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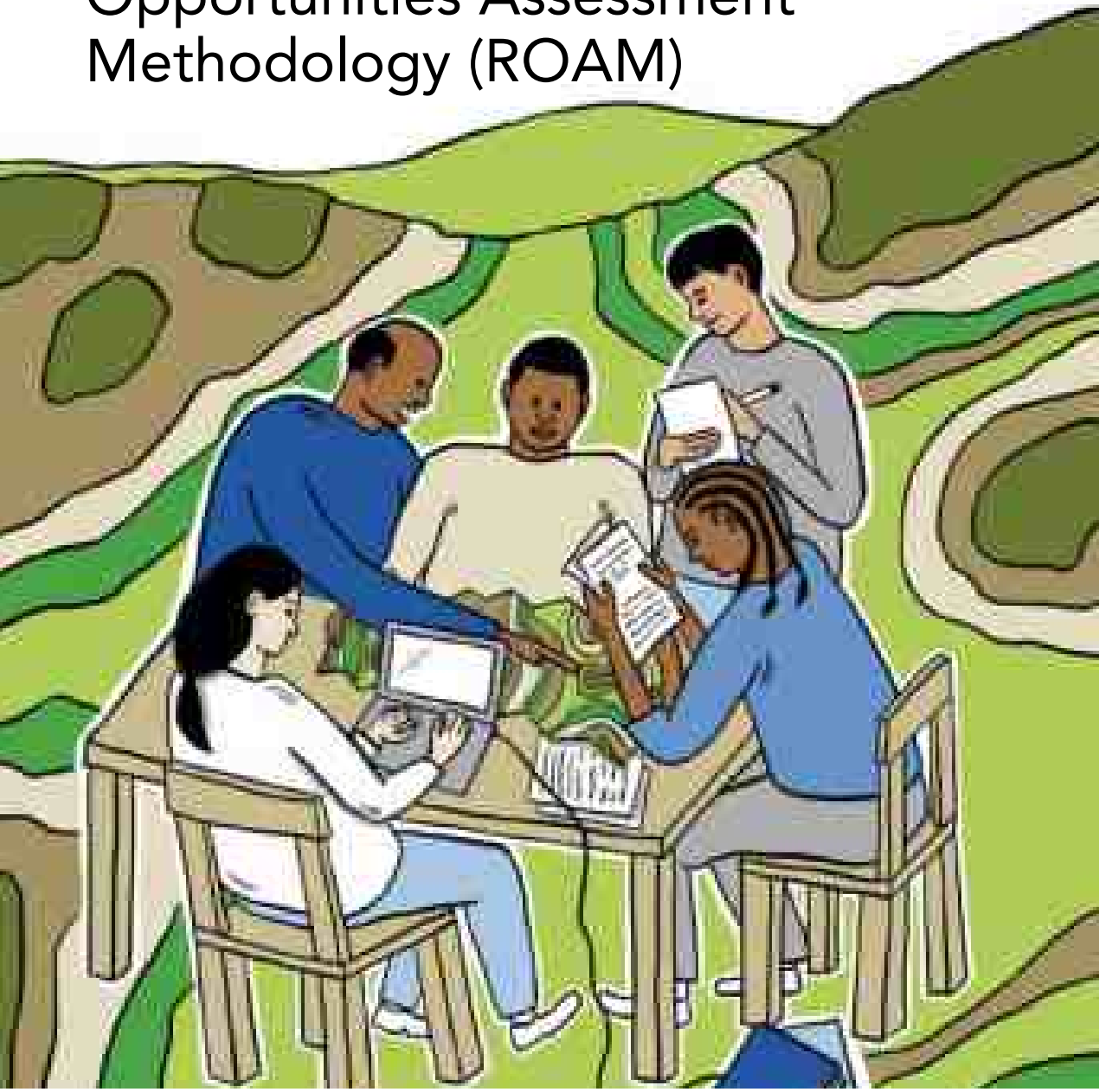
A guide to the Restoration Opportunities Assessment Methodology (ROAM)



Assessing forest landscape restoration opportunities at the national or sub-national level

THE GLOBAL PARTNERSHIP ON FOREST LANDSCAPE RESTORATION

BONN CHALLENGE 2011

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About this handbook

This handbook has been developed to guide assessment teams through the Restoration Opportunities Assessment Methodology (ROAM), or any part of it. The handbook has been developed for three main target groups:

- those who are commissioning an assessment, e.g. senior-level government officials, who need to know what it will entail and what outputs to expect;
- those who are conducting an assessment, i.e. members of the core team, who need to know how to do it; and
- those who are contributing to an assessment, e.g., experts and stakeholders at the national or regional level, who need to know what it involves.

This 'road-test' edition of the handbook is being circulated to engage others in the process of learning about – and improving – the methodology. A revised version of the handbook will be published at a later date in order to integrate learning from the road-testing process (see page 7 for more details on road-testing ROAM).

The handbook includes descriptions of the individual components of ROAM as well as guidance on how they can be combined and sequenced to suit different needs. As these components continue to develop, they are evolving into distinct and well-defined tools. The six main components or tools of ROAM are shown below, together with the location of the current guidance on them. More detailed guidelines on these tools will be produced throughout 2014 and 2015, as part of a forthcoming 'ROAM technical series' of publications. For more information, contact us at: gpflr@iucn.org

ROAM tools

- Stakeholder Prioritization of Restoration Interventions (see pages 58 to 63)
- Restoration Opportunities Mapping (see pages 68 to 83)
- Restoration Economic Modelling and Valuation (see pages 83 to 90)
- Restoration Cost-Benefit-Carbon Modelling (see pages 90 to 94)
- Restoration Diagnostic of Presence of Key Success Factors (see pages 94 to 98)
- Restoration Finance and Resourcing Analysis (see pages 98 to 105)

Acknowledgements

The Restoration Opportunities Assessment Methodology (ROAM) has been developed through a collective and collegial learning process that has involved a large number of organizations in Ghana, Mexico and Rwanda as well as local stakeholder groups in these countries. We would like to express our gratitude to all involved and to our committed donors who have supported the work.
Major contributors to the methodology include: in the USA the University of Maryland; in Ghana the Centre For Remote Sensing and Geographical Information Services, the Resource Management Support Centre of the Forestry Commission, and the Ministry of Lands and Natural Resources; in Mexico the National Forestry Commission, the National Commission for Knowledge and Use of Biodiversity, the National Commission of Natural Protected Areas and the Mexican Campesino Forest Producers Network; and in Rwanda the Rwanda Natural Resources Authority and the Ministry of Natural Resources. Those involved in a similar national assessment in Guatemala, which also contributed to the methodology, include the National Forest Institute, the Ministry of Agriculture, Livestock and Food, the Ministry of the Environment and Natural Resources and the National Council for Protected Areas.

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Preface

This handbook comes at an exciting time in the evolution of forest landscape restoration (FLR). Recent developments have seen FLR become widely recognized as an important means of not only restoring ecological integrity at scale but also generating additional local-to-global benefits by boosting livelihoods, economies, food and fuel production, water security and climate change adaptation and mitigation.

The 2011 launch of the Bonn Challenge was a key milestone in this regard. The Bonn Challenge serves as an implementation platform for numerous existing international commitments with restoration components, with a goal to restore 150 million hectares globally by 2020. As such, the Challenge seeks to catalyse early action on Reducing Emissions from Deforestation and Forest Degradation (REDD+) under the UN Framework Convention on Climate Change (UNFCCC) as well as action towards achieving Aichi Biodiversity Target 15 on restoration of at least 15 per cent of the world's degraded ecosystems by 2020, and international goals related to combating desertification and land degradation.

The handbook has been developed by our organizations, the International Union for Conservation of Nature (IUCN) and the World Resources Institute (WRI), as a contribution to the Global Partnership on Forest Landscape Restoration (GPFLR) and the Bonn Challenge. It sets out the Restoration Opportunities Assessment Methodology (ROAM) for conducting national or sub-national assessments of FLR potential. This methodology has been developed based on pilot national assessments of FLR potential that have taken place in Ghana, Mexico and Rwanda.

As we go to press, numerous countries are continuing, starting or planning their own assessments. We hope that this handbook will inform those assessments and, in turn, be informed by them. The handbook will evolve and be updated. We would very much like to hear from those who have conducted assessments – particularly if they involved adaptations or innovations to the methodology – so we may continue to share the learning. We will also be complementing the handbook with a series of guidance materials focused on the tools and components of ROAM. **For more information, please contact us at** gpflr@iucn.org.

Julia Marton-Lefèvre
Director General, IUCN

Andrew Steer
President and CEO, WRI

A rough guide to ROAM

The Restoration Opportunities Assessment Methodology (ROAM) described in this handbook provides a flexible and affordable framework for countries to rapidly identify and analyse forest landscape restoration (FLR) potential and locate specific areas of opportunity at a national or sub-national level.

A ROAM application is generally undertaken by a small core assessment team through collaborative engagement with other experts and stakeholders. A national-level assessment typically requires 15-30 days of work by the assessment team spread over a two-to-three month period.

ROAM outputs

A ROAM application can deliver six main products:

- A shortlist of the most relevant and feasible restoration intervention types across the assessment area
- Identified priority areas for restoration
- Quantified costs and benefits of each intervention type
- Estimated values of additional carbon sequestered by these intervention types
- A diagnostic of the presence of key success factors and identification of strategies to address major policy, legal and institutional bottlenecks
- Analysis of the finance and resourcing options for restoration in the assessment area

ROAM can support the development of national restoration programmes and strategies, enabling countries to define and implement pledges to the Bonn Challenge target (to restore 150 million hectares worldwide by 2020) and thereby meet their existing international commitments under CBD, UNCCD and UNFCCC. Overall, ROAM can be expected to generate the following types of outcomes:

- Better information for improved land-use decision-making;
- High-level political support for FLR;
- Inputs for national strategies on FLR, REDD+, adaptation and biodiversity, among others, and for mutually reinforcing convergence between such strategies;
- A basis for better allocation of resources within restoration programmes;
- Engagement of key policy-makers and decision-makers from different sectors, as well as other stakeholders with interests in how landscapes are managed; and
- Shared understanding of FLR opportunities and the value of multifunctional landscapes.

Road-testing Roam

This handbook is based on a limited number of experiences in assessing restoration opportunity in a handful of countries. If you are conducting an assessment or using this handbook to guide decision-making about restoration, we want to hear from you. Write to us at gpflr@iucn.org to share your experiences and visit www.iucn.org/ROAM to learn more about our on-going road-testing process. A new edition of this handbook will be available at a later date.

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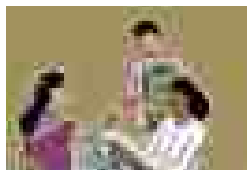

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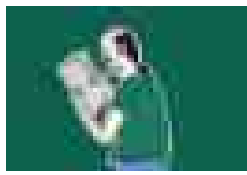

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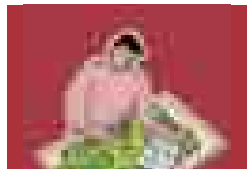

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Introduction

If you have decided to pick up and start to read this handbook, it could very well be that you are already familiar with forest landscape restoration (FLR), with its potential benefits and impact, and with the rationale for assessing FLR potential and opportunities at the national or sub-national level. If you are, you might want to skip ahead to the next chapter. However, if any of this is relatively new to you, this introductory chapter aims to give you a brief explanation of the context and rationale of FLR and the Restoration Opportunities Assessment Methodology (ROAM).

Forest landscape restoration

What is forest landscape restoration?

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

Successful forest landscape restoration 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 typically entails balancing a mosaic of interdependent land uses across the landscape, such as protected forest areas, ecological corridors, regenerating forests, agroforestry systems, agriculture, well-managed plantations and riparian strips to protect waterways.

- *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 can be done in many ways, one of which is to restore the landscape "back" to the "original" vegetation, 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, implementation 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 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".

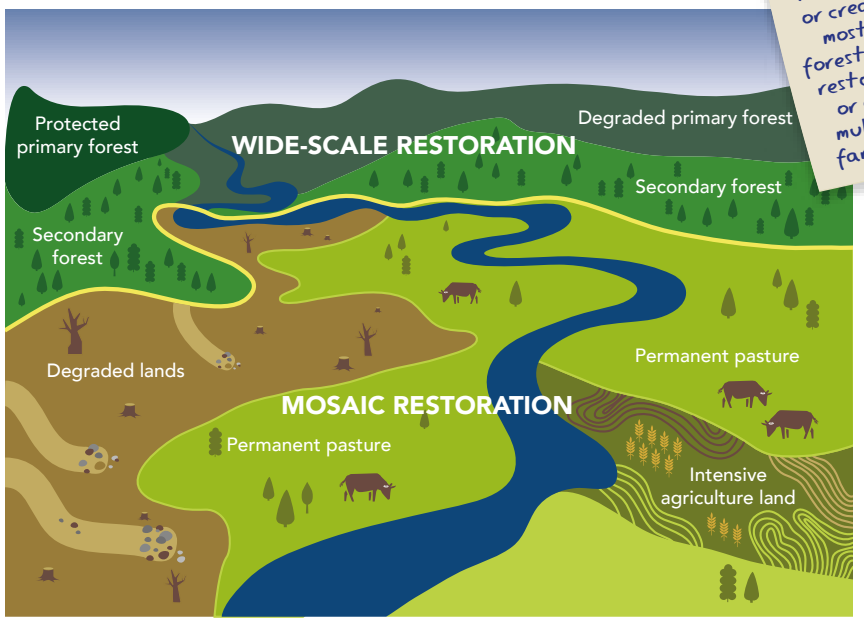
- *Avoid further reduction of natural forest cover.* Address ongoing loss and conversion of primary and secondary natural forest.

- *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 forest land (what we call wide-scale restoration) particularly in less populated areas, the majority of restoration opportunities are found on or adjacent to agricultural or pastoral land. In these situations, restoration must complement and not displace existing land uses; this results in a patchwork or mosaic of different land uses, including for example agriculture, agroforestry systems and improved fallow systems, ecological corridors, discrete areas of forests and woodlands, and river or lakeside plantings to protect waterways. This is illustrated in Figure 1.

Figure 1.
Wide-scale and mosaic restoration opportunities

Figure 1a. Wide-scale and mosaic restoration opportunities (schematic representation)



Most FLR opportunities belong in one of two basic groups. Wide-scale restoration aims to restore or create a landscape that most people would call a forest, whereas mosaic-type restoration aims to restore or create a landscape of multiple land uses, making farmland more productive.

Figure 1b. Wide-scale and mosaic restoration opportunities (photograph from Rwanda, prior to restoration)

In this photograph, the agricultural lands in the foreground represent a mosaic-type restoration opportunity while the forested hills beyond (including the denuded area to the right, where mining has taken place) are better suited for wide-scale restoration.

© IUCN/Michael Verdone

Why restore forest landscapes?

According to a recent global assessment of restoration potential, commissioned by the GPFLR (Global Partnership on Forest Landscape Restoration) and carried out by IUCN (International Union for the Conservation of Nature), WRI (World Resources Institute) and the University of Maryland, there are more than two billion hectares of land around the world that would benefit from some type of restoration intervention (GPFLR, 2011). Figure 2 shows the map produced from this global assessment.

There are many compelling reasons to restore such land. The urgent need for better food and water security and more secure livelihoods among forest communities and the growing demand for forest products and bioenergy all underline the need to massively scale-up current restoration efforts. Meeting these needs while also increasing carbon stocks, improving adaptive capacity and addressing the decline in biodiversity cannot be achieved solely by efforts to tackle deforestation. Avoided deforestation is critically important, particularly for reducing greenhouse gas emissions, but such efforts need to be supplemented by ambitious restoration initiatives that can help take the pressure off existing forest land, provide alternative sources of forest products, improve soil fertility and reduce erosion (through agroforestry and evergreen agriculture) and generally contribute to carbon-intensive land stewardship. Forest landscape restoration therefore complements well other approaches to improving food security and climate change mitigation and adaptation, including climate-smart agriculture and REDD+ (Reducing Emissions from Deforestation and Forest Degradation). By integrating these two concerns within a landscape approach and bringing degraded land back into production, FLR helps expand the world's stock of agricultural, agroforestry and forest land.

This is what FLR offers – the transformation of large areas of degraded and deforested land into resilient, multifunctional assets that can contribute to local and national economies, sequester significant amounts of carbon, strengthen food and clean water supplies and safeguard biodiversity. Of these benefits, the handbook gives particular attention to the potential economic and carbon sequestration benefits of FLR, as these were the main foci of the pilot assessments.

Figure 2.
Global potential for forest landscape restoration

The global assessment of FLR potential has given a good overview of restoration opportunities; national-level ROAM assessments can provide more detailed, nuanced pictures of what types of restoration interventions would be suitable and where.

FLR and carbon storage

Among the multiple benefits that can be delivered by FLR, carbon sequestration and storage is increasingly important. It is already well known that restoring degraded or deforested land can significantly increase the carbon levels in the soil and rehabilitated vegetation. The fact that these carbon gains come on the back of tangible economic and livelihood benefits to communities makes FLR an attractive option for local people as well as an effective means of sequestering carbon and helping slow down climate change. By helping take pressure off existing forests, FLR also helps to avoid the release of carbon stored in these forest ecosystems.

While historically FLR initiatives have not focused on carbon sequestration as one of their primary objectives, they have often yielded considerable carbon benefits. The opportunity to sequester carbon can provide additional impetus for FLR efforts, particularly as it delivers a global benefit while also offering additional financial incentives at a local level via, for example, new employment opportunities and increased household income.

The level of carbon sequestration achieved by FLR will depend on both the density of carbon in the restored land and the scale of the restoration. Thus, while restoration of closed forest may yield the greatest carbon impact per unit area, restoration of a mosaic landscape using lower tree planting densities (e.g. an agroforestry mix of trees and crops or improved farm fallow practices) can yield a greater mitigation impact overall, due to the significantly larger areas of land involved.

