration transitions. Economic valuation places monetary value on changes in ecosystem goods and services, aiming to put ecological and biodiversity values 'on equal footing' with other economic benefits and costs. However, some values such as some intrinsic, cultural, spiritual or religious values cannot be measured but need to be recognized and have their values accounted for by other mechanisms.

Discounting makes events that occur at different points in time comparable by assigning different weights to future versus present events. There is a lot of debate over the 'correct' discount rate to use. For example,

10 Natural Capital Project, Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST). Spatial mapping and modeling of multiple ecosystem services.

11 International Union for Conservation of Nature (IUCN) and The Natural Capital Project, the Restoration Opportunities Optimization Tool (ROOT). ROOT is a software tool that optimizes trade-offs among different ecosystem services to help decision-makers visualize where investments in restoration could be made that would optimize benefits for multiple landscape goals.

when considering the welfare of future generations, lower discount rates are recommended. Most climate change analyses use discount rates between 0 – 3%. Oversight agencies often specify which discount rates to use. In ROAM and FLR planning, the stakeholders can decide the discount rate they want to utilize.

Net Present Value (NPV) is used to measure the profitability of a project. NPV analysis is done using stakeholder-identified discount rates to facilitate comparison of restoration events over different time horizons. The NPV of each restoration transition is calculated by subtracting the NPV of degraded land uses from the NPV of the restoration activity. Resulting NPVs for each restoration transition can then be compared and assessed.

To facilitate engagement with investors and private sector actors, NPV is calculated using the following costs:

Implementation costs represent investments in land, labor and materials (e.g. hours of labor, kg of sees or seedlings, ha of land).

Transaction costs are the costs to identify viable land and negotiate terms for restoration (e.g. hours or days of extension services).

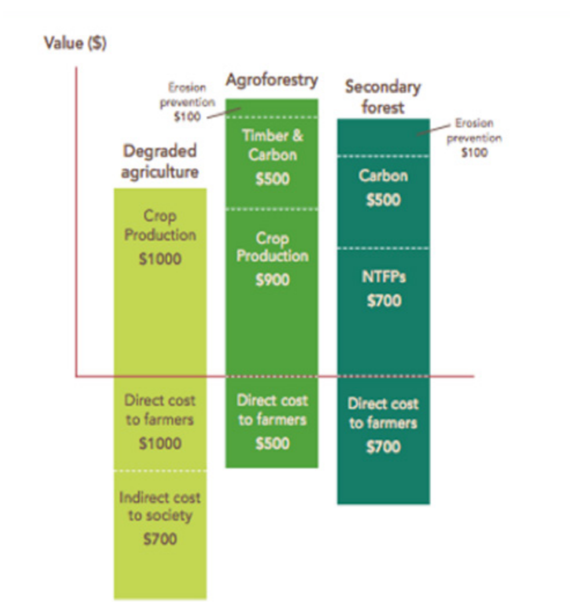
Opportunity costs are the goods and services from alternate land uses that were given up to make restoration possible.

It is important to ensure that the CBA takes into account all potential socio-economic and environmental costs and benefits of forest landscape restoration activities.

Return-On-Investment (ROI) is the analysis of different FLR investment packages tailored to the targeted landscape. This analysis, informed by market and value-chain analysis, reveals and compares the types of activities that would be expected to generate positive financial returns to investors, assuming a standard set of benefits. ROI measures gain/loss generated from restoration and is expressed as a percentage.

Every analysis will have uncertainty about the magnitude of impacts. Because the costs and benefits of restoration interventions depend on

Computing the marginal value of restoration interventions



Land Use	Benefits – Costs	Next Benefit	Marginal Benefit
Degraded Agriculture	$1,000-$1,200	$-200	-
Agroforestry	$1,500-$500	$1,000	$1,200
Secondary forest	$1,400-$700	$700	$900

Figure from IUCN & WRI, 2014.

inherently variable economic and ecological parameters, such as market prices, interest rates, precipitation and biological growth dynamics, a sensitivity analysis is performed on the results of the cost-benefit analysis using "Monte Carlo" simulations[12]. Sensitivity analyses help determine how subject the results are to change due uncertain variables. Normally the option with the largest NPV should be recommended. Other factors will also enter the discussion and influence the ultimate decision about how to proceed. This technique allows confidence intervals to be constructed around the estimated NPV of restoration transitions as well as identify situations under which a restoration transition is unlikely to create benefits.

CBA is a tool that provides analysis that can influence the discussion on what to do and where. The results provided can help land-use professionals use the limited funds for landscape restoration as efficiently as possible.

This chapter is based on the Restoration economic modeling and valuation, ROAM (IUCN & WRI, 2014) and Verdone, M. (2015). A Cost-Benefit Framework for Analyzing Forest Landscape Restoration Decisions. Gland, Switzerland: IUCN.

7.2 Activity: cost-benefit analysis

Following a spatial prioritization of forest landscape restoration opportunities completed by the Ministry of Environment, the Ministry of Planning and Finance has been directed to undertake a cost-benefit analysis of different restoration interventions. This analysis should balance the procurement of ecosystem services with increases in human livelihoods and the interventions should respond to the concerns addressed by the selection of priority areas.

To be filled in from Training Day 1 results

1 ....

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2 ....

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12 Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models.
Read more: Monte Carlo Simulation | Investopedia https://www.investopedia.com/terms/m/montecarlosimulation.asp#ixzz5AIjkbksr

As economists, you are tasked with completing an analysis of the biophysical, social and economic costs of restoration from the following restoration transitions (see table below) for the FLR priority areas identified by the Ministry of Environment and have been provided with the following costs and benefits for each transition.

Intervention Type	Social Costs $	Biophysical Costs $	Economic opportunity costs $	Social Benefits $	Biophysical Benefits $	Economic Benefits $
Planted forests and woodlot	-50	-20	-10	50	50	100
Natural Regeneration	-20	-10	-50	10	100	20
Silviculture	-50	-20	-50	50	50	100
Agroforestry	-20	-50	0	100	20	100
Improved fallow	-10	-20	-50	50	50	50
Watershed Protection and erosion control	-20	-10	-10	10	50	50

For each of the 10 areas identified earlier, decide what intervention among the options above would be best and calculate the cumulative costs and benefits of all the different interventions. For each priority square, only one intervention may be selected, and the intervention must align with current land use, such that the identification of the intervention type does not transform the underlying land use (i.e. agroforestry can only be chosen on land use types where agroforestry would be appropriate).

Calculate how much restoration will cost and what the benefits will be of your plan. The minister, will present the intervention plan to a room of interested, but skeptical, donors who are ready and willing to fund forest landscape restoration.

Notes:

Figure (right) from IUCN & WRI 2014, pp.30. This figure outlines one framework for approaching forest landscape restoration decision-making around the types of interventions that a practitioner might consider in assessing restoration opportunities. It includes six broad categories of FLR options (i.e. interventions) and descriptive text to provide guidance on terminology.

The FLR options framework

Land Use	Land sub-type	General category of FLR option	Description
Forest land Land where forest is, or is planned to become the dominant land use → **Suitable for wide-scale restoration**	If the land is without trees, there are two options:	1. Planted forests and woodlots 	Planting of trees on formerly forested land. Native species or exotics and for various purposes, fuelwood, timber, building, poles, fruit production, etc.
		2. Natural regeneration 	Natural regeneration of formerly forested land. Often the site is highly degraded and no longer able to fulfil its past function – e.g. agriculture. If the site is heavily degraded and no longer has seed sources, some planting will probably be required.
	If the land is degraded forests:	3. Silviculture 	Enhancement of existing forests and woodlands of diminished quality and stocking, e.g., by reducing fire and grazing and by liberation thinning, enrichment planting, etc.
Agricultural land Land which is being managed to produce food → **Suitable for mosaic restoration**	If the land is under permanent management:	4. Agroforestry 	Establishment and management of trees on active agricultural land (under shifting agriculture), either through planting or regeneration, to improve crop productivity, provide dry season fodder, increase soil fertility, enhance water retention, etc.
	If it is under intermittent management:	5. Improved fallow 	Establishment and management of trees on fallow agricultural land to improve productivity, e.g. through fire control, extending the fallow period, etc., with the knowledge and intention that eventually this land will revert back to active agriculture.
Protective land and buffers Land that is vulnerable to, or critical in safeguarding against, catastrophic events → **Suitable for mangrove restoration, watershed protection and erosion control**	If degraded mangrove:	6. Mangrove restoration 	Establishment or enhancement of mangroves along coastal areas and in estuaries.
	If other protective land or buffer:	7. Watershed protection and erosion control 	Establishment and enhancement of forests on very steep sloping land, along water courses, in areas that naturally flood and around critical water bodies.

8 Data and information for ROAM

The data collection and analysis portion of ROAM is predicated on the interaction among the best local knowledge and the best science. This is what sets it apart from many other methodologies. Collecting the best knowledge and utilizing the best science is the hallmark of ROAM and generates information that will be relevant and useful for stakeholders.

Data itself are simply facts, figures and numbers that are qualities of an object or process. It is only through analysis and interpretation that these facts can be converted into information upon which decisions can be made.

It is often the case that gathering the best knowledge and the best science occur simultaneously, but for clarity, they will be treated separately here. It should be noted that during the ROAM process often the two approaches will influence each other. This is especially important at stakeholder workshops which should be designed such that they capture knowledge and information that will be useful in geospatial, social and economic analysis.

The table on the following page outlines a process for the digital mapping approach to spatial analysis in ROAM. It has six steps:

1. Identify the restoration opportunities to be explored (e.g. food security, biodiversity)
2. Identify data layers to help quantify where these restoration opportunities exist
3. Collect GIS datasets
4. Reclassify GIS datasets into priority categories for restoration
5. Combine all datasets
6. Apply algorithms for identifying specific restoration opportunities by intervention type

It should be noted that the nature of the assessment process is always context-specific. Data availability is variable, local and regional spatial data analysis and modelling capacities differ and the goals and methods of FLR are as different as the nations or regions that have committed to FLR. As a result, there is no single strategy for using spatial data in FLR assessments that will generate all the results and interpretations that are required by the ROAM process.

While there is a focus on geospatial data, it is also important to consider economic data on costs and benefits related to restoration interventions and activities and information on laws and policies. These data will also be gathered in ROAM processes and are necessary for CBA's and for analyzing the enabling environment of FLR.

8.1 Multi-criteria analysis for ROAM

The purpose of a multi-criteria analysis is to use objective and empirical geospatial data to define features of a landscape that would be of interest to restoration practitioners at varied geographic and administrative scales. The process uses a series of spatial indicators related to landscape restoration and arranges them on a map to identify where they overlap.

For instance, if an assessment process is interested in defining degraded land that would be appropriate for restoration, stakeholders must first work to define degradation. As a composite term, degradation can contain any number of measurable indicators that, when aggregated, could satisfy a stakeholder-defined definition of degradation. These may include areas of elevated erosion or declining soil fertility, for example. The indicators may also include areas that are more susceptible to degradation, such as areas of high slope. Additionally, they may include sociological or economic indicators such as poverty, food insecurity, or population pressure.

Within a multi-criteria analysis, each of these indicators is individually assessed for how it may contribute to landscape restoration potential. This includes setting the parameters for how the data contribute to the analysis. For instance, priority areas within landscapes suffering from erosion may be parameterized in the analysis to only include where soil erosion is categorically high. Therefore, as a proxy for landscape restoration potential (degradation in this case), areas with higher erosion would be parameterized and included in the multi-criteria analysis as a layer. In other words, the data analysis would analyze the spatial data on erosion level and determine either through the structure of the spatial data or through published sources, the level of erosion that would present an opportunity for remediation through successful landscape restoration interventions.

As each of the many indicators used in an FLR assessment have their parameters defined by expert analysis and by peer-reviewed scientific literature, they become criteria for the multi-criteria analysis. Each criterion taken individually contains information that would be useful in identifying opportunity areas for landscape restoration, but by combining this information, a deeper analysis of priority areas for landscape restoration interventions can be understood by demonstrating where and how often these criteria overlap.