The ultimate package of restoration options will depend on the needs and priorities of local people and national government. The point here is that FLR has major potential as a climate mitigation mechanism but if we are to fully realize that potential, interventions must be designed to deliver against a basket of societal needs. While it may appear counterintuitive, the temptation to maximize carbon benefits in any single FLR intervention needs to be resisted. FLR implicitly involves carbon-intensive land stewardship but that seldom means that a successful FLR programme will deliver the absolute maximum amount of carbon that an individual landscape could theoretically deliver. In other words, carbon should be treated as an important and abundant 'co-benefit' of FLR but not the sole objective.

FLR and biodiversity

Forest landscape restoration has the potential to generate significant biodiversity benefits. In order to maximize this potential, the following issues should be considered:

- **The potential of restoration to re-establish connections between different habitats**. In many ecosystems there are habitats that have become fragmented as a result of degradation. Restoration can be used to recreate these connections thereby facilitating the movement of species (e.g. during migration).

- **The potential of restoration to increase habitat extent.** In situations where very little of a given habitat remains or where a habitat has been lost completely, restoration can be used to recreate a semblance of it.

- **The potential of restoration to improve habitat quality.** Restoration, by ensuring that a greater diversity of species are found in a given habitat, can be used to improve habitat quality.

In identifying possible areas for restoration, consideration should be given to opportunities to improve the extent, quality and connectivity of high-biodiversity areas, including areas rich in biodiversity or home to threatened or endangered species, as well as those that deliver important ecosystem services.

Better accounting for the potential biodiversity benefits of restoration can help ensure that these biodiversity benefits are optimized. These impacts can include improved provision of ecosystem services (such as water supply, pollination, erosion control or carbon sequestration) and more resilient ecosystems that are better able to cope with stresses and adapt to climate change. In addition accounting for biodiversity in restoration activities can help countries meet their international commitments such as those associated with the CBD Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets.

National and sub-national FLR assessments

Why look beyond the global level?

While the global assessment of FLR potential (mentioned above) provides some indication of the extent and location of areas suitable for restoration within a given country, the constraints inherent in a global assessment (including the low resolution and the inability to use country-specific data) make it of limited use for supporting restoration strategies within countries. The global assessment therefore needs to be refined and improved through national (or sub-national) assessments, the results of which may be quite different from those seen in the global assessment map. See for example the two different images of Mexico's FLR potential in Figure 3.

A national (or sub-national) FLR assessment can:

- Provide missing ***landscape-level land-use and economic analysis and data*** that can be used to improve the quality of land-use decision-making and inform possible reforms (e.g. of land tenure or of agricultural and forestry sectors);

- Set the stage for ***national-level strategies and programmes of work*** on FLR, sustainable land management and REDD+, by providing a general overview of the priority areas for restoration, the different restoration options available and their relative costs and benefits, and the key stakeholder groups who will need to be involved in any follow-up work on FLR in the country;

- Build ***high-level support*** for FLR, by engaging key policy-makers and decision-makers from different sectors as well as other stakeholders with interests in, or influence on, how landscapes are managed;

- Enhance a ***shared understanding*** of FLR opportunities and the value of a multi-sectoral, landscape-level approach to restoration, by bringing government agency staff, civil society actors and researchers together to work on the assessment.

Figure 3.
Mexico's FLR potential – as shown by the global and national assessments

3a. Map of Mexico's FLR potential, derived from the global assessment

The contrast between these two maps reflects the very different scales of the two assessments. The national assessment, which was able to uncover opportunities missed or misjudged in the global assessment, also indicates the relative priority of restoration opportunities.

3b. Map of Mexico's FLR potential, produced by the national assessment

Top priority for restoration
Second-level priority for restoration
Third-level priority for restoration

Restoration Opportunities Assessment Methodology

ROAM is designed primarily to provide relevant analytical input to national or sub-national policy and operational processes, such as the development of programmes of work related to a national REDD+ strategy, a national adaptation programme of action, a national biodiversity strategy and action plan, or requests for development assistance. In addition, ROAM will often be able to fill in missing information relevant to other national policy priorities, such as rural development, food security or energy supply. Many of these types of policies tend to ignore the potential of degraded or sub-optimally managed land.

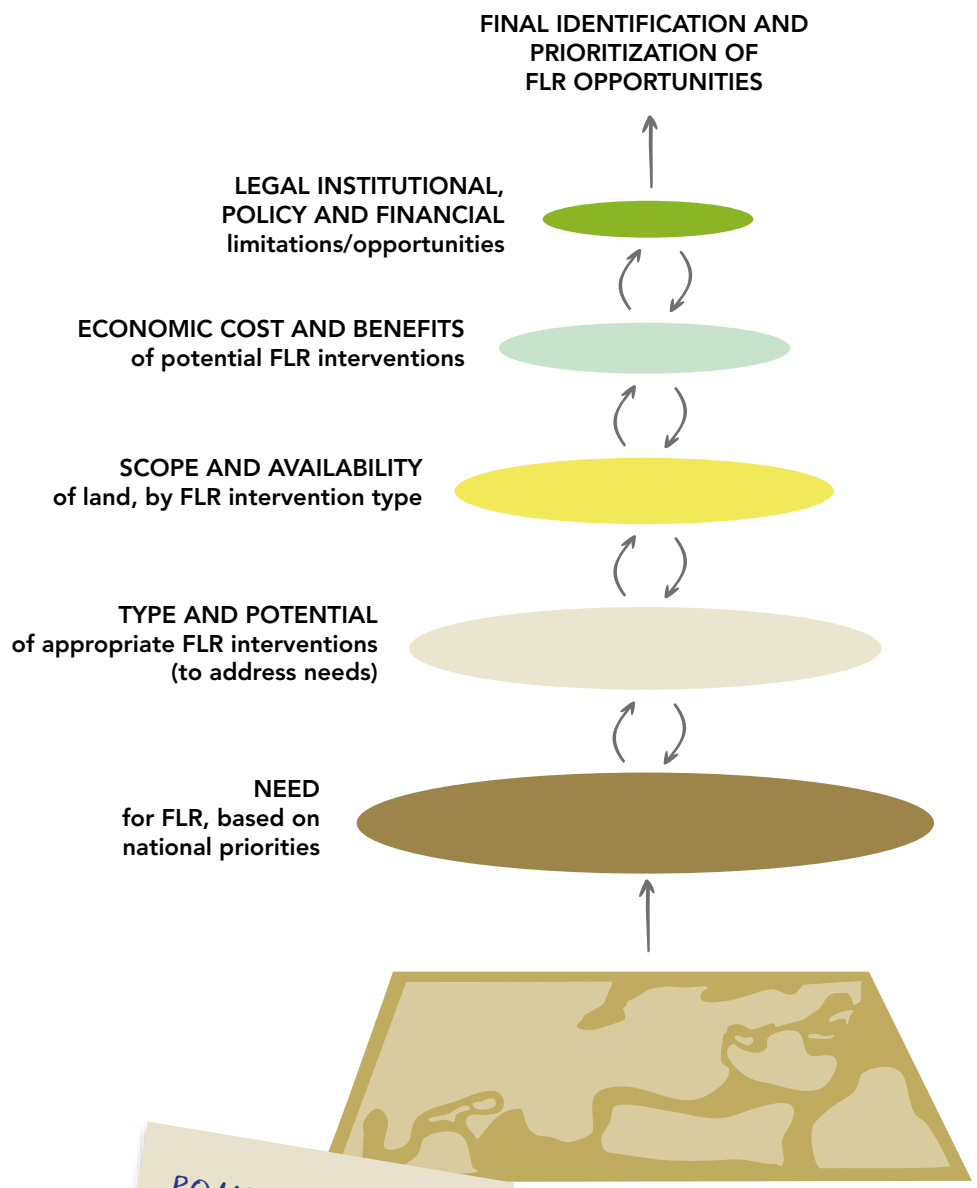
Essentially, ROAM involves a stepwise and iterative application of a series of analyses to identify the best set of FLR opportunities applicable to the area in question. This stepwise process (which is presented conceptually in Figure 4) is designed to help address the following types of questions:

- Where is restoration socially, economically and ecologically feasible?
- What is the total extent of restoration opportunities in the country/region?
- Which types of restoration are feasible in different parts of the country?
- What are the costs and benefits, including carbon storage, associated with different restoration strategies?
- What policy, financial and social incentives exist or are needed to support restoration?
- Who are the stakeholders with whom we need to engage?

It should be noted that none of these questions is of a purely technical nature, easily answered using hard facts and data alone. A good deal of information will need to come from local experts and other stakeholders with first-hand knowledge of the landscapes and livelihoods in the areas being assessed. So those carrying out the FLR assessment will need to use a combination of 'best science' and 'best knowledge' (as illustrated in Figure 5) to obtain accurate, realistic answers. In addition, many of the questions will necessitate discussion, debate and negotiation among the different stakeholders. The multi-stakeholder approach of FLR offers a mechanism to identify and address any trade-offs between different, sometimes competing, land uses.

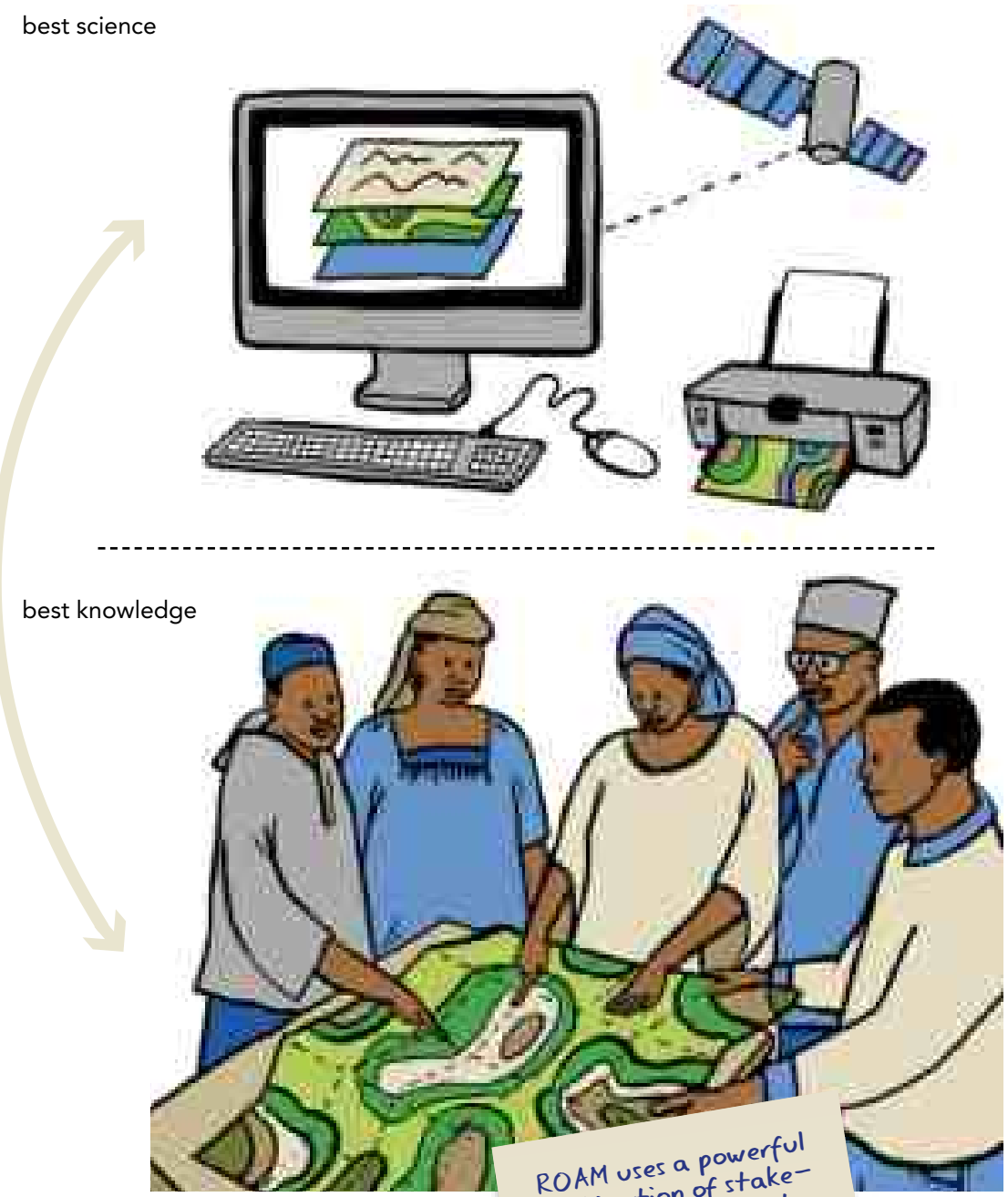
While ROAM is not intended to be used for detailed, district-level planning, it can nonetheless help inform subsequent planning exercises, as outlined in Box 1.

Figure 4.
Simplified conceptualization of ROAM



ROAM involves looking at FLR potential through a number of different lenses, to arrive at the final set of 'best bet' opportunities.

Figure 5.
Combining best knowledge and best science



ROAM uses a powerful combination of stake-holder engagement ("best knowledge") and analysis of documented data ("best science") to identify and investigate FLR opportunities.

Box 1.
Role of ROAM applications in supporting follow-up restoration projects

While ROAM applications are not intended to be land-use planning exercises, and are not designed for planning specific restoration projects, they can nonetheless be a useful point of departure for these types of exercises. The assessment map and other outputs will point decision-makers and planners to areas where they are more likely to find restoration opportunities, and will provide preliminary information on how to go about restoration of these areas (including which type of restoration would be most suitable and what costs and benefits would be expected). These inputs would obviously need to be verified and supplemented through further data gathering, consultations and site visits.

What does a ROAM application involve?

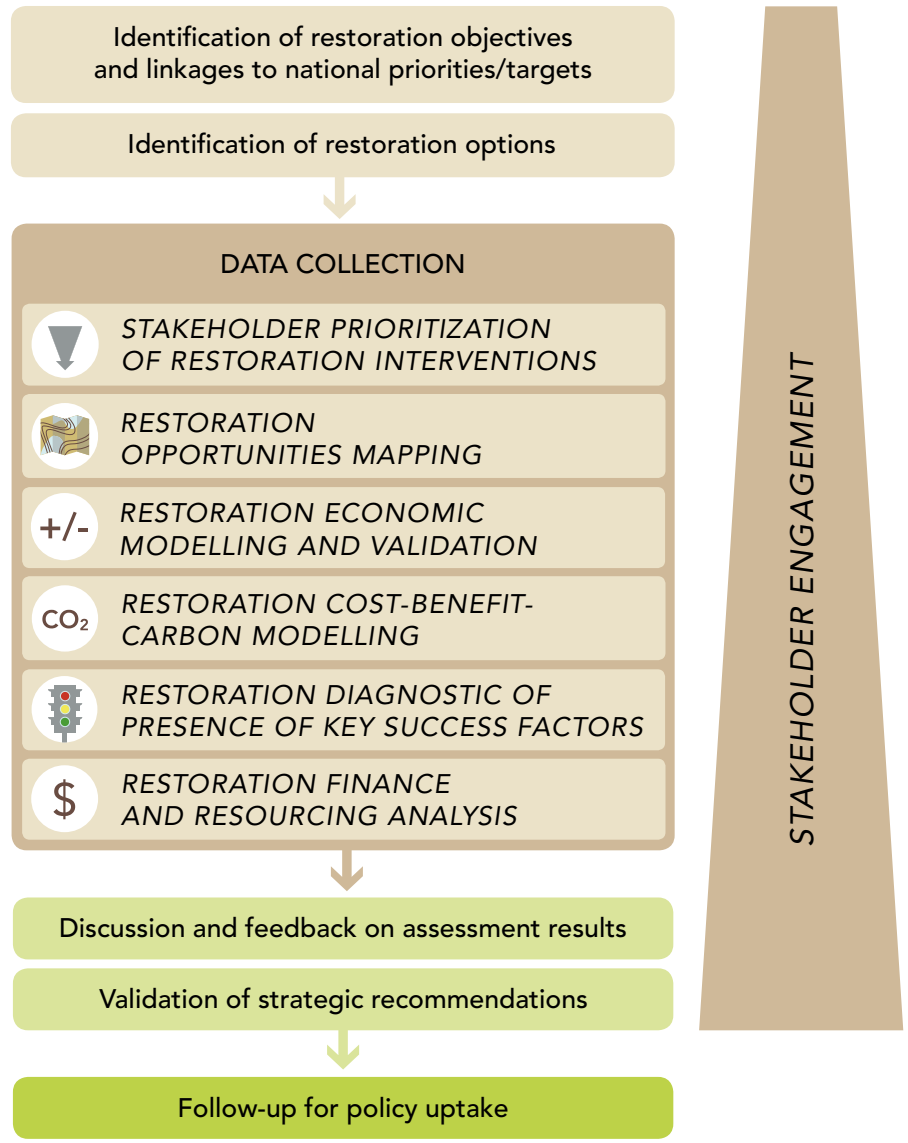
Whether undertaken at a national or sub-national level, a ROAM application will generally involve three main phases of work: (1) preparation and planning; (2) data collection and analysis: and (3) results to recommendations. The overall process of ROAM is illustrated in Figure 6. The individual components within this process, and the order in which these steps are undertaken, may vary to some degree from one assessment to another. This handbook provides guidance on each of these components.

A national-level assessment typically requires 15-30 days of work by the assessment team spread over a two to three month period. It is preferable to allow time for sufficient engagement with public and private sector actors as well as civil society and local stakeholders. Broader participation in the process is likely to lead to a stronger sense of ownership in the results and better prospects for follow-up. For example, the assessments in Ghana, Mexico and Rwanda all required approximately two to five weeks of activity, spread out over two to four months to allow for wider engagement and to fit in with other commitments of the key participants.

Pilot applications

In developing and testing this methodological framework, three national assessments were conducted, in Ghana, Mexico and Rwanda. Each of these 'pilot' applications of ROAM was tailored to provide specific analytical insights and policy recommendations based on the best data available, in response to requests from national authorities. In addition to these three cases, a fourth assessment was carried out in Guatemala, based on the Mexico experience. Box 2 briefly describes each of these pilot applications. In choosing these pilot countries, the aim was to cover a wide range of conditions relevant to national assessments, including for example a diversity of biomes and different levels of data availability, to test ROAM's applicability across these situations.

Figure 6.
Key steps in a typical ROAM process



Box 2.
The pilot applications of ROAM

The four assessments carried out in the development and testing stage of ROAM were each tailored to match the context of the assessment work, the level of data available and the desired outputs.

In **Ghana**, a key objective of the assessment was to fill the large gaps in Ghana's data on the condition of its forest resources. Since little GIS data was available for the spatial analysis and mapping, the assessment relied heavily on the knowledge and expertise of local and national stakeholders. A rapid 'knowledge mapping' approach covering the entire country (nearly 240,000 km²) was used. The assessment produced a national-level map of FLR potential and supplementary analyses on, for example, the costs and benefits of possible FLR interventions including the potential carbon sequestration benefits. The map and the economic analysis informed Ghana's successful application for support from the Forest Investment Programme of the World Bank. The assessment results are also being used for high-level decision-making in the forest sector, and have been in constant demand from a range of national and international stakeholders.

In **Mexico**, the main aim of the assessment was to contribute to the development of a cross-institutional national forest landscape restoration strategy for Mexico. A wealth of GIS was available. While the assessment involved broad-based stakeholder involvement in selecting the restoration-relevant criteria to be included, it was based largely on the amalgamation of these existing data (using a 'digital mapping' approach). The geographic scope was national, covering nearly 2 million km². This assessment produced a national-level map of priority areas for FLR which is being used by federal institutions to prioritize actions in support of different national objectives and to formulate the national FLR strategy and strengthen existing policy instruments on forest restoration.

In **Rwanda**, the initial impetus for the assessment came from the ambitious commitment, announced by the Government of Rwanda in 2011, to implement forest landscape restoration countrywide by 2035. The main aim of the assessment was therefore to guide the scaling up of Rwanda's restoration efforts. Extensive GIS data were available for the assessment, so the pre-existing data could be combined with information and analysis provided by the experts and stakeholders involved in the work. The scale of this assessment was much smaller than the other two, reflecting the small size of the country (approximately 26,000 km²). A series of assessment maps was produced, relating to the eight 'best bet' FLR interventions identified for the country. Additional outputs included, for example, an initial diagnosis of the country's readiness to implement such a strategy and a preliminary analysis of the resource mobilization options for financing different kinds of FLR interventions. The results of the assessment have been summarized in a presidential briefing and taken up at cabinet level.

In **Guatemala**, the National Forest Institute decided to initiate a participatory process to develop a map of FLR opportunities. The aim of the assessment was to provide a basis for the development of the country's first national-level forest landscape restoration strategy and the re-shaping of existing reforestation incentive schemes to better align with the FLR approach. This was seen as important for assisting the country in meeting its commitments under international conventions and national policies related to land use. The mapped assessment and national strategy process was also intended to provide a platform for cross-ministerial engagement so that priorities related to poverty reduction, food security and mitigation, for example, can be addressed in a complementary way with those related to forests and other land use.

Phase 1: **Preparation and planning**

This phase is likely to involve a series of discussions and meetings to help prepare and plan the assessment, culminating in a national inception workshop to share the plan and seek high-level endorsement of the assessment.

Defining the problem and FLR objectives

In initiating an assessment, the best way to start is to identify a problem statement or specific challenges and a set of higher-order, national or sub-national objectives to which FLR can make a significant and tangible contribution (see some examples of these in Box 3 overleaf). You may find that the problems have been defined already in policy documents, study reports, etc. They would include any major land-use challenges in your country that result from land degradation, erosion, deforestation, declining soil productivity and significant climatic events such as flooding or drought.

It is very useful to articulate how the FLR objectives relate to national, sub-national or sectoral policies, bearing in mind that FLR is relevant to multiple sectors. Aligning the FLR objectives with these priorities – and keeping this alignment in mind throughout the assessment process – will help ensure the assessment results are relevant and compelling to key decision-making institutions in the country. Figure 7 shows how the assessment team in Rwanda presented the potential contributions of FLR to the country's key national development targets relating to forest cover, energy production, access to clean water, food production, poverty reduction and per capita GDP.

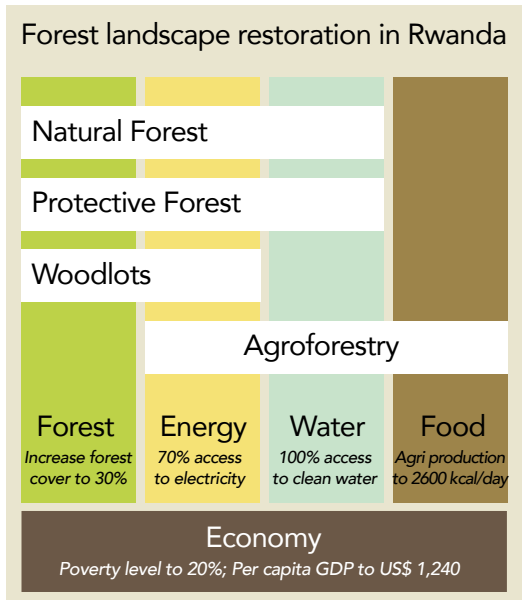


Figure 7.
Potential contributions of FLR interventions to national development targets in Rwanda

The assessment team in Rwanda produced this chart to show policy-makers how the portfolio of potential restoration interventions can contribute to a number of different national development targets, as set out in the country's Vision 2020.

Make sure that you clearly articulate the problem statement and objectives before presenting them to decision-makers. Avoid the temptation to apply FLR to every national challenge. It is better to limit the problem statement and long-term objectives to those issues that FLR can help address in a concrete and credible manner. Once you have defined the problem and objectives, you will be much better placed to identify which stakeholders need to be involved in the assessment process.

Box 3.
Examples of problem statements and objectives for FLR

These are some examples of how a problem statement or a statement of FLR objectives could be articulated.

Major problems to be addressed:

- Agricultural land is producing poorly due to erosion and insufficient soil water retention
- Coastal areas are being affected by flooding and salinization
- Forest land has been degraded or converted, so that trees have been removed from the landscape
- Forest reserves and national parks have been fragmented by major land-use changes
- Water quality has declined due to excessive run-off and siltation

Long-term objectives of FLR:

- Improve the resilience and productivity of vulnerable forest land
- Control erosion and improve watershed management
- Arrest and as far as possible reverse ongoing land degradation
- Improve income flows of people living in these areas
- Conserve biodiversity, new habitats and ecological connections
- Restore natural coastal protection systems
- Improve the provision of environmental services to local, regional and global beneficiaries

Engaging key partners

Finding an institutional home for the assessment

It is important that the institutional responsibility for leading the assessment be clearly identified. The assessment needs to be given an institutional home in an in-country institution or as a partnership between several institutions. This is important not only for ensuring credibility and follow-up of the assessment's findings but also for providing the institutional 'hub' around which the multi-sector and multi-stakeholder collaborative approach of the ROAM application can be built. The actual institution(s) involved could be, for example, a government ministry (such as the Ministry of Natural Resources, or the Ministry of Agriculture) a national agency (such as the National Water Authority) or a non-profit or academic technical institution (e.g. a specialist GIS group at the national university). Any one government ministry will not have all the necessary technical expertise required to oversee the assessment (due to the multi-sectoral nature of FLR) so if the institutional home is to be based in one specific government agency, it will be particularly important to ensure close collaboration between different ministries and also with other partner organizations. The inception workshop (described on page 51) will be an excellent opportunity to help forge and strengthen these partnerships.

Establishing the team to coordinate and lead the assessment

Those involved in initiating the assessment will need to convene a team to coordinate and lead the work. This team may involve three to four individuals who will lead most of the work and analysis, supported by a larger number of specialists who will engage on a more periodic basis, providing advice and insight on their particular areas of expertise.

While the make-up of the core team will obviously reflect the local situation, our experience shows that the following dedicated skills are very valuable:

- Team leader: a good understanding of national land-use processes including the overall legal, policy and institutional framework;
- An economist;
- A land-use specialist with good understanding of GIS; and
- A social scientist with clear understanding of formal and customary land and resource rights and gender issues and strong facilitation skills.

IUCN and WRI can recommend facilitators who have experience in ROAM processes. A list of facilitators can be obtained by contacting: gpflr@iucn.org.

Other participants who the assessment team should actively seek to engage can be selected on the basis of their affiliations and skills, including for example:

- Government decision-makers;
- Stakeholder representatives from for example NGOs, farmer associations and local trade associations;
- Technical staff from government, civil society or the private sector with specialist knowledge of, for example, forests, water resources, biodiversity, climate change, agriculture and tenure; and
- Staff from technical support institutions and universities, with skills in, for example, GIS, economic analysis and institutional analysis.

Defining the outputs and scope of the assessment

Defining the outputs and scope of the ROAM application will be something of an ongoing process during the early stages of the assessment. It will be a matter for discussion not only within the assessment team but also with other experts and stakeholders during the inception workshop (the multi-stakeholder workshop held to launch the assessment – see page 51). However it is important for the team to go into the inception workshop with a clear idea of what the assessment can practically deliver, given time and resource constraints, as this will help avoid lengthy, open-ended debate on these fundamental matters or the setting of overly ambitious aims.

Outputs

You will already have a problem statement and long-term objectives for FLR in your country that relate to existing national priorities (see page 31). Now it is time to establish the outputs for the assessment. These outputs will vary from one assessment to the next. Some countries, for example, may wish to simply identify the major areas of degraded land, while others may want to go further, to prioritize these areas and estimate the costs and benefits of possible restoration interventions. The statement of intended outputs should also articulate how the assessment results are intended to lead to specific follow-up actions. One example of a statement of intended output is provided in Box 4.

Box 4.
Statement of objectives of a ROAM application: example from Mexico

The assessment's intended outputs are:

- a space for institutional dialogue on forest landscape restoration (FLR) established;
- the different institutional programmes focused on FLR harmonized;
- priority areas for restoration identified;
- existing policy instruments prioritized and potential hosts of national FLR efforts agreed; and
- suitable forest restoration options identified.

The map of potential priority areas for forest landscape restoration will be used by the participating federal institutions to formulate a national strategy for FLR, aligning the different existing policy instruments that influence forest restoration, and optimizing and focusing their impact. This strategy, once formulated, will also serve as an instrument for the management of local and international financial resources, to fund the restoration initiatives derived from the strategy.

Geographic scope

Defining the geographic scale of the ROAM application will involve balancing the scope and ambition of the outputs with the constraints of resources, time availability and delivery deadlines. For example, while the intention may have been to cover the entire country, constraints may allow for only a sub-national assessment at this stage. Alternatively, a preliminary assessment could be made of the whole country, with more detailed assessments carried out in priority regions at a later date.

Stratifying the assessment area

Most countries contain significant diversity in terms the distribution of major physical, ecological and socio-economic features. There are hills and flatlands, wet forests and dry forests, coastal areas and inland areas, rural areas and peri-urban areas, etc. The assessment team will need to decide how to divide the national or sub-national assessment area into sub-areas (or 'strata'), each relatively homogeneous in terms of its restoration-relevant characteristics. This process of stratification will be important later on, as it will enable the analysis to use the same default values (e.g. population growth rates, labour costs and per hectare productivity) for each sub-area. As the process continues the restoration options and characteristics for each geographic sub-area can be analysed, reviewed and refined based on feedback from relevant stakeholders.

Be explicit about the 'rules' you put in place to direct the stratification process. The following 'rules of thumb' may be useful:

- Try to respect district boundaries (i.e. don't split districts across several sub-areas) as the district level tends to be the lowest administrative unit for which restoration-relevant biophysical, institutional and economic data are available.

- At the same time, try to respect agro-ecological zones (i.e. don't split these zones into several sub-areas) as the agro-ecological conditions will have a strong influence on the relevance and productivity of different restoration options.

- Limit the number of sub-areas by aiming to capture only the major differences in key restoration characteristics, otherwise the assessment will become a cumbersome process. Aim for between five and twelve sub-areas.

- Optimize the size of the sub-areas, avoiding very small ones, and try to keep them all roughly equivalent in size. This assessment methodology is intended to give a 'big picture' view of restoration potential, not a detailed analysis of any one area. It is not intended (or suitable) for the operational planning of restoration projects, so it should not be applied at such fine scales that the line between assessment and project- or location-specific planning becomes blurred.

Stratification is essentially a pragmatic process that will most likely involve compromises. The actual criteria used in stratification will be determined by data availability and by the major characteristics of the assessment area, such as topography, land use and drivers of degradation. As each sub-area should be coherent and distinct from other sub-areas, it is strongly recommended to start with the agro-ecological basics, such as rainfall, temperature, altitude, major soil types, etc. Other criteria can then be considered, such as:

- Land cover;
- Population density;
- Common natural resource-dependent sectors; and
- Level of demand for specific forest products (surplus/deficit).

Figure 8 and Table 1 show the results of the stratification process in the Rwanda national assessment, in terms of the location and characteristics of the different strata.

Figure 8.
Map showing stratification results for the Rwanda assessment (seven sub-areas identified)

Table 1.
Stratification results from the Rwanda assessment

	STRATA	FEATURES (based on existing data sets)
1	Lake Kivu Shore	High population in certain districts (e.g. Rusizi), high erosion vulnerability, high rainfall, presence of key sectors that impact or rely on natural resources (export crops, hydro-energy, mining, tourism)
2	Central Plateau	Highly degraded soils, elevated poverty rates, significant fuelwood deficit
3	Amayaga	Lowland, elevated drought risk, structured land reform, presence of key natural resource dependant sectors
4	Eastern Ridge & Plateau	Highly degraded soils, elevated poverty rates, high population pressure
5	Eastern Dryland Savanna	Lowland, elevated drought risk, good soil, high evapo-transpiration
6	Buberaka Highland	High population, significant fuelwood deficit, acidic soils, low temperature
7	Volcano and High Plains	Basic soil, high fertility, high population, presence of key natural resource dependant sectors (tourism, export crops)

The Rwanda assessment team defined seven strata, as shown in this Table and map. In this case the stratification was based primarily on the agro-ecological zones of the country and respected the district boundaries (the grey dashed lines on the map).

Identifying potential FLR options

The team will need to draw up a preliminary list of FLR interventions that, on first analysis, would appear to be the most appropriate for the national situation. Coming up with a limited number of socially appropriate and economically feasible FLR interventions will require several iterations and this will only be finally settled once the results of the biophysical, economic and institutional analyses (later on in the assessment process) and consultations with – and feedback from – stakeholders provide the final pieces of the information 'jigsaw'.

Most likely you will start with a longer – and quite detailed – list of locally appropriate interventions and during the assessment several of these options will be combined and some will be discarded. By the end of the process you will probably have a concrete list of between five and fifteen interventions. At this early stage of the process the best way to produce your list of possible interventions is to classify ongoing restoration activities in your country by: (1) those that take place primarily on forest land; (2) those that take place primarily on agricultural land; and (3) those that take place primarily to protect slopes, rivers, wetlands or coastal areas.

As shown in Table 2, the GPFLR has produced a framework of seven general categories of FLR interventions, based on these three land-use situations and it may be useful to start with, and adapt, this listing as a basis for your initial identification of appropriate interventions. The seven categories include:

- **Forest land:** This is land where forest is or is meant to become the dominant land use. It can include both protected and productive forests. If the land is without trees, it can be restored either through planting (*Category 1*) or natural regeneration (*Category 2*). Degraded forests can be restored through rehabilitation and silvicultural treatments (*Category 3*).

- **Agricultural land:** This is land that is being managed to produce food. If the land is under permanent management, it can be restored through agroforestry (*Category 4*). If it is under intermittent management, it can be restored through improved fallow (*Category 5*).

- **Protective lands and buffers:** This is land that is either susceptible to, or critical in safeguarding against, climatic or other events. While the land may be used for agricultural or forest production it also has a very special value in safeguarding lives, property and ecosystem services. It is typically – but not always – closely associated with marine and freshwater ecosystems. FLR interventions can involve mangrove restoration (*Category 6*) or watershed protection and erosion control (*Category 7*).

Table 3 shows the preliminary list of potential restoration options drawn up in the Rwanda assessment. The types of restoration options identified for the different sub-areas, and the level of priority assigned to these interventions, relate directly to the characteristics of these areas. For example, the high population clusters, steep slopes and high level of erosion vulnerability found in Lake Kivu shore sub-area make agroforestry on terraced land a high priority restoration option for this area. This preliminary listing of 21 options was subsequently reduced to eight, as described later in the handbook (see page 62).

Table 2.
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.

Table 3.
Restoration options initially identified for the different assessment strata in Rwanda

Intervention / Area	Lake Kivu Shore	Central Plateau	Amayaga	Eastern Ridge & Plateau	Eastern Dryland Savannah	Buberaka Highland	Volcano & High Plains
1. Agroforestry							
Agroforestry on terraced land	●	●				●	●
Agroforestry on non-terraced land	●	●	●	●	●	●	●
Farmer-managed natural regeneration	●	●	●	●	●	●	●
2. Woodlots for biomass production							
New large / commercial (>2Ha) woodlots	?		●	●	●		
New domestic (>2Ha) woodlots	●	●	●	●	●	●	●
Improved management of small woodlots	●	●	●	●	●	●	●
Improved charcoal production	●	●	●	●	●	●	●
Improved cook stoves	●	●	●	●	●	●	●
3. Natural forests							
Improved mgmt & recovery of degraded natural forest	●	●			●	●	
Establishment and return of natural forest on non-forest land	●	●	●	●	●	●	

Intervention / Area	Lake Kivu Shore	Central Plateau	Amayaga	Eastern Ridge & Plateau	Eastern Dryland Savannah	Buberaka Highland	Volcano & High Plains
4. Industrial timber plantations and estate crops							
New industrial timber plantations (>2Ha)	●	●	●	●	●	●	●
Better managed timber plantations (>2Ha)	●	●	●	●	●	●	●
Integration of natural forest set-asides (>2Ha)	●					●	●
5. Forests for watershed management							
New upper catchment forests	●	●	●	●	●	●	●
Gully stabilization & mine site recovery	●	●				●	●
Replacement of eucalyptus with native species on sensitive sites (hilltops & water towers)	●	●	●	●	●	●	●
6. Forests for wetland, lake and river protection							
Improved buffering of water bodies	●	●	●	●	●	●	●
Re-introduction of native species in wetlands	●	●	●	●	●	●	●
7. Silvopastoral							
Fencing pasture land in forest areas	●	●	●	●	●	●	●
Trees on pasture land	●	●	●	●	●	●	●
Fire management & control		●	●	●	●		

Priority

●	●	●	?
first-level priority	second-level priority	third-level priority	to be confirmed

The Rwanda assessment team later refined the set of potential restoration options from the 21 shown here to the 8 'best bets' shown in Table 10 (page 62).