Following a multi-criteria analysis, these overlapping criteria can be analyzed in a number of different ways. Analysis can show which districts contain the greatest number of overlapping criteria – indicating that restoration has the potential for many benefits. Criteria can also be analyzed by land-use or land-cover type to show which types of land uses hold the most opportunity for addressing the restoration criteria used, but also how many criteria may be addressed for restoration in each land use type. It also allows for the planning and design of restoration interventions that are locally targeted to specific land uses with a reasonable expectation of the magnitude of criteria that may be addressed by restoration in a specific area.

Finally, the multi-criteria analysis method can be used to explore restoration options and land-use transitions with specific criteria in mind. In the analysis, the areas of criteria overlap have been identified, but not which criteria overlap with each other. The final step in the spatial analysis portion of this process is to identify the specific criteria that overlap in an area, align this with the underlying land use and/or ecology and then refine categorical restoration interventions (e.g. agroforestry, silviculture, etc.) to more specific interventions that can respond directly to the criteria within the current land use and economic context and with the explicit consideration of local ecology and habitats.

Output of a multi-criteria analysis of degradation in Malawi

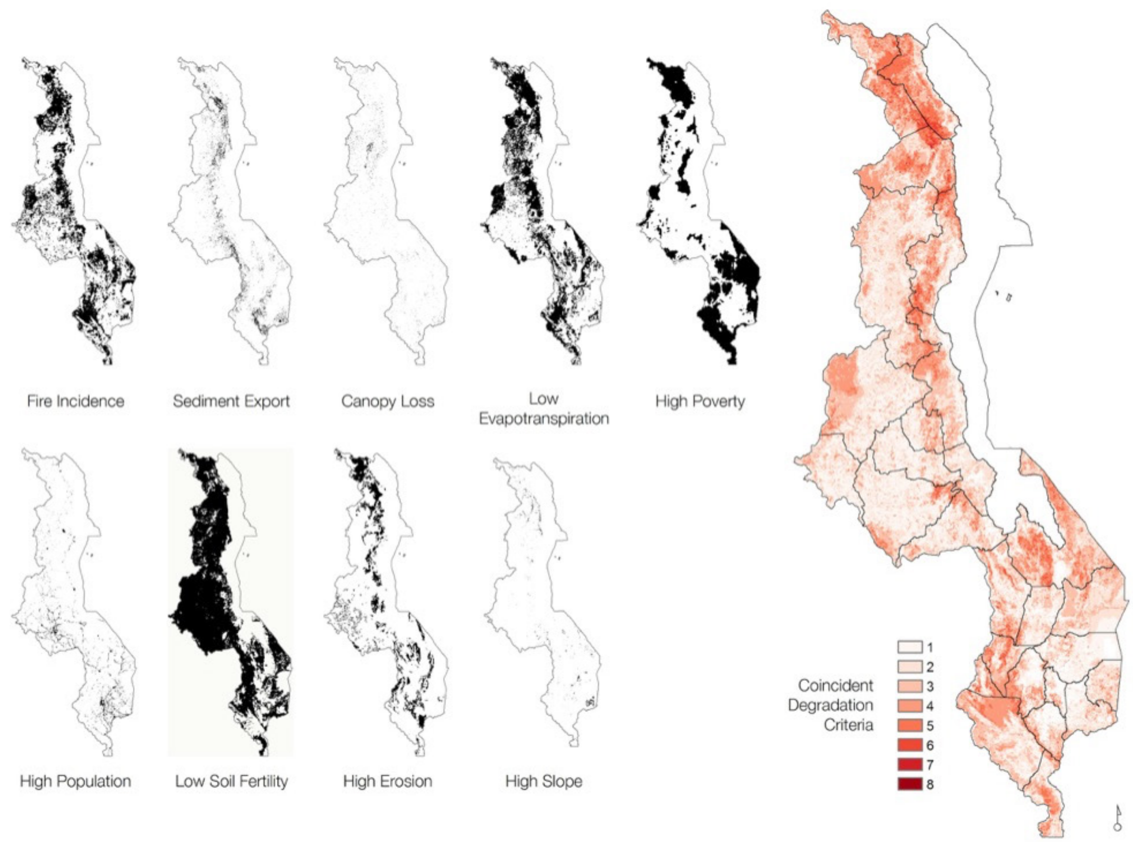

Figure from Ministry of Natural Resources, Energy and Mining - Malawi (2017).
Forest Landscape Restoration Opportunities Assessment for Malawi. NFLRA (Malawi), IUCN, WRI. xv + 126pp.

This figure demonstrates the input data and output of a multi-criteria analysis of degradation for Malawi. These criteria represent proxies for some components of landscape degradation and have undergone refinement by experts and stakeholders within the Malawi restoration opportunities assessment process to determine the range of attributes that are of interest. In the analysis each input map (black) carries the same weight in the output map of degradation (red). In the degradation map, the intensity of red indicates the frequency of overlap among all input criteria, such that darker areas have more overlapping input criteria.

8.2 Activity: finding and evaluating data

Considering your group's FLR objective:

Part 1: Please discuss and respond to the following questions on post-it notes or paper.
What specific information do you need to understand and evaluate your FLR objectives? (Maps? Policies? Reports?)

- Where could you acquire this information? (Ministries, online, etc.)
- At what scale is this information useful? (is national-scale census data appropriate?)

As you list the information needed, think back to the different factors and variables (i.e. degradation drivers, disturbances, stakeholders, social factors, GIS data and FLR interventions, cost-benefit information, etc.) discussed in regards to your FLR objective over the past few days.

Notes:

Part 2: Please discuss the following:

- In the opinion of your group, is there enough information to make decisions to address your objectives? What are some data gaps or assumptions you have made? (Information needed that cannot be found in existing documents or datasets)
- Considering that most FLR and ROAM efforts have limited time and budget, is certain data more relevant or important than other data? Make a prioritized list of data you may need to assess FLR opportunities that will help you achieve your FLR objective

Notes:

Please share with the group: what relevant resources did you find in your literature search during the online primer?

9 Scaling up forest landscape restoration

9.1 Overview

One challenge in moving forward is that many forest restoration projects conducted to date have been through pilot projects or research plots that have been only a few hectares in size. These small-scale initiatives can provide landowner economic benefits and provide some ecological services. However, they are limited in their ability to achieve the landscape-scale ecological benefits of restoration, like climate change mitigation and biodiversity conservation, that motivate the regional or international targets. As such, there is a need to scale-up restoration activities.

On the other hand, some practitioners are concerned that scaling up will diminish the quality of restoration efforts by making it impractical to adapt restoration strategies to the social and ecological conditions of each site. For example, they worry that approaches to scaling up that use monocultures of fast-growing exotic species or that ignore local community rights could have deleterious impacts.

What Is Scaling Up?

"...expanding, adapting and sustaining successful policies, programs or projects in different places and over time to reach a greater number of people." (Hartmann and Linn 2008, pg. 8) is a common definition of "scaling up" in the context of natural resource management.

Mosaic forest and agricultural landscape in Kenya © Karin Bucht

The concept of "scaling up" can be divided into two different strategies:

Horizontal Scaling Up: Referred to as replication, growth or expansion in activities, interventions and experiences encompassing 1) geographical spread and scope (total land area) and 2) number of people and communities involved, usually of the same stakeholder type. This concept can also be called "Scaling Out" or "Quantitative Scaling Up."

Vertical Scaling Up: Vertical scaling up is "institutional in nature and involves expansion to other sectors/stakeholder groups, from grass roots organizations to policymakers, donors, development institutions and international investors" (Middleton et al. 2005). Vertical scaling up can be further divided into three subcategories:

- **Functional Scaling Up**- expansion in the types of activities being conducted.
- **Political Scaling Up**- moving beyond service delivery towards larger structural and institutional changes.
- **Organizational Scaling Up**- improvements in the efficiency and effectiveness of organizations to allow for growth and sustainability of interventions.

9.2 Approaches to scaling up

It is important to realize that one-size-fits-all landscape restoration strategies to scaling up can be dangerous because they may ignore important local factors or context that will affect the relevance and success of a particular strategy. It is for this reason that using scalable methodologies and approaches such as the ROAM are critical for scaling FLR out and up, as it is adaptable to local context and is stakeholder driven.

"Finding the right approaches, paths and drivers for scaling up is necessary, but not sufficient. Interventions need room to grow, if they are to be scaled up. More often than not this space needs to be created. This may require replacing existing institutions, activities, policies and expenditures which could constrain the scaling up of the new initiative. Creating space for new initiatives to grow can cause resistance and friction that has to be foreseen and managed."

(Hartmann and Linn 2008)

With respect to FLR, factors that can create pathways for scaling up can be summarized in the four different groups:

- **Political and Cultural Factors**- the right stakeholders reached, cultural factors addressed, political support obtained
- **Capacity and Partnership Factors** - networks, learning needs met, sharing of information
- **Policy or Legal Factors** - incentives and regulations align with goals
- **Fiscal or Financial Factors**- raising funds, reducing costs, enabling markets

Case Study: Rwanda

Who: FONERWA (Rwanda: National Climate and Environment Fund) is a national basket fund in Rwanda, which began in 2012 to facilitate access for international environmental finance for local stakeholders (ministries, districts, charities, enterprise, civil society & research institutions).

What: FONERWA coordinates funds from a number of sources, including domestic capital (environmental fines and fees, environmental impact assessment fees, proceeds from Forestry & Water Funds and other environmental revenue), as well as external capital (bilateral and multilateral development partners' contributions and access to international environment and climate funds).Stakeholders can then apply for FONERWA funds to implement projects related to FONERWA's core themes, which include projects related to FLR. Funds are administered as in-kind contributions, grants, loans, investments, or other financial instruments, depending on the scale of the project.

This example required creating space within two of the factors that affect FLR up-scaling implementation:

Capacity & Partnership Space: "Initially, applicants were interested in developing and submitting many micro projects that demonstrate limited impact. FONERWA orientation workshops have encouraged applicants to develop more programmatic and integrated projects with the potential for greater impact towards Rwanda's climate-resilient development needs. This has resulted in projects that are integrated in scope."

Fiscal or Financial Space: FONERWA's activities operate largely using financial space to allow for scale of FLR in Rwanda. This has been done by:

- Coordination and administration of funds available for FLR and other related activities.

- Allowing stakeholders (line ministries, Government agencies, Districts, Civil Society Organizations and the private sector) to access these funds through a multi-step application process to implement projects.

Conclusions

This section is just an introduction to some key concepts on what it means to "scale up" and major pathways for achieving scale. As with selecting restoration strategies, the appropriate approach to scaling up will be different in different parts of the world depending on local circumstances. It is important to reflect on the questions below to consider scaling up in the context where you work.

- How do you define scale for your local context, and what does it mean for scale to be achieved?
- How would you determine whether or when to scale up in your restoration circumstance?
- What are the "spaces" in which FLR could be enabled to grow or scale up? How would you influence those spaces to allow for scaling up?

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10 Financial Analysis: financing forest landscape restoration

Finance analysis focuses on answering "how are we going to pay for restoration and who are the groups who will invest in forest landscape restoration"?

There a wide variety of potential investors, for example, the primary investors could be farmers (land, labor, input materials, time) and government (public financing). Other investors could be the private sector (local/ national businesses, value chains, corporate social responsibility, private foundations), development agencies (development and climate funding, technical assistance, grants), development finance institutions, civil society organizations (NGOs, public foundations), and private financiers (crowdfunding, impact investors, private equity impact funds, commercial banks, pension funds). Different investors expect different socio-economic and environmental returns. For example, private sector may look at economic returns related to commodities or marketable forest products, but also will consider the sustainable productivity increase (higher revenues), higher land value (restored and productive land), access to local markets, access to new markets for forest and tree products and most recently renewable energy products. ROAM outputs can be tailored to meet the needs of each investor. This allows the stakeholders to access a variety of financing mechanisms for FLR. Some of the financing options are briefly reviewed below.

10.1 National budgets and subsides

Funding for landscape restoration can be mobilized from a diverse selection of domestic and international arrangements. Some examples of international funding are the Forest Carbon Partnership Facility (FCPF) and the Global Environment Facility (GEF). Some of these funds can be accessed by linking ROAM analysis with support to implement Nationally Determined Contributions (NDCs), Sustainable Development Goals (SDGs), Aichi targets and other international commitments. Domestic funding, similarly, can be mobilized by linking assessment results with inclusive funding mechanisms across sectors and through improved national and sub-national understanding of the relation of FLR to national priorities.