Identifying the assessment criteria and indicators

Beyond the limited number of criteria used to guide stratification, the team will need to identify a broader set of assessment criteria that can be used to analyse FLR potential within each sub-area. Importantly, these criteria should be selected on the basis that they can help assess the core issues of a ROAM application:

- The need for FLR;
- The type and potential of appropriate FLR interventions;
- The scope and availability of land for the different intervention types;
- The costs and benefits of potential FLR interventions; and
- The legal, institutional, policy and financial limitations/opportunities.

The criteria selected will vary with the particular objectives of the assessment. Thus, for example, if the purpose is to ***identify*** restoration opportunities on the basis of the extent of very degraded land, criteria relating to land and soil degradation will suffice. Alternatively, if the purpose is to ***prioritize*** FLR options, further criteria will need to be identified, relating to, for example, the availability of land and the feasibility and benefits of FLR in these areas.

Table 4 presents some questions, relating to these five factors, which can be considered when identifying assessment criteria, while Table 5 provides some examples of possible criteria and indicators. Table 6 shows the set of criteria and indicators selected for the Mexico assessment. These were defined through a participatory process involving two separate technical workshops. In the Mexico case, the selection of indicators was based on what cartographic data were available to reflect the chosen criteria.

Table 4.
Some guiding questions to help direct the identification of assessment criteria

Layers of analysis	Possible questions to guide selection of assessment criteria
Need for FLR based on existing national priorities	What parts of the area are in need of, or would benefit from, restoration?
Type and **potential** of appropriate FLR interventions (to address needs)	What types of restoration would be most appropriate and most needed?
	What needs could they help address?
Scope and **availability of land**, by FLR intervention type	What intervention types would be suitable where?
	What is the overall potential coverage of each intervention type?
	What types of land tenure regimes are in place?
	What are the government policies or strategies for these areas?
	Are land owners and land users interested in restoration?
	Are there any commercial or community interests in the area?
	Are there any conflicting interests?
Economic **costs and benefits** of potential FLR interventions	How much would these potential interventions cost, overall and by intervention type?
	What economic benefits could they deliver? To whom? Over what time frame?
Legal, institutional, policy and **financial** limitations/ opportunities	Which of the existing policy and institutional arrangements are conducive to restoration? Which create barriers to restoration? What financing sources are available or could be secured?

These layers of analysis are shown in Figure 4 (page 24).

Table 5.
Some examples of criteria and indicators of relevance to FLR assessments

Focus of assessment	Examples of criteria	Examples of indicators
Need for FLR	Soil degradation	Susceptibility to erosion
	Disturbance and deforestation	Primary and secondary vegetation; historical land cover
	Flood risk	Major flood areas during last 50 years
	Topography	Slope > 8.5° (15%) i.e. > a moderate slope
Type and potential of appropriate FLR interventions	FLR potential	Presence and location of any ongoing or completed restoration initiatives
	FLR type	Categories of restoration interventions already implemented
	Appropriateness of different FLR interventions	Assessment of success of previous restoration initiatives
Scope and availability of land for FLR	Competing interests for land	Sectoral strategies/plans (e.g. industrial or agri-business development)
	Land cover/land use constraints	Roads, railways, settlement areas, rocky outcrops, etc.
	Social availability	Presence of well-functioning community conservation areas, community-managed forests
Economic costs and benefits of FLR interventions	Costs of FLR interventions	Estimated costs of existing FLR interventions in the area
	Improved local livelihoods	Market for non-timber forest products; estimated productivity and profitability of timber production
	Improved productivity	Estimated productivity gains from agro-forestry; estimated fisheries productivity gains from restored mangroves
	Improved connectivity of protected areas	Distance between existing protected areas; potential for strategic reforestation to connect existing protected areas
	Carbon sequestration	Estimated carbon sequestration achieved by different restoration interventions, from global or national studies
Legal, institutional, policy and financial limitations/ opportunities	Government policies and laws	Government policy papers and strategies on land use, conservation, restoration, etc. Land tenure regimes (formal and customary) in operation
	Institutional arrangements	Financial rates of return from previous restoration initiatives
	Financial conditions	Funding sources used for previous restoration initiatives

Table 6.
Some of the assessment criteria and indicators defined for the Mexico assessment

Criteria	Indicators
Ecological factors	
Soil degradation	Vulnerability to erosion, by soil type
Fire	Resilience to fire
Poorly represented, globally important ecosystems	Mesophyll forest; mangroves
Connectivity between protected areas	Distance to protected areas
Disturbance and deforestation	Economic pressure index
Socio-economic factors	
Conflicts over forest land use	Comparison between actual and potential land use
Potential effectiveness of forest restoration interventions	Deforestation risk
Legal status of land conservation	Lands belonging to the protected areas network

The indicators shown here relate to specific national-level GIS datasets that the assessment team used as proxies for the assessment criteria.

Planning the work

Identifying data and capacity needs

Data requirements
At this stage, you can start thinking about what kinds of data you will need. While most of the data will probably need to be spatial in nature – that is, either in mapped form or easily mappable – other data will be in the form of contextual reports and studies, particularly those related to policies, strategies and programmes as well as various kinds of socio-economic data.

If you are already aware of specific gaps in the data you will require, you will need to decide whether these gaps can be addressed and, if so, how. While it may be possible to commission new information-gathering exercises such as field surveys, interviews with key stakeholders or professional interpretation of new satellite imagery, this should only be done if absolutely necessary; ROAM is explicitly designed to work with existing data, even when these are limited. In general, opt to use simpler or readily available data sets; don't make provision to commission major pieces of analysis if there is any doubt on whether they will be delivered in time. This is particularly important for new geospatial and economic data, as reliance on data that are not produced within the required timeframe could derail the whole assessment. In general, avoid an over-reliance on geospatial data alone.

A more pragmatic approach to address data gaps is the use of Delphi-type surveys. A Delphi survey involves collecting opinions from relevant experts over several iterative rounds with the results of each round given as feedback to the survey participants, allowing them to comment on and refine the collective knowledge of their peers. It is also acceptable to use values generated for other areas with similar characteristics to the assessment area, as long as it is made clear that the analysis is based, in part, on secondary source data. For example, in the Ghana assessment, economic cost and benefit data were scarce, so the assessment process built in a Delphi-type expert assessment to produce credible estimates that could be used in the absence of formal, peer-reviewed economic surveys. The earlier you undertake these types of work-around solutions the better, since these kinds of exercises, while not requiring a large amount of man hours to do, require a few weeks to collect responses.

You may also need to look for proxy indicators for some of the criteria you have selected, if directly related data are not available. For example, variations in the local market price of unprocessed fuelwood can act as a reasonable proxy indicator of firewood scarcity or abundance.

Capacity needs
Once you have some idea of the kinds of information you will need and how much data is readily available, you can see whether the capacities of the assessment team will need to be supplemented by identifying and calling on additional in-country expertise. For example, you might need to secure the help of national experts to prepare and analyse GIS maps using different series of spatial data (e.g. land cover, land use, etc.) Or you may want to consult with key academics or other experts in the country on other information about land and resource tenure, cultural norms, and social conflicts over resource use within the assessment area.

The key strategic question at this stage is how best to combine the expertise of local and national experts ("best knowledge") with existing datasets, maps and literature ("best science"). A combination of technical expertise, stakeholder engagement and other data sources tends to give the optimal result.

Planning for stakeholder engagement

The next task for the team is to identify the main stakeholder groups relating to FLR in the assessment area. Stakeholder groups can be categorized in different ways, and for the purposes of the handbook three types of stakeholder are identified (as shown in Figure 9):

- **Primary** (or direct) stakeholders who have a direct interest in the resource, either because they depend on it for their livelihoods or because they are directly involved in its utilization. Primary stakeholders may include farmers, pastoralists, harvesters of forest products and private enterprises operating within the assessment area. None of these is necessarily a homogeneous group; for example you may need to distinguish different groups of farmers according to wealth, size of landholding, or numbers of livestock. Such groups have different resources, different degrees of commercial orientation, and would normally favour different land-use options in any future FLR programme. Gender differences in particular need to be considered. If the assessment area includes community lands, elected community representatives need to be involved.

- **Secondary** (or indirect) stakeholders who have a more indirect interest, such as those involved in institutions or agencies concerned with managing the resource or those who depend at least partially on income or business opportunities generated by the resource. Secondary stakeholders could include local, regional and national government agencies with a strong influence over forest and land management in the assessment area.

- **Interest groups** who are those individuals or organizations that are not affected by, and have no direct influence over the FLR process, but who have significant interest in the outcome of FLR. These might include, for example, international and national NGOs interested in environmental protection, biodiversity conservation and poverty reduction.

Figure 9.
Typical stakeholder groups relevant to a ROAM application

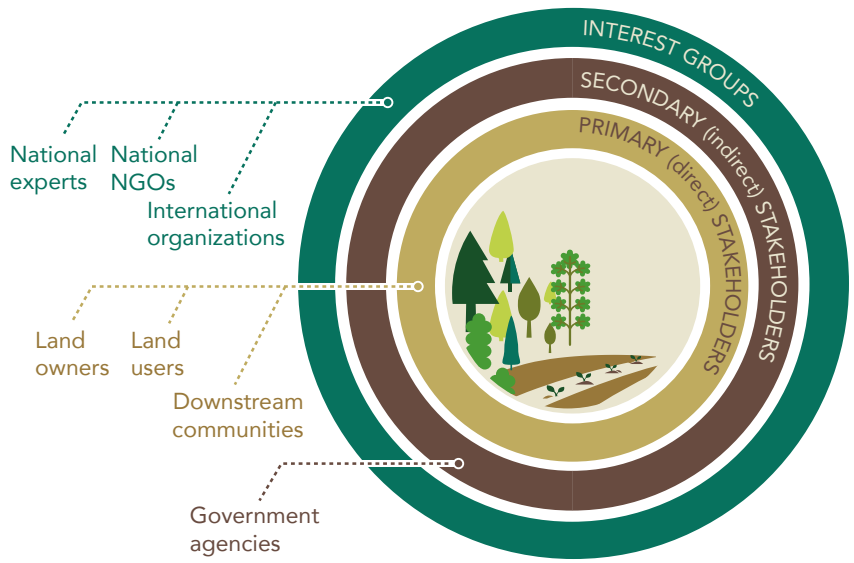


Table 7 lists some typical examples of stakeholders in these three categories, their likely interests and their potential roles in relation to an FLR assessment. Discussions among the assessment team and with other people familiar with the assessment area will help identify the key stakeholder groups of relevance to the assessment. The team will then need to plan how and when they will select and engage representatives of these stakeholder groups during the assessment process. A clear distinction needs to be made between those stakeholders participating on their own behalf and those with a legitimate mandate to represent a wider stakeholder group. Balanced stakeholder involvement is a critical aspect of a successful assessment to ensure that the analysis is properly informed by their knowledge and experience, and takes into account their views on the potential impacts of FLR on their livelihoods and interests.

Ideally, the team will reach out to stakeholders as early as possible in the assessment process, to allow their knowledge and perspectives to be brought into the discussions and analysis alongside other inputs including scientific data. However in some cases there will not be sufficient information available at the early stage to be specific about land management in degraded areas, so it may be necessary to periodically reconsider and reassess which additional stakeholders need to be included in the assessment process as it develops.

The choice of the institutional home of the assessment will influence the engagement of stakeholders, as each institution has its own sectoral stakeholder relationships. It is important to compensate for any bias that this may lead to, for example by actively engaging stakeholders in the agricultural sector if the institutional home is in the forest sector.

The assessment team also needs to be strategic and proactive in keeping key stakeholders well informed about the process and emerging results, in order to ensure knowledge uptake among the individuals and agencies that will be critical in any follow-up activities (e.g. those involved in the country's Forest Investment Programme). This might entail, for example, targeted written communications, individual meetings and invitations to the inception, analytical and/or validation workshops.

Depending on the timeframe and context of FLR interest within the country, the team may wish to issue occasional updates on the process to a more general interested public. Once the assessment is complete, the results can then be published and reported on nationally and internationally.

The final section of this handbook offers guidance on entry points for encouraging uptake of the national assessment findings and any recommendations that emerge from it.

Table 7.
Interests and potential roles of different stakeholder groups

Stakeholder category	Stakeholder groups	Stake / interest	Potential involvement in FLR assessment
Primary (direct) stakeholders	Land users in the landscapes	These are the people who historically or currently use the degraded land that is being targeted for restoration. They will be the most involved in any effort to restore degraded land, and will also be the ones to benefit the most. There may be many different types of land users (cultivators, herders, women, youth, rich / poor farmers, large / small farmers etc.).	Representatives should be identified and invited to the relevant workshops and consulted and involved regularly as the assessment proceeds. It may be necessary to commission specific pieces of work to ensure their opinions are adequately reflected.
	Land owners in the landscapes	These are likely to be customary leaders or local authorities. They have a stake in ensuring that their land is better managed in the future. Their role in the process is to represent the customary or statutory owners of the land and make sure that they understand the implications of FLR for them as landowners. Note that in some countries ownership may not be clearly defined.	Efforts should be made to check if there are clearly identifiable public and/or private land owners in the degraded areas and if so, invite them to participate at the relevant workshops. As with land users, efforts need to be made to communicate to, and involve, this group throughout the assessment process.
	Downstream communities	Communities and businesses living downstream from a water catchment will have particular interest in how land is managed in an area from which their water flows, since land management may affect the quantity and quality of water available to them downstream.	Representatives may be invited to the relevant workshops and/or community-level presentations of the assessment results.
Secondary (indirect) stakeholders	Government agencies	National and decentralized government institutions responsible for forestry, agriculture / rural development, environment, water resource management, land management, land cadastre, etc.	Key agencies should be closely involved, and may actually be represented in the assessment team. These stakeholders will need to be consulted at major decision-making points, and/or invited to review results. Other agencies can be invited to send representatives to the relevant workshops.
Interest groups	National experts	Experts with special knowledge about, e.g. the national and/or local landscape, the appropriate techniques for restoration, and the costs and benefits involved.	These experts should be identified and involved, particularly to help fill data gaps.
	National NGOs	NGOs with interest in nature conservation, environmental protection, or rural development.	Representatives can be invited to the inception and/or validation workshop, and kept informed of the assessment results.
	International organizations	International organizations with interest in, e.g. conservation of nature and mitigating climate change.	Representatives can be invited to the inception and/or validation workshop, and kept informed of the assessment results.

Organizing the inception workshop

The assessment team should if at all possible organize an inception workshop to inform key stakeholders of the potential for FLR and engage their interest and involvement in the ROAM process right from the start. This is essential in order to obtain political and professional ownership of the assessment process and commitment to its results. Depending on the scale of the assessment, the workshop will be at a national or sub-national level.

Invitees should include decision-makers and experts from government ministries, departments and agencies, as well as technical experts from NGOs, research institutes and the private sector. Other stakeholders important to the assessment process and/or any follow-up actions should also be invited, including for example representatives of communities and field staff working in the degraded areas to be covered by the assessment.

Typical objectives of an inception workshop would include some or all of the following:

- Assess the opportunities for FLR in the country/area;
- Share information on existing FLR activities in the country/area;
- Share an overview of the strategy, parameters and plan as developed by the assessment team;
- Invite feedback on these ideas and plans;
- Discuss options for institutionalizing FLR in the country; and
- Explore how the potential for FLR could be integrated into national REDD+ strategies.

Summary of 'preparing and planning' phase

Table 8 shows a summary of the main tasks involved in preparing for an assessment.

Table 8.
Summary of parameters and questions to consider in planning an assessment

Key parameters	Some questions to consider
Define the **problem** and **objectives** for FLR in the assessment area	• What are the major land-use challenges? • How can FLR help address these challenges? • How can FLR contribute to national policies on, for example, rural development, food security, natural resource management, conservation?
Engage with key **partners**	• Which institution(s) would be most suitable for leading the assessment? • Which other institutions should be closely involved? • What knowledge and skills are needed on the assessment team? • Which in-country individuals can be brought onto the team?
Define the **specific outputs** of the assessment	• What are the desired outcomes from the assessment? • What can the assessment realistically deliver, given time and resource constraints?
Define the **geographical scope** of the assessment	• At what scale will the assessment be done (national or sub-national)? • Is this feasible, given the resources available?
Stratify the assessment area	• What are the main distinguishing features (in terms of restoration-relevant characteristics) between different parts of the assessment area? • What are the factors (physical, social, economic) behind this heterogeneity? • Can we base the stratification on the area's agro-ecological zones?
Identify a preliminary list of **potential FLR interventions**	• What kinds of restoration interventions do we know exist or are feasible in the area? • Which other kinds of restoration might be possible?
Identify the **criteria** and **indicators** of relevance to the assessment	• What ecological and socio-economic restoration-relevant factors are we interested in? • What spatial data are available on these factors? • Are other data available that we could use as proxy indicators?
Identify a preliminary list of the **data required** to conduct the assessment and compile an inventory of all **available data** relevant to the exercise	• Given the criteria and indicators that have been identified, what data is needed to assess the potential for FLR, and prioritize potential FLR areas (if this is a desired output)? • What data is available and where is it? • What is its quality and scale? Is the scale appropriate for the scope of the assessment? • What major data gaps exist?
Identify **capacity** within the assessment team and **potential resource persons** outside the core team	• Who has knowledge about the subjects or of specific degraded areas that could assist the assessment team?
Identify which **stakeholders** need to be involved, how, and when	• Who has a stake in restoration? • When and how to engage them? • Who do we want to keep informed about the progress and findings of the assessment? • What is the best way to inform them (individual meetings, in a workshop setting, via email, in writing, etc.)?
Inception workshop	• What do we want out of this workshop? • Who should we invite to achieve this?