Restoration interventions and associated economic and finance analysis can be tailored and packaged for national economic development to meet multiple national targets and access different budgets. Such analysis is important because benefits from the restoration interventions may vary. For example, in Malawi, restoration interventions targeting *agricultural land* produce more private benefits than public, while *forest restoration* interventions that focus on sediment retention and flood control generate significant public benefits[13]. As such, financial analysis will help both public and private funding allocations for implementation.

On the other hand, business models stimulate private sector investments in activities that add value to the products derived from restoration interventions. Small or medium forest and agriculture enterprises are more common in rural areas, and key beneficiaries of such products. In addition, interventions developed for the private sector can help address deforestation impacts on supply chains and target the most appropriate measures for social, economic and environmental sustainability. This can produce benefits for rural economies.

Some restoration activities require smallholders to invest financial and human resources up front. Because the benefits are foreseen in long run, smallholders may find such investments risky and not a priority. Smallholders may also lack skills or financial capital for implementation. Therefore, the finance analysis should target rural and community-level development plans and public work programs to promote smallholders' adoption through investment in extension workers, trainings and other capacity building activities.

It is important to note that the budgetary constraints and lack of cross-sectoral policies limit the financing the environmental project and therefore some sources of financing may be hard to access. The potential mechanisms through grants and fiscal instruments are key to finance environmental projects.

Field visit in Côte d'Ivore © Karin Bucht

13 Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models.
Read more: Monte Carlo Simulation | Investopedia https://www.investopedia.com/terms/m/montecarlosimulation.asp#ixzz5AIjkbksr

10.2 Inclusive finance for restoration

A wide variety of innovative financing instruments have been proven to work across different countries. Some examples are listed below:

1. **Community-owned Restoration Facility** (CRF) is a tool developed by IUCN Uganda that combines community-owned land-use plans with a community-owned solidarity fund. The community develops its own restoration land-use plan with performance-based bylaws, then receives training to set up, own and operate a revolving fund. The revolving fund provides a livelihood option that shifts pressures on natural resources whilst providing livelihood options for the community. It guides the community's natural resource use through agreed rules and practices. The revolving fund is capitalized by a grant. Loans are disbursed to households for own needs with a condition that they implement the restoration land-use plan. The tool is modeled on the successful Care International's Village Savings and Loans Associations[14] principles with some changes. It is implemented in micro-catchments but is scalable at landscape level. It catalyzes and promotes the collective action for forest landscape restoration and integrates household 'restoration businesses' based on sustainable value chains[15]. The governance and technical support is provided at sub-national level but may extend to catchment level(s) across landscapes. At catchment level, the structure brings together several districts/villages to jointly manage a catchment or targeted landscape. The CRF can be manages by four structures: general assembly (all beneficiaries of the fund), executive committee, loans/audit committee and environmental committee.

2. **Climate-Smart Lending Platform:** Climate change impacts both smallholders and agri-lenders, as climate change may reduce yields of crops and income. Smallholders are vulnerable to climate change and lack access to finance and information to become more resilient. Therefore, it further reduces farmers' ability to access and bear the debt. This increases the credit default risk and the risk of agri-lenders loan portfolios. The Climate-Smart Lending Platform (CSLP) uses climate risk mitigation tools for smallholder lending. It incorporates climate risk by increasing the climate resilience of smallholder farmers and improves their bankability. Under CLPS, farmers sign loans and land management agreements with the condition that they adopt climate-smart farming practices. Monitoring systems are used to track implementation of climate-smart agriculture and land management practices. Once farmers comply with the loan agreement and meets its criteria, they are provided with a score that enhances their credit score. Accordingly, farmers' bankability and the resilience to climate change risks are improved while agri-loan portfolios are no longer at risk.

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14 Village Savings and Loans Associations is CARE's successful micro-finance model under which savings groups are formed at community level to reduce poverty by financially and socially empowering poor and vulnerable people. http://www.care.org/vsla

15 Farmer businesses, for example via climate smart agriculture – maize, beans, food crops or via on farm/communal forestry – Shea nuts, poles, timber, sustainable fuelwood. It is linked to markets and supported by government incentives.
See F3 Life - F3 Life enables the provision of climate-smart credit by financial institutions and companies to their farming clients.

10.3 Public-private partnerships (PPP)

ROAM informs stakeholders on where investments in FLR could make sense socially, economically and ecologically. This information is built on existing financing models (e.g. carbon financing, reorganizing public funding, micro-credit scheme for communities, payment for environmental services, grants, private equity impact funds, landing). Some financial analysis can be obtained during preliminary analysis of national and sub-national policies, assessing the extent to which key success factors are in place to facilitate restoration at scale. This analysis, for example, can reveal the types of policies and policy changes that can create incentives for private landowners to restore degraded land. Analysis can also reveal the extent to which public-sector investments in FLR may be warranted, particularly where public benefits are not captured by private-sector actors are high. Results of this analytical component can feed into more detailed consideration of these issues with private and public sector, once all assessment results have been compiled.

600

hectares

PPP example: Payment for ecosystem services (PES)

In Uganda, a downstream Coca-Cola plant experienced water shorta[...]o wetland encroachment in upstream areas. The plant tried to dam the [...]i to increase water supply, but failed. The project resorted to creating a PE[...]e scheme to motivate communities upstream to restore 600 hectares of degraded wetland. The project resulted in success, leading to year-round water availability downstream.

11 Monitoring Landscape Restoration

11.1 What is monitoring and why is it important?

A monitoring protocol is a system that provides information about whether a restoration project is progressing successfully. In practice, a monitoring system usually involves creating measurable environmental and social metrics for judging restoration success (i.e. tree survival rate or number of community members involved). Robust monitoring systems are often lacking from restoration projects. However, having robust monitoring systems in place is vital to ensure initial and continued success of restoration projects for four important reasons:

1. Without a monitoring system, it is difficult to provide evidence with any high degree of certainty about whether your restoration project is effectively and efficiently meeting its ecological and social goals.
2. Monitoring provides information that can be used to change restoration prescriptions to make them more effective and efficient. Due to inherent differences in environmental or social conditions, a successful restoration protocol at one site may not be effective at another. Monitoring allows forest managers, scientists and practitioners to learn about the effects of different restoration approaches and modify them, if necessary, before they are repeated or applied on a broader scale.
3. Robust monitoring systems are increasingly a requirement of both national and international donors. This is especially the case when forest restoration projects are being implemented for the benefit of generating carbon credits, but can be true when other goals are being pursued as well.
4. Finally, restoration is still a relatively new science, therefore, monitoring also provides an opportunity for other scientists and practitioners to continue to learn from the project.

11.2 Stages of monitoring

The monitoring process involves multiple stages, each of which is an essential component of the process and should not be overlooked. When followed, a monitoring plan should involve continuous interaction between these stages and be cyclical in nature. These stages are: 1) determining objectives and information needs, 2) developing a monitoring plan, 3) data collection and analysis, 4) evaluating and reporting results.

This figure shows the cyclical nature of the stages of monitoring and how each stage informs the others, providing constant feedback about the effectiveness of the monitoring system

Objectives must include:

- At least one indicator or variable that can be measured (for example, number of trees planted or number of people employed by the project).
- A target for comparison (for example, number of trees expected per hectare or number of jobs expected for local community members).
- A timeline indicating when the objective should be achieved.

Stage 1: Determining Objectives & Information Needs

The first step to developing a monitoring plan is to examine the project goals, ideally defined through a collaborative process by the various stakeholders. To reach project goals, clearly defined objectives must be identified.

An **objective** is a definite target that the project seeks to reach (e.g. increasing soil productivity in the restoration site). Objectives are often not directly measurable, however, because they might consist of various elements. Soil productivity, for example, is comprised of various factors including soil texture, pH and the amount of organic matter and various soil nutrients.

As such, it is necessary to choose some of those elements that can be directly measured as indicators to show that the objectives are (or are not) being met. For each indicator, an approach to measure it should be designed. For example, to measure soil productivity the measurements may include collecting a series of soil samples and analyzing them in a laboratory.

The monitoring program will actively measure changes in the indicators over time. In order to explain the significance of those changes, however, it is often useful to create a comparison with a set of baseline data. That data can come from any of the following three sources:

- Data about the biophysical conditions of the site and the socio-economic conditions of the neighboring communities collected at the site before restoration. This serves as baseline data, which allows for an evaluation of how things change from the beginning of the project.
- Data gathered from nearby sites that still have intact ecosystems, such as primary forest. This ecosystem can serve as a target at which to aim. However, reference ecosystems can only serve as a guide because the area being restored will have different conditions from the reference ecosystem.
- Data from a control area where project activities have not taken place and which remains unaffected by the project activities. The control allows you to show what would have happened over time if your restoration project had not been implemented.

When determining objectives and information needs it is important to consider that information about the site may have been previously collected. Useful information, such as inventories, surveys, census data or field measurements, often exist online, in government records, in books, articles or reports. Utilizing this information can significantly reduce the costs of generating further data for monitoring.

Once the gaps in information have been determined, a monitoring plan can be designed. This plan will direct how to gather the information needed to assess the project objectives and evaluate if they are being met.

Stage 2: Developing a Monitoring Plan

Step 1 of developing a monitoring plan is to specify what indicators will be measured to obtain wanted information. An indicator uses verifiable measurement data to communicate information about a larger issue or question. Good indicators quantify information so that its significance is more readily apparent and meet the criteria of being measurable, precise, consistent and sensitive (i.e. able to detect small changes).

Step 2 of developing a monitoring plan is developing the monitoring methodology. Methods vary in their accuracy and reliability, cost-effectiveness, feasibility and appropriateness. The key is to select the most cost-effective method that will provide data reliable enough to meet information needs. If possible, variables selected should require as little technical skill or knowledge as possible and be consistently repeatable by multiple people.

It is crucial to note the importance of standardizing methodology throughout a monitoring system. Restoration projects are long term endeavors and methods for determining the success of a restoration project through monitoring must remain constant to provide comparable data. If monitoring methodology changes, data collected after the change may become incomparable to data collected previous to the change, potentially leading to a failure to demonstrate the project’s success. This fact highlights the importance of including simple, accurate, representative and repeatable monitoring protocols in the initial monitoring plan.

SM(a)RRT criteria for choosing appropriate and effective indicators for a restoration monitoring system.

Once indicators and methods are determined, the third and final step in developing a monitoring plan is to specify:

- What specific activities and tasks are required to complete each planned monitoring step
- Who will be responsible and who will be accountable for completing each activity and task.
- When each task will be undertaken
- How much money or resources will be needed to complete each activity and task.

Establishing this information creates a timeline to guide monitoring activities and designates responsibilities. The monitoring plan should be as specific as possible, such that there is minimal uncertainty about what is to be done.

Stage 3: Connecting to Biophysical and Social Data Collection & Analysis

The following categories highlight the range of monitoring activities for biophysical indicators:

- **Visual Monitoring:** Such as photographing the site and monitoring the site through satellite images can give a visual clue as to the ability of the project to restore forest cover.
- **Tree Performance:** This typically includes the measurement of growth and survivability of the planted trees. This type of monitoring provides the project team with basic information to determine if the planting was successful.
- **Forest Productivity and Regeneration:** Includes monitoring the effectiveness of the actions taken to increase the productivity of the trees, timber value, as well as regeneration/self-perpetuation of species in the forest understory. Possible measurements are: standing basal area, volume of merchantable wood and counts of understory regeneration.
- **Ecosystem Services:** When restoration is conducted for the objective of restoring ecosystem services, monitoring is essential to assess the changes in the delivery of those services over time. Possible measurements here are: carbon and biomass, species richness and abundance, biodiversity indicators, soil productivity and water quality and flow.