Do you have experiences to share on the preparation and planning of an assessment? Write to gpflr@iucn.org to let us know how we can improve this aspect of the methodology.

Phase 2: **Data collection and analysis**

This chapter covers the core phase of ROAM, involving the collection and analysis of data. The data collection activities are described first (although in practice the sourcing of information and data will continue throughout the analysis stage of the work), followed by brief guidance on five discrete analytical components, as outlined in Table 9.

The handbook's descriptions of these five analytical components (or 'tools') are primarily intended to help readers consider and plan these pieces of work. Additional publications will be produced in 2014 and 2015 to provide more detailed guidance on how to conduct these analyses.

This is the phase of the work which will vary most from one national application to the next, in terms of the techniques used and the process undertaken. Nevertheless in most situations it should be possible to deliver the following analytical products:

- A refined list of priority restoration interventions, based on a review of the initial interventions identified;
- A spatial analysis of restoration potential, including a series of national opportunity maps;
- An economic analysis of the costs and benefits associated with the identified restoration interventions;
- An analysis of the carbon sequestration potential and the associated co-benefits;
- A diagnosis of the presence of key success factors for restoration, that examines the opportunities and challenges presented by the prevailing legal, institutional, policy, market, social and ecological conditions, as well as the implementation capacity and resources and the level of motivation among key actors; and
- An analysis of the financing and resourcing for the implementation of the identified FLR opportunities.

However, while ROAM is capable of delivering all of the above, the choice of which products are actually required is a decision that is based on national priorities and available resources. The positive thing with ROAM is that investing in one product at one point in time does not preclude the delivery of others later on.

Table 9.
Summary of the analytical components of ROAM

Component/tool	Objectives	Page
Stakeholder prioritization of restoration interventions	• Conduct and refine the analysis of the priority restoration interventions	58
Restoration Opportunities Mapping	• Identify major areas of restoration potential within the assessment area. • Categorize these opportunity areas (e.g. by general type of restoration (wide-scale, mosaic, protective) or by priority (high, medium, low). • Assess which restoration interventions would be most appropriate for these areas (e.g. agroforestry on steep slopes, natural regeneration of forest land).	68
Restoration Economic Modelling and Valuation	• Estimate the additional (marginal) costs and benefits (financial, carbon, livelihoods, biodiversity, etc.) of each of the restoration intervention types under consideration. • Assess how sensitive these cost and benefit estimates are to changes in key variables (such as prices, interest rates, and biological assumptions).	83
Restoration Cost-Benefit-Carbon Modelling	• Estimate and analyse in more detail the carbon sequestration benefits which could be gained from: (a) the overall restoration potential identified; and (b) each of the restoration intervention types under consideration. • Estimate the net value of anticipated additional benefits per ton of CO_2 sequestered, per restoration intervention type.	90
Restoration Diagnostic of Presence of Key Success Factors	• Assess the extent to which the country (or region within the country, if ROAM is used at a sub-national level) is 'ready' to develop restoration strategies and programmes. • Identify gaps and weaknesses (e.g. in the legal, institutional and policy arrangements, or in the market conditions). • Identify and analyse potential ways to address these gaps and weaknesses.	94
Restoration Finance and Resourcing Analysis	• Identify the types of finance and resourcing options available to support national FLR strategies or programmes. • Assess which types of funding options would be most appropriate for the different restoration intervention types.	98

In developing these products, the most important things to bear in mind are to:

- Try to maintain an adequate balance of expertise and perspectives among those involved in the analysis, including agriculture, land, forests, water, economic development, energy, gender, etc.;
- Bear in mind the needs of the key end-users when considering the most appropriate outputs to aim for in this phase. Periodically assess whether the emerging insights talk directly to national priorities;
- Ensure that everyone involved in the analysis understands the process and is clear about the kinds of outputs being sought;
- Make sure that the analytical process is as intellectually robust and scientifically defensible as possible; and
- Be transparent, when sharing results, about the analytical techniques used and any subjective decisions taken (e.g. weighting of criteria, setting of threshold levels).

It is also important for the assessment team to revisit: (1) the assessment criteria (see pages 42); and (2) the preliminary set of restoration options (see pages 38) during the data collection and analytical phase. The reason for this is that the insights gained during data collection and from spatial and economic analysis will invariably challenge some of the initial assumptions the team worked with during the preparatory phase. For example, spatial analysis may indicate that an identified restoration option is simply not feasible because it directly competes with agricultural land, or soil erodibility may prove not to be a useful assessment criterion because data exist for only a very limited area of the entire national territory.

Do you have experiences to share on data collection and analysis for assessing restoration opportunity? Write to gpflr@iucn.org to let us know how we can improve this aspect of the methodology.

Stakeholder prioritization of restoration interventions

Data collection and analysis may sound as if it is a rather straightforward and technically driven process. However in this case it requires proactive stakeholder engagement in the analysis and a regular revisiting of the underlying assumptions that were used during the preparation and planning phase. This is necessary because it is quite common to encounter significant information gaps or outdated and inaccurate narratives about land degradation, land-use dynamics and ongoing restoration policies.

One example illustrates this point. In the West African state of Guinea, it was a widely held belief among government officials and conservationists that islands of dense forest in savannah landscapes were the last relics of previously extensive forest cover that had been lost during the early and mid-20th Century, due to poor land-use practice. Indeed, if one was thinking of landscape restoration in this area in the 1980s, one conclusion would have been to enforce protection in these areas from local use and to build outwards from these so-called 'relic' areas. That would have been a mistake as Fairhead and Leach illustrated in their excellent book 'Misreading the African Landscape' (Fairhead and Leach, 1996). What were officially regarded as relic old growth forests were in fact relatively recently created forest islands by local communities. Indeed, these areas of forest were evidence of a type of landscape restoration and rather than restricting communities' activities, forest policy would have been better directed at encouraging and building on this type of activity.

The analytical phase of ROAM therefore offers a quick and unique opportunity to take a fresh look at established understanding of land-use change. Spatial analysis offers a good snap-shot of the mosaic of land uses across the landscape at one point in time but in order to place that understanding in a broader context of forest landscape restoration opportunities local stakeholders and different government agencies will need to be brought into the analytical process. As the ideal situation is to get these different perspectives into the same room to give their collective opinion on preliminary data analysis, a series of analytical workshops – either by sub-national region or theme – is an essential part of this phase.

These analytical workshops should be designed to seek the input of a wide range of stakeholders and to have them respond to the interim results from spatial analysis and mapping. They also provide the opportunity to garner further refinements to the list of restoration options and analysis of their potential implications. Any questions raised can then be followed up with specialist analyses, such as detailed valuations of costs and benefits and calculations of carbon sequestration for the different restoration options identified.

The desired number and mix of participants will inevitably vary, depending on the objectives of the workshops. However it is very important to get a good mix of technical expertise and stakeholder perspectives (and particularly to avoid an over-representation of professional foresters), as well as a good gender balance. Among those you may want to invite are:

- Forest agency staff (decision-makers and technical staff)
- Land agency representatives
- Agricultural agency representatives
- Local government officials
- Local chiefs and/or leaders
- Farmers
- Forest companies (commercial and community-based)
- Landowners and those with customary rights over land or natural resources
- Forest users (charcoal producers, non-timber product harvesters, firewood sellers, etc.)
- Non-governmental organization representatives
- Researchers
- Indigenous peoples (if present in the area)

The assessment team may find it helpful to engage stakeholders with a reliable, up-to-date base map of FLR-relevant features for the assessment area. In a data-rich country, a pre-existing map is likely to be available and the team simply needs to procure and reproduce this map in an appropriate format (a large poster format is best).

In a country where no such map exists, the team may need to commission one. The base map produced for the FLR assessment in Ghana is shown in Figure 10.

The characteristics of a good base map will depend on the assessment area. Here are some points to consider:

- The ***scale*** should be such that, when the map is printed as a table-top size poster, it shows the area of assessment with appropriate resolution;
- The map must have a ***scale bar*** on it so that working groups can determine the size of any block of land during the assessment;
- The ***theme*** of the map should support the assessment. A map that shows populated points and infrastructure against a background of land cover types, density of tree cover, and watercourses is generally appropriate. Other topographic features, such as mountains, should also be included if significant;
- The map needs to be sufficiently ***accurate*** and ***up-to-date*** to allow the participants to arrive at informed interpretations about the landscape.

Figure 10.
Base map produced for the ROAM application in Ghana

This pre-existing map, showing Ghana's current forest cover, was used as the starting point for the country's national assessment. Participants at the analytical workshop worked in small groups, each focused on a different region of the country, to identify and map areas of restoration opportunity directly on poster-sized versions of this 'base' map.

The rigor of the analytical phase is contingent on having a well-defined set of criteria that enables a credible assessment of the need for restoration, the availability and scope of land for restoration, the types and potential of appropriate restoration interventions, the costs and benefits of these restoration options and the presence of key success factors. The assessment team will have already worked on this task (see pages 38 to 45), so stakeholder engagement should include, as appropriate, a review of these criteria and a discussion on any necessary additions and changes. Refining the criteria and indicators for the assessment tends to run concurrently with the refinement of restoration options (see below). A worked example is provided in Box 5.

Box 5.
Refining the assessment criteria: example from Rwanda

In the Rwanda assessment, several criteria were initially identified, related to the protective function of forests – this included upper catchment protection, gullies and gully formation, riparian strips, wetlands, siltation and water quality. During the early stage of the assessment, potential indicators and indicative interventions were identified and discussed with different stakeholders. However by the time that supportive data were collected and analysis undertaken it was apparent that land pressure and economic constraints would limit the opportunities to treat each of these as a significant intervention. The team also ran into some practical challenges of accessing sufficiently reliable data on the expected costs and anticipated benefits of each situation.

During the refinement process these challenges were resolved by re-examining the issues and simplifying the approach. Common to each situation (riparian strips, gullies, hill tops and ridges) was the fact that: (1) the main benefit was protection of soil and water; (2) any intervention on any site would be limited to very discrete areas that were not under intense competition from another land use; and (3) the protective functions would be optimized by establishing mixed stands of native species rather than monoculture stands of exotics.

The team then simplified the criteria to one of protective forest function and redefined the criteria (for GIS analysis) to very specific and discrete parameters – e.g. steep slopes greater than 55%, 20-meter buffers by major water courses, etc. At the same stage, five broad types of land use/potential intervention were grouped and reclassified to a single type – protective forests.

Using the preliminary list of locally-appropriate restoration interventions drawn up earlier (see page 38) the assessment team can now work with other stakeholders and experts to refine the specific restoration options identified during the preparatory phase.

As an example of the iterative, refining process of this stage of analysis, the number of candidate FLR interventions in Rwanda was eventually reduced from 21 (as shown in Table 3) to eight (see Table 10), based on the feedback from stakeholders as they reviewed the results of spatial and economic analysis. For example, as evident from Table 3, the single most relevant intervention around woodlots was improved management of small woodlots. Subsequent GIS analysis confirmed that this was where the largest single gain could be achieved and given current land-use pressure there was, with a few exceptions, very little land for new woodlots or plantations. Therefore, improved woodlot management eventually emerged as the most credible intervention among the eight initially listed under the headings 'Woodlots for biomass' and 'Industrial timber plantations'. This does not mean that other specific interventions in this category are irrelevant, simply that the local conditions are such that it is difficult to envision any of them being able to deliver FLR at scale.

Table 10.
Revised listing of most appropriate FLR options, from the Rwanda assessment

These top 8 candidate FLR options were identified from an initial list of 21 — see Table 3 (page 40).

Type of intervention /land-use	Top candidate FLR option
Agroforestry	Agroforestry on flat lands
	Agroforestry on sloping lands
	Agroforestry on pasture lands: farmer-managed natural regeneration
Improved woodlot and timber plantation management	Improved management of existing small woodlots for fuelwood or structural wood
	Improved management of existing industrial timber plantations (pine)
Natural forests	Restoration of natural forests in or around protected areas
Protective forests	Restoration or establishment of protective forests on steep lands (55%)
	Restoration or establishment of protective forests on very steep lands (20%-55%)

Table 11 shows the results of this refinement step from a different ROAM application – the Ghana assessment. It should be noted that in this case the list of specific interventions was considered too extensive to enable a rigorous analysis of each intervention. This experience subsequently led to the recommendation to limit the number of specific interventions to between 5 and 15.

Table 11.
List of locally adapted FLR interventions (example from Ghana)

Land Use	General category	Specific restoration interventions	Description
Forest Land - suitable for "wide-scale" restoration	1. Planted forests	Exotic plantations	Primarily teak plantations. Variations in mean annual increment were reported during workshops because of differences in climate and soil productivity. Rotation length of 20 years.
		Fuelwood lots	Rotation length of 8 years and re-growth occurs through coppicing. Workshop participants reported higher growth rates in wet climates and areas with rich soil.
		Indigenous plantations	Plantations of Terminalia ivorensis and commercial Meliaceae. Northern regions of Ghana may contain plantations of tamarind or other indigenous species.
	2. Natural regeneration	Direct seeding	Involves preparing restoration site and seeding to connect separated forest patches. More expensive interventions in this group include added measures for fire prevention.
		Prevention of overgrazing	Could involve community agreements to exclude grazing using community management. Could also involve additional patrols in forest reserves.
		Weed suppression	Selective management favouring natural regeneration of desirable species and limiting disturbances.
		Wildfire prevention	Excluding fire from otherwise undisturbed native areas to enable natural regeneration.
	3. Silviculture	Bush fire prevention	Preventing fire in degraded forest landscapes.
		Direct seeding	Using silvicultural practices with seeding to connect separate patches of degraded forest.
		Enrichment planting	Using silvicultural practices with seedlings to connect separate patches of degraded forest.
		Restricted grazing	Using silvicultural practices in combination with community managed grazing restrictions.
Farmed land - suitable for "mosiac restoration"	4. Agroforestry	Intercropping with food crops	Establishing leguminous trees at approximately 50-150 trees per hectare.
		Intercropping with cocoa	Intercropping with commercially valuable, shade providing species.
		Silvopastoral	Planting and managing leguminous and/or protein rich trees either on pastureland or wood lot/stall feed systems.
	5. Improved fallow	Contour management	Retain rows of leguminous and woody tree species along the contours of sloping land during fallow preparations in order to improve soil stability and prevent erosion.
		Fallow enrichment	Improve fallow through low-density establishment of leguminous trees and/or selection of naturally occurring beneficial trees.
		Fire management	Proactively excluding fire on fallow areas to optimize the formation of organic matter.
Protective land and buffers - suitable for mangrove restoration, watershed protection and erosion control	6. Mangrove restoration, watershed protection and erosion control	Improved management of degraded shoreline	Using community management to prevent further degradation of shorelines and promote regeneration.
		Shoreline restoration	Restore degraded shorelines and mangrove systems using direct establishment.

Data collection

You will already have drawn up a list of the kinds of data you need to collect and a list of data that you understand to be actually available and accessible.

You should aim to review and collate as much relevant data as possible before the first analytical workshop. Subsequent analytical workshops will also produce considerable amounts of secondary data, information and insights from the participants' discussions. Time should be allowed for refining the assessment results on the basis of this new information.

Table 12 shows some of the kinds of data you may want to consider for the assessment.

Table 12.
Potentially relevant data sets for a ROAM application

Issues	Potentially relevant data
Physical and ecological	Geology, soil conditions, rainfall, slope, current land cover, historical land cover, land degradation, flood risk zones, deforested areas, fire resilience, biodiversity hotspots, endangered species ranges, protected areas, water quality, forest species richness, stand density, endangered ecosystems (Red Listed), crop yield data, timber growth data
Social and economic	Current land-use, agricultural plantations, forestry concessions, mining concessions, no-go zones, community conservation areas, certified forestry operations, land ownership, population density, population change in forest areas, poverty levels, community-managed forests, gender-differentiated management, effectiveness of protected areas, sacred forests, ethnic groups, economic costs of different restoration options, profitability of community forestry enterprises, productivity gains from agroforestry, market prices of relevant goods and services, management practices for each restoration intervention
Policy, legal and institutional	National climate change mitigation, adaptation strategies, conservation policies, restoration policies, forestry development policies, agricultural development policies, statutory and customary land and resource rights, major infrastructure programmes, development corridors, existing major restoration initiatives

Sourcing relevant data

There are three main ways of sourcing relevant data for the assessment:

- **Collecting data directly from experts and stakeholders.** Workshops, interviews and other meetings capture knowledge and perspectives from those who are familiar with the assessment area.
- **Using existing data sources.** Requesting pre-existing data from technical agencies, statistics bureaux and research institutions searching the Internet and consulting specialist libraries and data collections for relevant maps and other secondary data.
- **Commissioning new information-gathering exercises.** If necessary, commissioning new pieces of work such as surveys, satellite imagery and calculations to fill specific data gaps, verify existing data or update old data.

Remember, when looking for spatial data, focus on what is available at a scale appropriate for the assessment.

Stakeholder surveys
Surveys can be a powerful tool for collecting basic data. In the Ghana national FLR assessment, surveys were used with good results to collect information about the establishment and operating costs of restoration projects. The assessment team sent out approximately 30 surveys to land owners and land managers who had recently restored all or part of their land. The surveys collected information on a detailed breakdown of operations and their unit costs per hectare for each restoration intervention and provided a means for collecting more detailed information than would be possible in a workshop setting.

Existing maps
Existing maps, if up-to-date and reliable, are a valuable source of data for assessments. In Mexico the assessment team held several technical meetings with national institutions such as the Forestry Commission and the Commission on Protected Areas, to request digital thematic maps of variables relevant to the assessment criteria. The officials of these institutions provided digital copies of the maps as well as background documentation and metadata. The officials also provided valuable explanations and recommendations on how to process the information. The team was able to obtain a good number of relevant maps and data sets on a wide range of variables including, for example, forest zoning, economic pressures on forests, soil conditions for plant growth, fire resilience, and potential land use. Most of these maps were available at a scale of 1:250,000 which is quite sufficient for a national-level assessment.