Indicators for social monitoring are very different from biophysical indicators (e.g. participation in restoration projects, direct employment through the project, fuelwood availability or non-timber forest products and negative indicators such as trees illegally logged or number of fires started in a given area. There can also be challenges unique to conducting social monitoring, because unlike with trees and biophysical features that can be directly measured, social monitoring typically requires getting information from people verbally or in written form. And, unlike trees, people are known to sometimes answer untruthfully, be influenced by the way the questions are worded, or by whom asks the questions, etc. Strategies may need to be devised to overcome these problems.

There five methods of social data collection that are most frequently used:

- **Document Review:** Document review is used when the information needed is already available, for example in national statistics, student research projects, etc.
- **Participant Observation:** Participant observation is used to access behavior and/or interactions, such in a meeting to assess the degree to which typically marginalized groups are participating in planning meetings or the degree to which workers are using equipment safely, as trained.
- **Surveys:** Surveys are typically used to collect basic information in a structured way where answers are clear-cut. They are often used to gain an understanding of a larger population through systematic sampling. Questions often revolve around demography, wealth, social structure and perceptions.
- **Interviews:** Interviews can be good for gaining an understanding of the issues or verifying findings from other data sources. These are one-on-one interactions with individuals and can be structured (i.e. predetermined questions) or semi-structured.
- **Focus Group Discussions:** Focus group discussions are used to understand complex relationships, perceptions, or attitudes. Several discussions might be held, each with groups of 5-10 people from the same stakeholder groups, who react to open-ended questions from a facilitator meant to stimulate dialogue.

Once all the data is collected, data analysis must be conducted to ascertain what story the data tells and whether changes should be made to the restoration protocol.

Stage 4: Evaluating and Reporting Results

Some common ways to report the results of a monitoring program are through newsletters, annual reports or posting information online. In some cases, however, reporting has to be tailored for distinct audiences and the kinds of questions that concern them. Presentation and/or field visits can also be given to the relevant stakeholders as a way to showcase achievements and discuss how best to move forward. In cases where projects are not living up to stakeholders' expectations, there might be a natural tendency to try to withhold or suppress that information, but it is often better in the long run to report the results and discuss how changes in management are addressing those shortcomings.

Adaptive Management

The goal of monitoring is to gain the understanding needed to improve management practices and interventions. Evaluating monitoring results may lead the project to make mid-course corrections to prevent further degradation or to improve restoration success. For example, monitoring may show that a certain species has low growth and/or survival on the site and the solution may require the planting of a different species or a different planting/treatment approach.

Example from the Philippines

An example of adaptive management can be seen in the National Greening Program in the Philippines. The project aims to plant 1.5 billion seedlings on 1.5 million hectares of public land by 2016. The project is being carried out as a partnership between the Philippines Department of Environment, the Foundation for the Philippine Environment and the Philippine Tropical Forest Conservation Foundation, as well as many civil society organizations (CSOs). After one year, the different stakeholders met in a National Greening Program Summit to discuss the progress of the project and discuss what methods were working and what needed to be changed. This summit not only gave a chance to review the information the organizations had after one year of work and monitoring, it gave people a chance to discuss how their objectives were or were not being met, and to change their methods to better address these objectives. This represents the end of one monitoring cycle and the beginning of another. Now the organizations will improve their monitoring plans, implement them and will review their progress together again in the future.

Conclusions

This guide has introduced a wide range of biophysical and social monitoring objectives. Most projects will incorporate all such indicators, the monitoring process should be tailored to the objectives and scope of the project. Because monitoring does require time and resources, some projects develop a relatively basic monitoring system, but then develop cooperative relations with academics who can pursue additional aspects of the project impact through supplementary research.

Many monitoring projects, however, are not adequately planned or sustained, so a real effort needs to be made to make sure that all stakeholders understand and agree upon the importance of implementing and maintaining the monitoring system. The true benefits of monitoring can only be realized if the monitoring program is maintained over time and the data is analyzed, reported and used to reevaluate the strategies employed in this and future restoration projects.

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11.3 Self-reflection

1. For your area of jurisdiction, what type of monitoring would be needed to determine if the objectives of FLR are being met?

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2 What might be measurable indicators (both biophysical and social) for monitoring, measurements that need to be collected, and how monitoring data will be analyzed and used?

12 Final Activities

12.1 Activity: ROAM road map

What FLR objectives are most relevant to your own work?

After extensive exploration by an FLR assessment exploratory committee your group is now tasked with leading a ROAM assessment to achieve the objective(s) above, please respond to the following:

Considering all the activities and considerations of the previous sessions of the training, please determine the staffing requirements for a ROAM core-working group of 6-8 people. Describe the titles, sectors, roles and responsibilities of each member of this core working-group.

1 ....

2 ....

3 ....

4 ....

5 ....

6 ....

7 ....

8 ....

Who would use the results of the assessment? How would they use the framework of the assessment process for other reasons? (e.g. High-level political support for FLR, inputs for national planning, etc.)

What do you expect are the outputs of your ROAM assessment? (specific deliverables/products, and which stakeholders will utilize these). What are the outcomes of ROAM?

Considering the responses above, outline a series of general action steps to generate your expected outputs in the template below. You may also identify where you would need more information to plan or realize a certain step as needed.

It might also be helpful to consider the various assessments described in Phase 2 of ROAM and include plans for any assessments that are of particular importance for your local context.

(Your action plan may have more or less steps than in the given table, depending on your local context).

Action Steps	Responsible Parties	Potential Parties to engage with	Timeframe / Deadline	Any additional information or resources needed to enable this step?	Deliverable / product
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

12.2 Activity: Course Wrap-Up

What skills or information did you learn at this training?

Which you can implement? What are your next steps after this course?

13 Field Visits Notes

During the field visits, please reflect on the questions below for each site. We will be asking you to share your responses the following day.

Site 1 - ....

What is the history of the site? Why does it look like it does now? Was is degraded? If so, by whom and why?

....

....

Who decided to restore? Why did they decide to restore? Who does the restoration? and who does the restoration benefit?

....

....

What restoration interventions were used? How did the practitioners learn of these techniques? How did they start?

....

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What were the challenges in restoration for this site? How were these addressed?

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Would you approach restoration in the area differently or what management recommendations would you make to the landowner?

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If you were managing the site for cattle, NTFPs, agriculture, or biodiversity how might you restore these areas differently?