Scientific literature
Literature can be particularly useful to find data on growth rates of different tree species and restoration interventions, particularly if local growth and yield tables are not available. The FAO's Global Planted Forests Thematic study (FAO, 2006) contains several tables that give Mean Annual Increment values for dozens of common tree species across a variety of climate zones.

Specially commissioned maps
Where existing maps are not sufficient, new ones may be commissioned for the assessment. In Ghana, the existing land cover map was considered outdated as many land-use changes were known to have occurred since it was produced in 2000. A university was therefore contracted to produce a new land-cover base map using imagery from Landsat 7. Three mosaics of Landsat images were created at 60 metre ground resolution, representing the years 2000, 2005, and 2010. The new base map was used to produce a series of 'table top-size' regional maps ranging in scale from 1:200,000 to 1:600,000 depending on the size of the region. The regional maps were subsequently used in the analytical workshop.

Data to inform a critical look at restoration options

During the preparatory phase, the team will have drawn up a preliminary list of appropriate types of FLR interventions. While this may appear a relatively straightforward exercise, it is one of the critical steps on which the success of the assessment depends. The risk is that the interventions are assumed to be the most appropriate ones based on no other reason than "this is the way we have always done things". It is critical that this step is approached with an open mind and that long-standing assumptions are challenged as new data and analysis emerge.

One benefit of using ROAM is that it opens the door to take a fresh look at why past or existing interventions failed or only partially succeeded. For example, if national tree planting days, despite decades of effort, have produced very little tangible results on the ground, the assessment should be able to shed some light as to why this is the case. Above all, the final set of FLR interventions needs to withstand basic scrutiny as to why these would constitute the "best bet" for a national or sub-national restoration strategy.

Bearing this in mind, the aim of this particular exercise is to gather as much data as possible on local FLR options and interventions – even if these are of a preliminary nature or based on rough estimates – before the analytical workshop(s). The workshop participants can then help refine or supplement these data and use them for the analysis, while also considering the relative successes of ongoing or previous restoration efforts. Ultimately, the assessment should aim to produce a limited list of FLR interventions that have been rigorously evaluated to be nationally appropriate and that are underpinned with sufficient technical detail and quantified analysis to permit reliable and realistic evaluation of the extent of area that could benefit from these interventions and the costs and benefits associated with them. As a rule of thumb, the final assessment should have approximately 5-15 technically and/or geographically distinct interventions. Any less and the analysis becomes too generic, any more and it is unlikely that the associated parameters of the interventions can be reliably assessed without excessively inflating the costs of assessment. See page 61 for more details on finalizing the listing of FLR options.

Data on the costs and benefits of restoration

Central to a national assessment of FLR potential is an analysis of the costs and benefits of each specific FLR intervention (see pages 83 to 89). This will require data to be collected on relevant values, such as the prices of inputs (e.g. seedlings, land, labour, transport and equipment) and outputs (e.g. crops, timber and fuelwood, as well as specific services provided by the restored ecosystems). Timber growth rate data, such as mean-annual-increment, would also be helpful in order to estimate the potential of timber production and carbon sequestration.

Wherever possible, data should also be gathered on the economic benefits of restoration, based on the long-term objectives for FLR that were set out at the beginning of the assessment process. For example, if one of the objectives is related to watershed restoration the team should try to obtain information or estimates on how restoration might be expected to modify the water flow into streams and tributaries as well as information on how the water would eventually be used and who would be the primary beneficiaries.

There is no hard-and-fast rule on which cost-benefit data to gather, but generally the following estimates will be useful:

- The amount per hectare of woody biomass that would grow over the agreed time period. Where possible, estimates should be corroborated with data from literature and questionnaires. Estimates would also need to be adjusted based on expected levels of harvest over the agreed time period.
- The amount of carbon sequestered through growth of woody biomass, using applicable IPCC conversion factors.
- The value per hectare of non-timber forest products produced over the agreed time period. Use local estimates if available, otherwise general estimates.
- The crop yield increase and fertilizer cost reduction from agroforestry over the agreed time period. In the Ghana assessment, for example, the expected gain in crop productivity was modelled as a function of the avoided losses in yield due to improved soil erosion control.
- The effect of shifts in intercropping schemes over the agreed time period, such as a transition from open-grown cultivation of cocoa to shade-grown cocoa. Local estimates are likely to be available where such a transition is an important consideration.
- The effect of mangrove restoration, over the agreed time period, including for example the combined effect of an increased fish catch and increased supply of building materials. Local estimates are likely available where mangroves are important.

If possible at this stage, it is desirable to separate out whether costs/inputs are derived from public or private sources and equally whether benefits accrue primarily to society at large or individuals. The reason for this is that such distinctions can be useful later on in helping to define feasible investment packages – for example, making sure to avoid suggesting schemes or interventions where benefits accrue centrally but where the majority of inputs (finance, labour) are made locally or at the individual level.

Restoration opportunities mapping

This is a key element of the whole assessment process, involving the analysis of spatial data and any other restoration-relevant information that the team has been able to acquire (statistical data, technical reports, etc.) and that can be easily mapped.

The most appropriate approach to take will depend on the quantity and types of data available. If large amounts of GIS data are readily available and permission to use these data sets has been obtained, the assessment team will be able to conduct a large part of the spatial analysis using a 'digital mapping' approach. On the other hand, if only a limited amount of GIS data is available for use, the team will need to use more of a 'knowledge mapping' approach. Digital mapping is the classic GIS approach that builds up a spatial picture by combining layers of digital information and developing algorithms to test and visualize specific options, such as "target contour planting with agroforestry species on slopes greater than 5% on existing agricultural land". Knowledge mapping, as the name suggests, deploys local knowledge and involves a crowd-sourcing approach, whereby different stakeholders transfer this knowledge (and challenge each other's ideas) onto a base map. Once stakeholders agree that this represents their best collective knowledge it can be digitized and used for further analysis.

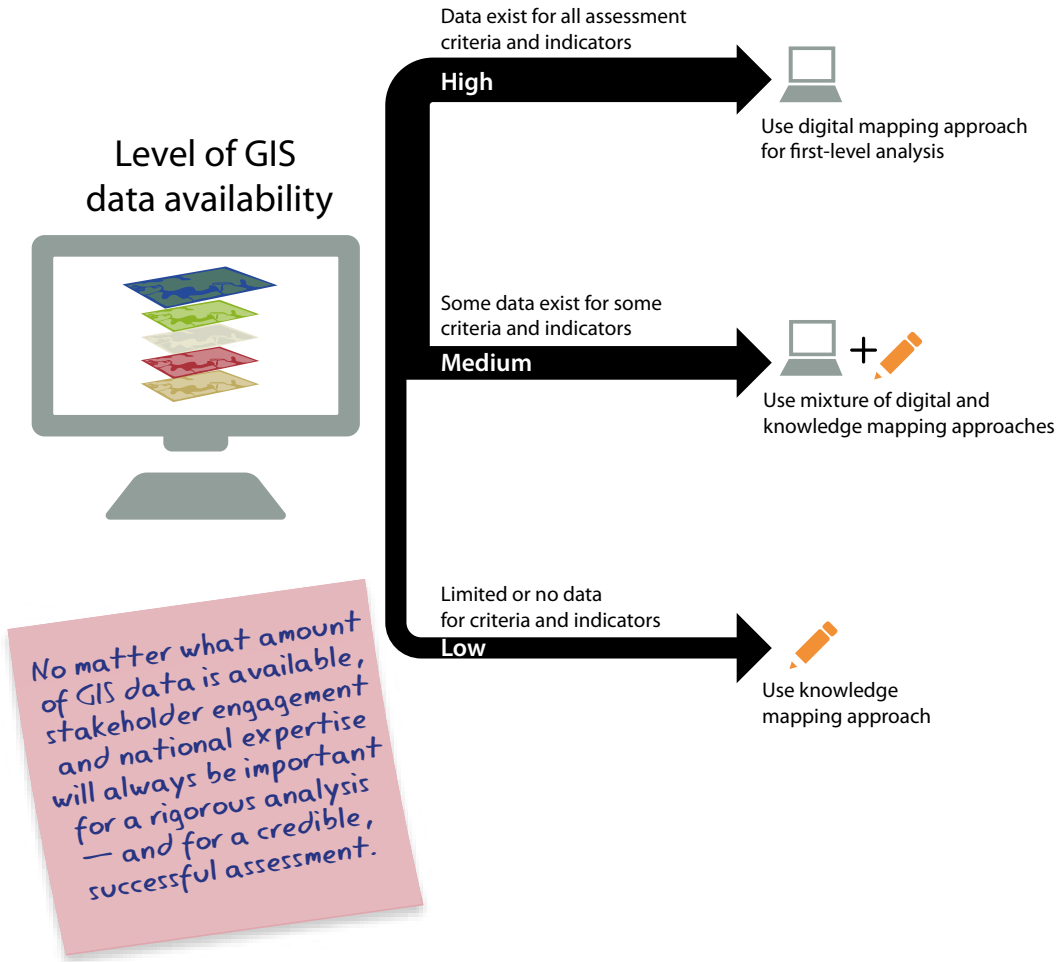
Both approaches have their strengths and weaknesses – digital mapping can be too precise and risks ignoring local realities if the biophysical data indicate that a restoration option is possible, while knowledge mapping captures a richness of undocumented local and technical insights but is not very specific when it comes to landscape-level biophysical constraints. For this reason, assessment teams may prefer to use a combination of these two approaches. This point is illustrated in Figure 11.

The three national assessments undertaken in Mexico, Ghana and Rwanda took somewhat different approaches to spatial analysis in response to the availability of data:

- In **Ghana**, a strong knowledge mapping approach was used as only a limited amount of spatial data was available and the identification of FLR potential relied heavily on the expertise and judgement of the assessment team and the input of expert participants from local communities, local government and technical agencies in the analytical workshop;
- In **Mexico**, a strong digital mapping approach was used, as good availability of GIS maps and data meant that the identification and prioritization of FLR potential could be based largely on pre-existing data sets;
- In **Rwanda**, a combined approach was pursued because, although Rwanda also had good GIS maps and data, the requirements of the analysis meant that different scenarios needed to be tested against expert opinion and judgement formed as to which appeared most viable in the national context.

The knowledge and digital mapping approaches are presented in separate sections, below. However, as highlighted above, they tend to work best in combination and an

Figure 11.
Analysis approach as determined by data availability



assessment would very rarely be entirely knowledge or digital based. Even in situations of good availability of GIS information, gaps and weaknesses in the existing data will always call for input from experts and stakeholders.

Knowledge mapping approach to spatial analysis

A knowledge mapping approach to spatial analysis involves one or more analytical workshops during which the assessment team and other participants manually construct an assessment map, usually at a sub-national level. In practice, this workshop also serves as the opportunity to consider, test and review the other, non-spatial analyses such as the valuation of costs and benefits of the different types of restoration interventions identified.

Knowledge mapping analysis is based on six simple steps:

1. Sub-dividing the area of analysis into polygons that are characterized by similar types of land use and land-use challenges;
2. Agreeing on the specific nature of restoration opportunities that would be both suitable and feasible in the geographic area under consideration;
3. Estimating individual portfolios of restoration interventions by polygon;
4. Gauging the feasibility of implementing these portfolios;
5. Reviewing and revising the restoration options; and
6. Digitizing the results.

Preparing the knowledge mapping analytical workshop
Prior to the workshop, the assessment team should prepare several sets of materials, so that each working group has the same equipment, including the following:

- A table-top sized base map (an example of which is shown in Figure 10). This could be a map specially prepared for the assessment, showing for example areas of degradation, or it could be images captured from Google Earth;
- A scaled quadrant for estimating areas on a map;
- A list of criteria to use in the designation of polygons to different categories of intervention (see discussion below and Table 13);
- A set of polygon description forms (see example in Table 14 on page 75); and
- Any supplementary information (e.g. thematic maps, statistics, reports, etc.).

An analytical sub-national workshop that is built around a knowledge mapping approach will probably take between one and two days; a day and a half should be ample time for the analysis tasks.

Table 13.
Criteria for guiding the designation of polygons to different categories of intervention (example from Ghana)

Type of land	Criteria for polygons	Rules for assigning interventions
1. Land that is **unsuitable or unavailable for restoration**	At least 75% of the area must be unsuitable or unavailable	No interventions.
2. Coastal area **suitable for mangrove restoration**	None – i.e. even small areas can be restored	Only restoration and rehabilitation of mangroves.
3. Land that is **suitable for wide-scale restoration**	Minimum size 1,000 hectares	Only interventions consistent with the wide-scale restoration strategy. Generally only one intervention per polygon.
4. Land that is **suitable for mosaic-type restoration**	Minimum size 40,000 hectares	All interventions are available here including no intervention. Opportunities are assigned as proportions of the total area of the polygon. The locations of individual interventions within the polygon are not indicated.

These guidelines were provided to the analytical workshop participants to ensure consistency across the different working groups in identifying areas and types of restoration opportunity.

Dividing the area into polygons
The aim of this step is to get the participants in the working groups to draw on their collective knowledge to identify particular landscapes or areas where restoration opportunities might exist. Ideally the working groups should contain representatives from different sectors (agriculture, forestry, biodiversity, energy, infrastructure). They will work on table-top-sized base maps, each group covering a different sub-national area (e.g. province or region), dividing it into polygons in such a way that each is coherent in terms of restoration opportunities. The groups will then describe possible restoration interventions for each polygon.

The groups start by dividing the base maps into polygons that are suitable for different general categories of restoration. The facilitator should encourage the groups to think about what polygons make practical sense, in terms of being suitable for one or another category of restoration.

The working groups should follow the sequence below:

- First delineate lands that **do not require** or are **unsuitable or unavailable for restoration**, e.g. intact natural areas, urban areas, road corridors, intensively farmed areas, etc.;

- Second, delineate lands with opportunities for restoration for **protective functions**, particularly those for which legal requirements already exist. These could include steeply sloping lands, lands in the vicinity of water bodies or coasts and restoration aimed at watershed protection, mangrove restoration and erosion control;

- Third, delineate lands with opportunities for **wide-scale restoration**, i.e. rehabilitation or restoration of land back to larger contiguous blocks of forest. These are generally identifiable as forest lands; and

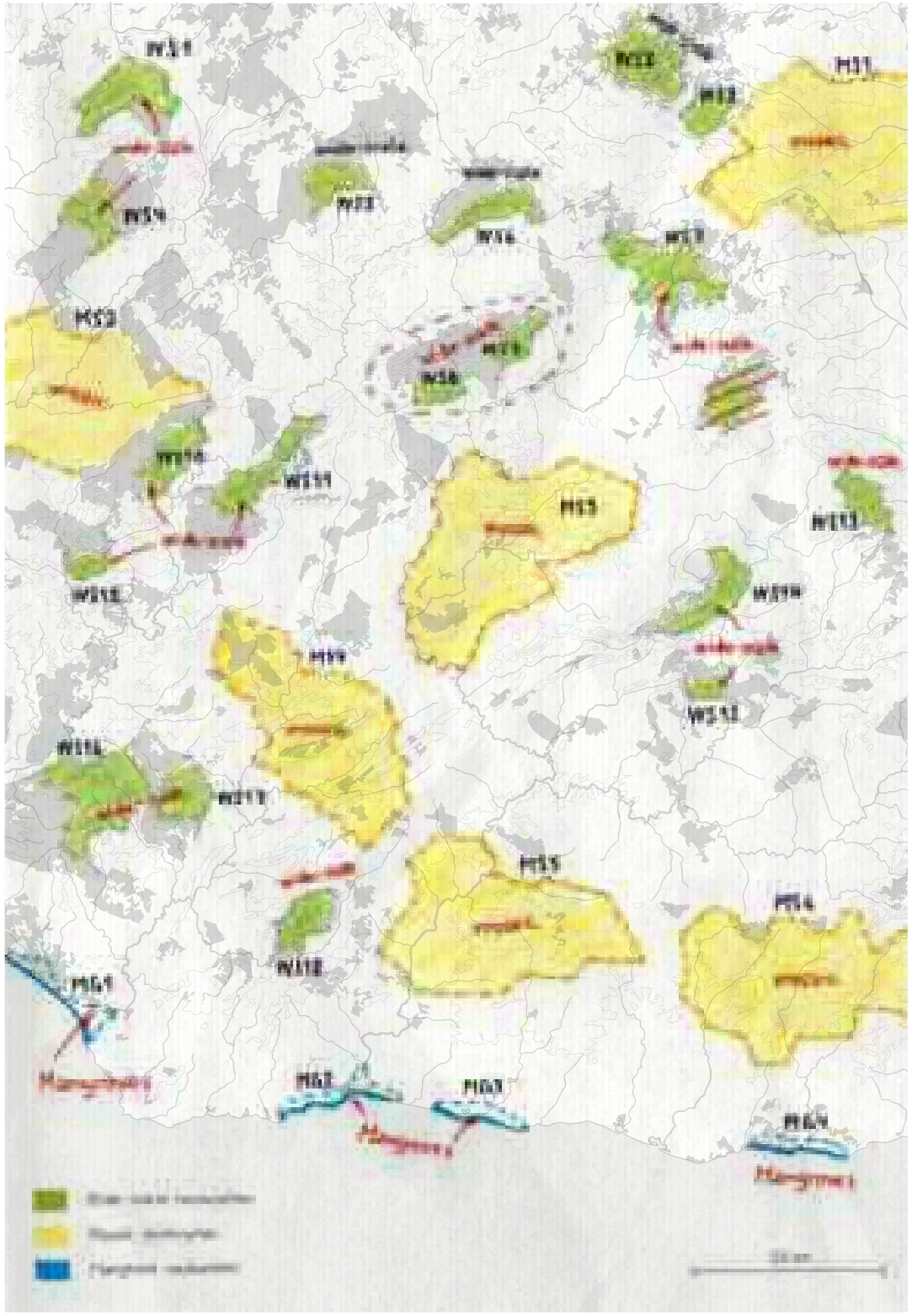
- Fourth, delineate lands with opportunities for **mosaic-type restoration**. This is generally restoration that interfaces with other land uses, notably agriculture.

The facilitator should encourage participants to avoid filling the entire base map with polygons. Indeed as the aim of this exercise is to tap into local knowledge and expertise, polygons should only be delineated if there is broad consensus on the current land use and the restoration need. Unassigned areas will be assumed not to require restoration or to be otherwise unavailable for restoration activities.

Each polygon should be clearly delineated on the base map, given its own unique identifier and marked as belonging to one of the three categories described above (i.e. wide-scale, mosaic or protective). Figure 12 shows an example of a map of one part of an assessment area, with hand-drawn polygons indicating opportunities for different kinds of restoration intervention.

This is what an initial output of a knowledge mapping approach might look like — a first attempt at identifying and mapping restoration opportunities in one part of a country. Working in small groups, the analytical workshop participants identify and roughly locate key restoration opportunities, and give each a unique code. Once the entire assessment area has been assessed in this way, the maps are then digitized (i.e. these opportunity areas are put into a GIS map) for further review and verification.

Figure 12.
Example of a hand-drawn polygon map of part of an assessment area



Identifying restoration options
The facilitator will then guide the working groups to fill in a description form for each polygon that they have identified as containing opportunities for one or another type of restoration. The forms are used to gather information on the approximate size of each polygon (which can be estimated from the map) as well as the proportion of the polygon that could be restored with different types of interventions. Again not every hectare of land within a polygon has to be assigned a restoration intervention – it is quite reasonable that a polygon might only have limited percentage of its area under FLR treatment (e.g. 3% protective restoration, 5% new plantings, 10% improved silviculture, 22% agroforestry and 60% no treatment).

The groups need to assign a unique code number for each polygon they identify, and place this code on both the polygon form and the relevant polygon on the map, so that the form and polygon can be linked. The left side of the polygon form is filled in during the initial part of the exercise, while the right side is reserved to record any alterations made later in the process.

An example of a completed polygon form following the initial part of the process is shown in Table 14.

Reviewing and revising the results
After the working groups complete the exercise of assigning restoration interventions, the polygon maps should be photographed and the information from the polygon forms entered into a specially programmed Excel spreadsheet model which calculates basic summary results, including the total area as well as the benefits and costs of the suggested interventions. If this exercise is taking place during a two-day analytical workshop, this task can easily be completed in the evening of the first day.

The assessment team then presents these preliminary results and their consequences to the participants. Following a discussion in the plenary, participants go back to their groups to revise, if necessary, the designation of polygons (as suitable for wide-scale, mosaic or protective restoration, or unsuitable/unavailable for restoration) and the suggested mix of restoration interventions within those polygons designated as suitable for mosaic restoration. This could involve changes to the polygon map (e.g. transferring some polygons from the 'wide-scale' category to the 'mosaic' category) and the polygon form (to shift the balance between the different intervention types). The revised outputs from the working groups are collected by the assessment team and entered in the spreadsheet as a final record of the knowledge mapping exercise.

Refining and digitizing the results
Immediately after the knowledge mapping exercise, the assessment team should finalize the results and capture the polygon maps in GIS software to produce a digital version of the polygon map across the entire assessment area.

First the team copies the polygon shapes into the GIS map, adjusting them in the process so that they reflect the intent of the groups and the characteristics of the landscape. This involves following the contours of the landscape more precisely than the groups may have done. The team also eliminates from the polygons lands that are:

- unavailable for restoration for land use reasons, such as villages and road corridors, applying a buffer zone around and along these objects; or
- unavailable for restoration for topographical reasons, i.e. steep slopes (if good data on slopes exist).

The team can make other adjustments of a similar nature, if there are sufficient data to allow for further refinements. Then the team measures the area of each polygon, using the GIS, and adds any available attribute data for each polygon (e.g. on specific intervention opportunities) into the GIS.

The final results will include a map of the entire assessment area and a series of charts (such as the one shown in Figure 13).

A polygon form is completed for each area marked in the polygon map (Figure 12), to detail the restoration options initially proposed and any changes made after further discussion and feedback.

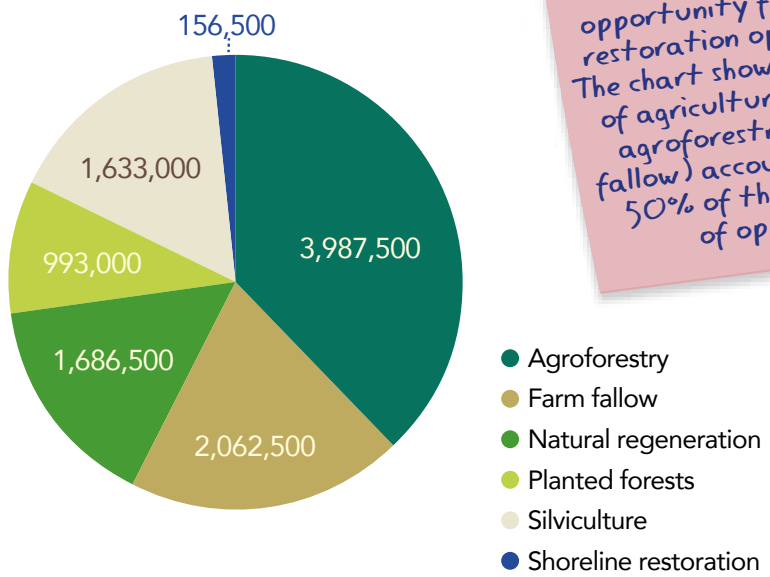
Table 14.
Example of a completed polygon form

Region: South-West | Polygon code: SW16 MS2

Estimated total area of polygon (ha): 375000

Day 1: Proposed mix of interventions			**Day 2: Revised mix of interventions**
FLR intervention category	Name	Proportion of area (%)	Proportion of area (%)
4	Agroforestry	30%	50%
5	Improved fallow	30%	20%
UNSUITABLE/UNAVAILABLE FOR RESTORATION (e.g. towns, villages, rocky outcrops, strict wildlife reserves, undegraded forest areas, etc.)		40%	30%
Total		100%	100%

Figure 13.
Example of a quantitative output from a knowledge mapping analysis: areas of opportunity for different FLR interventions in Ghana (ha)



A knowledge mapping approach to spatial analysis can produce valuable results, such as this tally of the areas of opportunity for the different restoration options identified. The chart shows how restoration of agricultural land (through agroforestry and improved fallow) accounts for more than 50% of the total coverage of opportunities.

Digital mapping approach to spatial analysis

The digital mapping approach uses digital (GIS) datasets to identify priority sites for restoration using a spatial analysis approach. The selection of GIS data (essentially GIS maps and associated metadata) is based on the desired output of the assessment and the criteria and indicators identified earlier on in the process.

In a digital mapping process, the priority lands for restoration are identified and mapped in six steps, as outlined in Table 15. In the Mexico assessment, for example, the team used seven main digital datasets, as well as stakeholder input, to develop the prioritization system (see Box 6). Table 16 shows an extract of the reclassification and weighting systems applied in the Mexico assessment, while Figure 14 illustrates how a few of the different datasets in the Mexico assessment provided layers of information for the final prioritization.

The Guatemala assessment, which was inspired by the Mexico experience, used a similar digital mapping approach to spatial analysis. The map produced in the Guatemala assessment (shown in Figure 15) identifies eight types of restoration opportunity: (1) riparian forests; (2) mangrove areas: (3) forests for conservation; (4) forests for production; (5) agroforestry with permanent crops; (6) agroforestry with annual crops; (7) silvopastoral areas; and (8) protected areas.

In addition to a map of restoration opportunities, other outputs can be produced to show the results of a digital mapping analysis in the form of pie charts, bar charts, data tables, etc.

Table 15.
The digital mapping approach to spatial analysis

Step	Action	Aim	Details	More Information
Step 1	Identify restoration opportunities to be explored.	Set the scope for the collection and analysis of spatial data.	An iterative process of identifying and refining a set of potential restoration options.	See pages 33 to 41 and 61 to 63 for guidance on identifying and refining potential restoration options.
Step 2	Identify data layers to help quantify where these restoration opportunities exist.	Select which data sets are relevant, given the restoration options being considered.	A list of the required data sets is drawn up and the availability of these data is verified.	See Table 6 for the digital data sets selected for the Mexico assessment.
Step 3	Collect GIS datasets.	Obtain datasets corresponding to the agreed assessment criteria.	GIS maps and associated metadata are sourced.	See page 65 for more guidance on sourcing relevant data and maps.
Step 4	Reclassify GIS datasets into priority categories for restoration.	Create a classification system to eliminate lands of lowest priority for restoration and classify remaining lands as high, medium and low priority.	Each dataset is reclassified to reflect priority for restoration. Data are assigned to high, medium and low priority categories (according to the assessment criteria) and a points system applied. A weighting system can also be applied to give more importance to particular criteria.	See Table 16 for examples of how two datasets were reclassified and a weighting system applied in the Mexico assessment.
Step 5	Combine all datasets.	Arrive at a final map based on all the different layers of data.	The assessment scores from each dataset are combined for each point on the map. A system will need to be developed to assign these scores to the final priority categories. Additional data layers can be added to the map by extracting information from other documents and databases. In the Mexico case, these additional layers included the location of all Protected Areas in the country, the location of zones of high biodiversity, and dominant patterns of land tenure.	Figure 14 illustrates how three of the datasets in the Mexico assessment helped provide prioritization information for the final map.
Step 6	Apply algorithms for identifying specific restoration opportunities by intervention type	Assess the potential scope and area of different restoration interventions	The assessment involves devising algorithms or rules about where in the landscape certain interventions would be the most appropriate and then using the existing combined spatial data sets to produce area estimates and identify key geographic locations.	Figure 22 illustrates this for one area of Rwanda.

Box 6.
A national-level digital mapping: example from Mexico

The Mexico assessment essentially consisted of applying and combining an agreed set of environmental, economic and social criteria (each weighted according to their importance) to construct a geographic model capable of identifying priority areas for forest restoration. There is a wealth of data available in Mexico and the following thematic data layers were used in the assessment:

- Forestry zoning (scale 1:250,000): lands suitable for forestry but currently under different land use or undergoing degradation (from fire, pests, etc.); erosion risk also indicated.
- Economic pressure index (scale 1:250,000): risk of deforestation, based on socio-economic data.
- Potential land use (scale 1:100,000): economic potential of lands suitable for forestry.
- Edaphology (scale 1:250,000): morphological, physical and chemical characteristics of soils, including any limiting factors for land use.
- State of vegetation conservation (scale 1:250,000): classification of vegetation according to level of conservation or transformation.
- Resilience to fire (scale 1:250,000): combination of fire risk and capacity of vegetation to recover from fire.
- Threats and opportunities for the conservation and sustainable management of mesophyll mountain forest: areas that present threats for the conservation of, or opportunities for the management of, mountain mesophyll forest.

Alongside this digital mapping approach, the assessment was a participatory one throughout. A multi-stakeholder workshop was held prior to the analysis to identify the agreed set of criteria and their weighting. The 48 participants at this workshop represented 13 different organizations, including government agencies, academic institutions and civil society groups. A follow-up workshop was held to present the findings, review the criteria used and start planning for a national FLR strategy for Mexico.

The assessment results indicated that Mexico has an estimated potential area of over 300,000 km^2 suitable for forest landscape restoration. The assessment model also indicated that, of this surface, almost nine per cent could be considered high priority, 17 per cent medium priority and 74 per cent low priority. In total, this represents about 13 per cent of Mexico's entire land area.

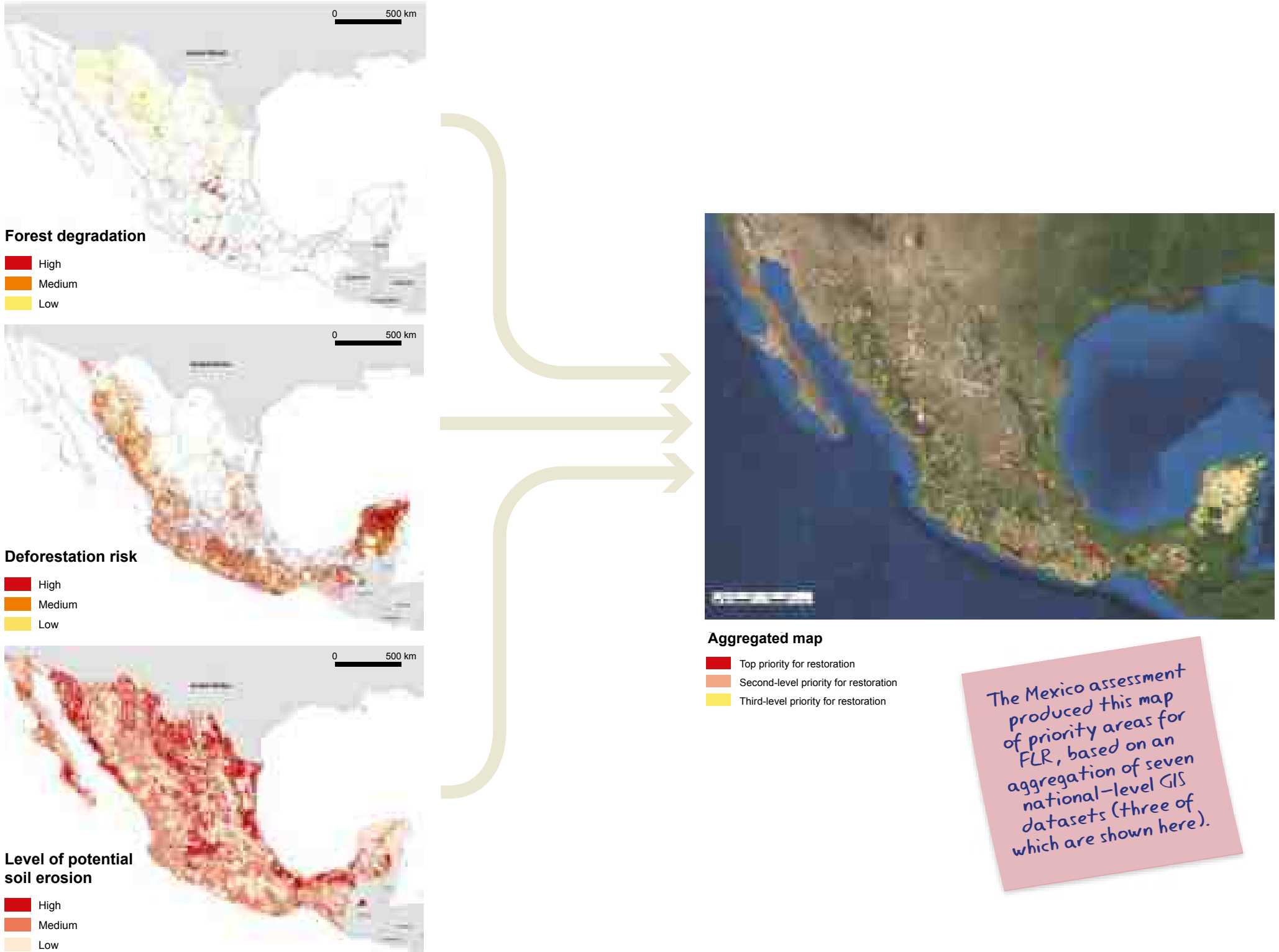
The assessment has not only provided outputs that have been used directly for high-level decision-making in the forest sector, but has also played an important role in bringing together the different national institutions working on forestry and restoration, creating a promising inter-institutional platform for the planning and implementation of joint restoration strategies.

Table 16.
Example of reclassification of data sets and application of weighting system (from Mexico assessment)

Criteria	Original categories of existing datasets	Restoration priority assigned	Weighting applied	Assessment score
Land degradation	Existing forest lands, highly degraded	High (3)	1.5	3 x 1.5 = 4.5
	Non-forest land most suited to forestry, highly degraded	High (3)	1.5	3 x 1.5 = 4.5
	Existing forest lands or land most suited to forestry, with medium degradation	Medium (2)	1.5	2 x 1.5 = 3
	Existing forest lands or land most suited to forestry, with low degradation	Low (1)	1.5	1 x 1.5 = 1.5
	Forest lands land most suited to forestry, degraded but already under restoration	Eliminated (0)	1.5	0 x 1.5 = 0
Fire risk	High probability of fire and low recoverability	High (3)	1.0	3 x 1.0 = 3
	High probability of fire and high recoverability	Medium (2)	1.0	2 x 1.0 = 2
	Low probability of fire and low recoverability	Medium (2)	1.0	2 x 1.0 = 2
	Low probability of fire and high recoverability	Low (1)	1.0	1 x 1.0 = 1

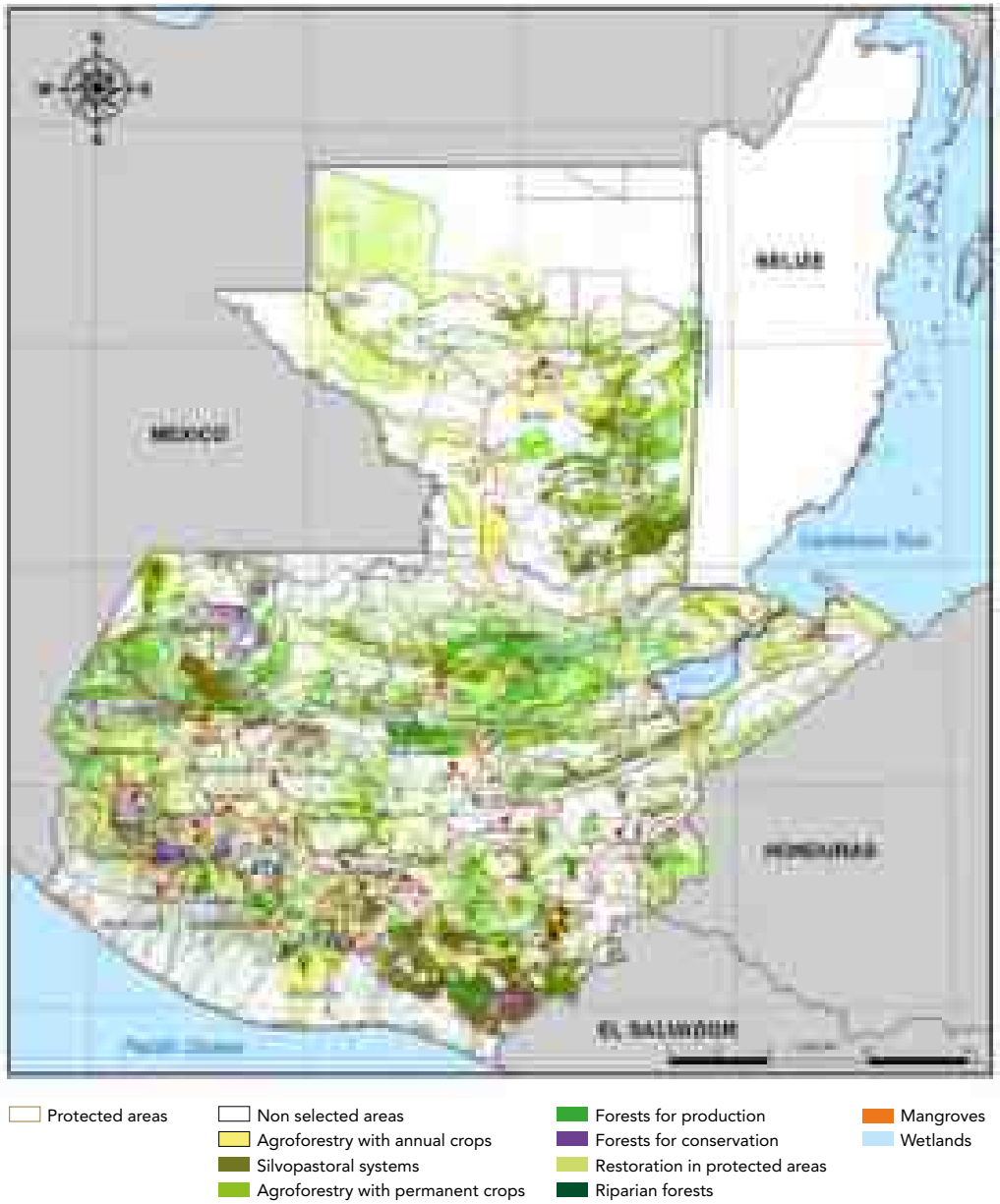
The GIS datasets representing the most restoration-relevant criteria are weighted so they will have a relatively greater influence on the final identification of top priority areas for restoration (see Figure 14).