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Sketch a quick map of the site. Are there any buffer zones? What are the land uses around the restoration site and in the surrounding landscape? How far does the restoration intervention extend?

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What surprised you about the field site?

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Do you have any other questions or comments about this site?

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Site 2 - ....

What is the history of the site? Why does it look like it does now? Was is degraded? If so, by whom and why?

....

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Who decided to restore? Why did they decide to restore? Who does the restoration? and who does the restoration benefit?

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What restoration interventions were used? How did the practitioners learn of these techniques? How did they start?

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What were the challenges in restoration for this site? How were these addressed?

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Would you approach restoration in the area differently or what management recommendations would you make to the landowner?

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If you were managing the site for cattle, NTFPs, agriculture, or biodiversity how might you restore these areas differently?

Sketch a quick map of the site. Are there any buffer zones? What are the land uses around the restoration site and in the surrounding landscape? How far does the restoration intervention extend?

What surprised you about the field site?

Do you have any other questions or comments about this site?

14 Closing

14.1 Closing remarks

In this handbook, we have compiled a summary of key topics and exercises that could be used during a training on FLR and ROAM. Many parts of this handbook summarize information that is presented in greater depth through ELTI online interactive presentations, IUCN publications, or other documents and many of these resources are listed in the following sections. When delivered as part of a training, it is expected that the presentations delivered in an online primer and the field course follow the relative order of this handbook and offer more in-depth theoretical and practical information for building capacity on these themes.

14.2 Glossary of key terms

Adaptive Management: a systematic approach to ecological management, that involves changes in management practices in response to previous management outcomes evaluated through monitoring protocols.

Assisted Natural Regeneration (ANR): a technique for accelerating the natural processes of forest ecosystem recovery by removing or reducing the barriers to succession.

Bankability: The degree of confidence in the success and return on investment that can be predicted from a restoration strategy or investment. This translates directly to a restoration projects' attractiveness to impact investors and donors.

Cost-benefit analysis (CBA): assesses, compares and optimizes the net present values of different management interventions and identifies those restoration transitions that provide the largest cost-benefit ratios and rates of return (see Net Present Value).

Data Analysis: a process of inspecting and evaluating data from a restoration monitoring protocol in order to discover useful information that can be used for suggesting conclusions (i.e. achieving project objectives) and supporting decisions during the adaptive management process.

Deforestation: the clearing or removal of trees from a forest in which the land is converted to a non-forest use.

Discounting: The current value of a future sum of money or benefits. Used to calculate present value of projected restoration success in the future.

Disturbance: a temporary change in environmental conditions that causes a pronounced change in an ecosystem. Anthropogenic disturbances are actions caused by human such as land clearing, logging, fragmentation etc. Natural disturbances occur without human interventions and include wind throw, naturally occurring fires, tree falls, etc.

Ecosystem Services: the benefits to humankind from the resources and processes supplied by a given ecosystem, in this situation forests.

Fallows: land that is left for grazing or for natural regeneration of native vegetation following traditional shifting, slash & burn cultivation practices that deplete soil fertility over time.

Firebreak: areas that prevent the spread of fires. Those breaks can be natural features (streams or rocky outcrops), cleared areas of slashed or pressed vegetation, or "greenbreak" areas with plants that are less flammable and serve multiple purposes,

Fragmentation: the act of separating forest into small patches by means of logging, land clearing or other human induced disturbances.

Functional Diversity: the number of functional roles represented in an ecosystem. These have to do with how the living species interact with the physical environment and each other.

Heavily Degraded Sites: sites in which changes (such as forest clearance, intensive agricultural use, intensive resource extraction) lead to dramatically reduced productivity, natural functioning (biotic and abiotic), and rate of potential regeneration on a site.

Indicator: verifiable measurement data that communicates information about a larger issue or question (i.e. objective).

Lethal Disturbance: type of disturbance that removes both the overstory and understory trees of a forest stand (e.g. fire, conversion of forest into permanent agriculture land)

Multi-Criteria Analysis (MCA):a method of geospatial analysis where spatial data are overlaid to display overlaps in extent. These overlaps are often ranked by magnitude and may confer estimations of intensity or priority.

Native Species Reforestation: the establishment of forest cover on deforested lands by planting tree species, most of which are indigenous to the area being restored.

Net Present Value (NPV): is used to measure the profitability of a project. NPV analysis is done using stakeholder-identified discount rates to facilitate comparison of restoration events over different time horizons.

Non-Lethal Disturbance: type of disturbance that removes the overstory without removing the understory tree seedlings and samplings (e.g. logging, tree fall from wind)

Non-Timber Forest Products: any product or service other than timber that is produced in forests. They include fruits and nuts, vegetables, fish and game, medicinal plants, resins, essences and a range of barks and fibers such as bamboo, rattans, and a host of other palms and grasses

Nurse Trees: fast growing species that can shelter slower-growing trees, achieve rapid canopy closure to reduce weed cover, facilitate the recruitment of other species, or ameliorate the local microclimate conditions.

Objective: a definite target that a restoration project seeks to reach that acts as a benchmark for measuring whether a restoration project is efficiently and effectively reaching broad project goals (i.e. reforestation of a site, or an improved watershed).

REDD+: Reducing Emissions from Deforestation and forest Degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. REDD+ is considered by many as an unprecedented opportunity to mobilize the global collaborative efforts and resources necessary to acknowledge the ecosystem services rendered by tropical forests while promoting sustainable livelihood and development and protecting biodiversity

Reference Ecosystem: a site of standing forest which can serve as a target or model for designing a restoration plan. It can be a useful tool for determining which species may be adapted to a similar site.

Restoration Monitoring: a system of measurements, data analysis, and result reporting that provide information allowing land managers, scientists, and interested stakeholders to evaluate the progress of a restoration project.

Succession: the process by which plant communities colonize after a disturbance and change over time.

Species Assemblages: the composition of species and their functions that exist in a given habitat, in this factsheet we refer to the collection of tree species selected for planting.

TerrAfrica: a NEPAD-led partnership present in 30 countries on the African continent that supports innovative solutions to sustain landscapes, address land and water degradation and adapt to a changing climate.

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