Figure 14.
Production of the Mexico assessment map, showing a few of the GIS datasets used



The Mexico assessment produced this map of priority areas for FLR, based on an aggregation of seven national-level GIS datasets (three of which are shown here).

Figure 15.
Restoration opportunities map from the Guatemala assessment



Source: Government of Guatemala (2013).

Restoration economic modelling and valuation

While restoration practitioners will ask questions such as where to start and which interventions to use, policy-makers will want to know how much it will cost, who will pay, would public money be better spent elsewhere, and if there is a more cost-effective way to deliver the same results. The analysis of restoration costs and benefits is therefore a central element of ROAM. The fact that it integrates closely with spatial analysis means that it can offer particularly useful insights for consideration of what constitutes the most supportive policy and institutional framework and it is an essential pre-requisite to the assessment of co-benefits from FLR-driven carbon sequestration and analysis of finance and investment opportunities.

Assessing the costs and benefits that can come from restored ecosystem goods and services gives rise to some concerns that this encourages the 'commodification' of nature (i.e. treating all ecosystem goods and services as inherently marketable), and the development of restoration strategies that simply embrace the most commercially attractive interventions and ignore non-market values. However such an outcome is unlikely if the analysis is designed and used properly. An appropriate cost and benefit analysis will:

- Capture a broad range of values that are important to society – not just those for which a formal market exists;
- Allow an 'even-playing field' comparison of market and non-market values;
- Make no judgement on how an intervention will be financed (this is the function of the finance and resourcing analysis) though it should be able to separate out the proportion of benefits that might accrue to individuals and the proportion of benefits that might accrue to society (this is particularly useful to know as it provides a more rational basis for a discussion on who should pay);
- Enable a fair comparison between the potential role of restoration and the potential role of other types of public and private works (e.g. the costs and benefits of: (a) restoring upstream woodlands; or (b) investing in water filtration infrastructure); and
- Put values on ecosystem goods and services that underpin other important sectors (e.g. the natural resources on which Rwanda's (and many other countries') tourist industry depends).

While some forms of economic analysis can be very complicated and require a good deal of time and resources, this module of ROAM is designed to be relatively straightforward and quick. Our experience has shown that because it combines with other types of spatial and non-spatial analyses, it can generate sufficiently robust insights that are capable of withstanding scrutiny at senior government level and from other professional institutions.

Underlying concepts

The ROAM approach to analysing costs and benefits aims to identify how much ***additional benefit*** would be expected from a restoration intervention and how much ***additional cost*** would be incurred by putting this intervention in place. This type of approach, known as marginal analysis, avoids the need to try to account for all the values in a landscape and all the investments made to sustain those values.

Figure 16 illustrates how a marginal analysis can be used in the restoration decision-making process. The baseline land use in this example (degraded agriculture) generates US$ 1000 a year in value from crop yields at a cost to the farmer of US$ 500 (for seeds, fertilizer, etc.) and an additional cost to society of US$ 700, which is the lost value resulting from soil erosion, or habitat made unsuitable for biodiversity, and other external effects. So under baseline land use of "degraded agriculture" the total value is -US$ 200.

Restoring the degraded agricultural land with agroforestry, meanwhile, would prevent US$ 100 of erosion damages while producing US$ 500 worth of sequestered carbon and marketable timber and US$ 900 in crop yields (slightly less than before) at a cost to the farmer of US$ 500. In total then, agroforestry would produce US$ 1000 in benefits (net of costs). This constitutes a US$ 1200 dollar change in the value of services when we restore to agroforestry lands from a degraded agricultural state.

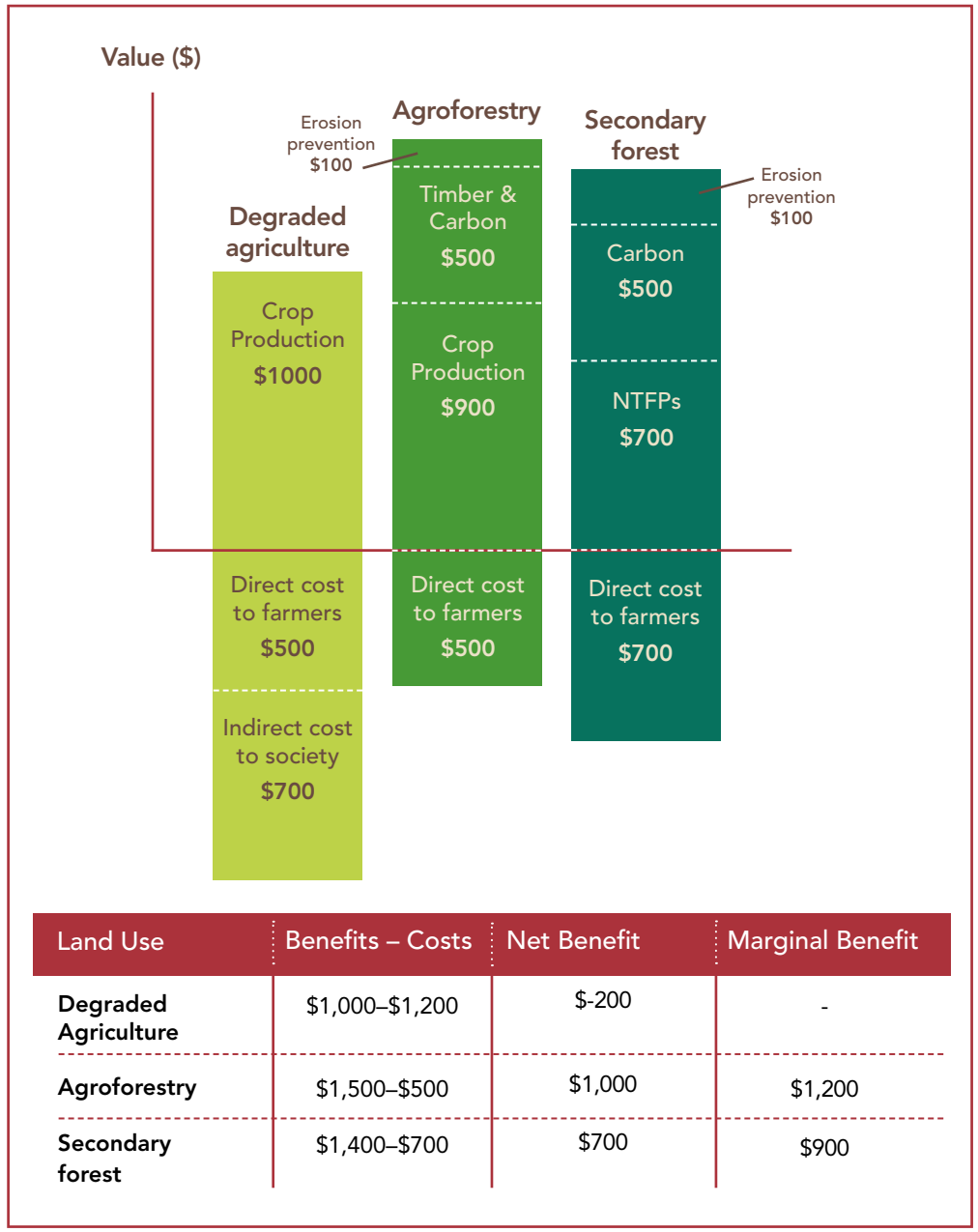
Alternatively, degraded agricultural land could be transformed into secondary forest, which would prevent US $200 of erosion damages, sequester US$ 500 worth of carbon, and produce US$ 700 of non-forest timber products (NFTPs) for a cost of US$ 700.

The analysis results from this type of framework can be used to identify landscapes that meet strategic local and national priorities. Even when ecological goals are prioritized over economic ones, the framework will still be able to identify landscapes that produce the desired ecological outcomes for the least cost.

It is clear that the benefits considered in this analysis should not be limited to financial benefits, but include other factors such as carbon sequestration benefits, biodiversity benefits, and benefits to farmers or landowners, such as improved food production and availability and improved water supply. Where benefits cannot be quantified, a simple rating system can be used to express their relative importance.

Often, comprehensive studies of the costs and benefits from FLR will not be available in-country, so part of the exercise may require collection of additional data. This can be done by compiling a series of reference tables of secondary information on the costs and benefits of different restoration options. The types and levels of costs and benefits will vary across the assessment area so it may be necessary to prepare a different reference table for each of the different geographic strata (sub-areas) that were identified earlier in the ROAM process (see page 35). Table 17 shows the general template used in the Ghana assessment for recording the results of the analyses of costs and benefits. Specific, adapted versions of this table were then filled in for the different regions on the country; Table 18 shows the completed table for the Northern region of Ghana.

Figure 16.
Computing the marginal value of restoration interventions



Land Use	Benefits – Costs	Net 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

Table 17.
Reference table for recording the results of an analysis of costs and benefits

Category of restoration intervention	Locally-specific interventions		Cost/ha (local currency) 20 years	Gain (after 20 yrs)		Expected revenues and other benefits from trees in restored landscape
	Code	Name		trees/ha	M³/ha	
1. Establish and maintain **planted** forests and woodlots	1a	Exotic plantations				
	1b	Fuelwood lots				
	1c	Indigenous plantations				
2. Establish and maintain **naturally regenerated** forests and woodlots on non-forest land	2a	Direct seeding				
	2b	Prevention of overgrazing				
	2c	Weed suppression				
	2d	Wildfire prevention				
3. **Rehabilitate** and maintain degraded forests and woodlands	3a	Bushfire prevention				
	3b	Direct seeding				
	3c	Enrichment planting				
	3d	Restricted grazing				
4. **Agroforestry** Integrate tree benefits on active agricultural land	4a	Intercropping with food crops				
	4b	Intercropping with cocoa				
	4c	Sylvipastoral				
5. **Improved fallow** Integrate tree benefits on farm fallow	5a	Contour management				
	5b	Fallow enrichment				
	5c	Fire management				
6. **Protective land and buffers** Establish and enhance forests on critical or vulnerable land	6a	Improved shoreline management				
	6b	Shoreline restoration (direct seeding)				
	6c	Watershed protection				
	6d	Erosion control				

Table 18.
Cost-benefit table prepared for the Northern region of Ghana

Intervention	Local qualifier			Intended change		Other benifits 1=No change 2=Marginal change 3=Considerable change 4=Significant change					
	Code	Name	Cost/ha (Ghanaian Cedis)	Trees/ha	M³/ha	Crop production	Livestock production	Wild plant food, fibres, medicines	Bushmeat	Water supply (e.g. hydro electricity, irrigation)	Drinking water quality
1. Planted forests	1a	Indigenous plantations	[illegible]	125	100	2	1	4	3	3	3
	1b	Fuelwood	5000	1000	300	1	1	2	2	2	2
	1c	Exotic plantation	[illegible]	250	150	1	1	1	1	2	2
2. Natural regeneration	2a	Wildfire prevention	[illegible]	600	80	2	2	3	3	3	3
	2b	Prevention of overgrazing	1200	600	80	2	2	3	3	3	3
	2c	Weed supression	1500	600	90	2	2	3	3	3	3
	2d	Direct seeding	2000	600	100	2	2	3	3	3	3
3. Silviculture	3a	Enrichment planting	250	140	70	2	2	3	3	3	3
	3b	Restricted grazing	1200	100	60	2	2	3	3	3	3
	3c	Bush-fire prevention	2000	600	80	2	2	3	3	3	3
4. Agroforestry	4a	Silvi-pastoral	1000	600	60	1	1	2	3	3	2
	4b	Inter-cropping with food crops	1000	60	30	4	2	3	2	3	2
	4c	Inter-cropping with cocoa	1000	20	15	4	1	3	2	3	2

This is a real-life example of a cost-benefit table, using an adapted version of Table 17.

Estimating costs and benefits

There are four basic steps in building up an estimation of costs and benefits:

1. Clearly agree on the main restoration interventions being considered, where and under what conditions (see page 68).

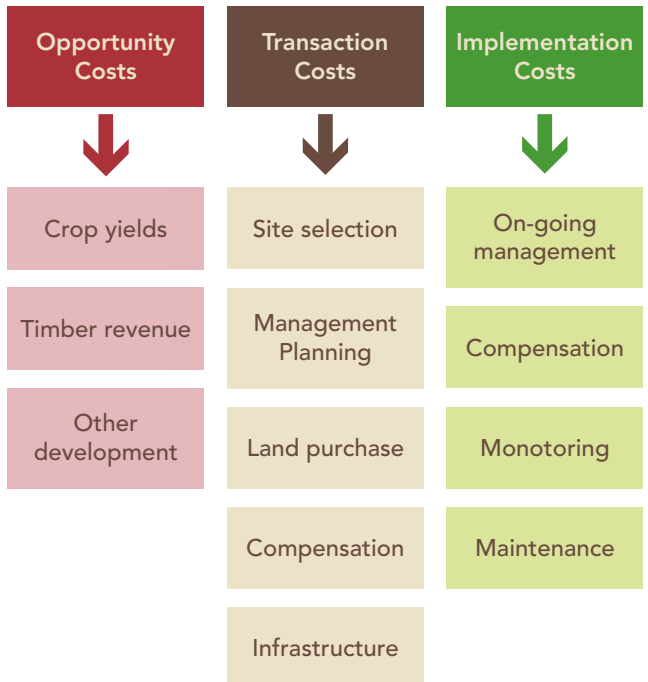
2. Make a relatively reliable estimate of the different technical specifications involved in each intervention (e.g. spacing of trees, required weeding, fire control or other protective measures, number of years before benefits accrue, growth rates, etc.) and the incremental benefits (or changes) that should be produced. On the basis of this it is often possible to complete the reference table (as illustrated in Table 17). It is important to clearly lay out any assumptions made so that these can be checked and verified as the analysis proceeds.

3. Calculate and model the additional ecosystem goods and services for restoration interventions and their associated costs and benefits. While the requirements for this step will depend on the broader parameters of the ROAM application, they may typically involve:
   - Estimating timber and non-timber (including carbon) values
   - Estimating additional contribution to soil conservation and reduced erosion
   - Estimating improvements in agroforestry and crop yields
   - Estimating the additional costs based on FLR-related inputs, as illustrated in Figure 17.

   More precise cost and benefit estimates can be produced using mathematical models. The level of analysis performed will depend on the objectives of the assessment and the expertise available to the assessment team. At its simplest, the analysis could involve rough calculations based on stakeholder-reported values, if other sources of cost and benefit information are not available. A more sophisticated analysis would use empirically-estimated production functions to model and value the ecosystem service impacts of different restoration options, based on official and peer-reviewed information.

4. Conduct a sensitivity and uncertainty analysis. See how sensitive the cost-benefit results are to changes in key variables such as prices, interest rates, and biological assumptions. The revenue streams and non-monetary benefits of restoration depend on inherently random ecological parameters, including precipitation and tree growth rates. However, the uncertainty over which values these parameters will take introduces an element of risk into the analysis. In order to take account of this uncertainty a repeated random sampling technique, known as Monte Carlo simulations, can be used. A Monte Carlo simulation creates data by drawing values from the distribution of a given variable instead of assuming a single average value that does not take into account the range that might be observed in the field. Since ecological outcomes such as tree growth determine the profitability of each restoration transition the Monte Carlo method can be used to generate data representing a range of outcomes one might expect on different land uses.

Figure 17.
Costs of landscape restoration



While restoration decisions can be based on a wide variety of criteria, including ecological priorities and restoration costs, an integrated approach that accounts for both the costs and benefits of restoration provides decision-makers with more actionable information. Assessing the costs and benefits is useful for prioritizing investments in restoration across a variety of criteria including net present value (NPV), return on investment (ROI) and multi-criteria decision-making. This information is useful for policy-makers, restoration professionals and natural resource managers who are interested in understanding more about the economic opportunities and trade-offs of restoring deforested and degraded landscapes. Given the amount of degraded land across the world, the ability to identify the most beneficial landscapes to restore is an important objective.

The results of this economic analysis component will be important inputs for the evaluation of feasible restoration options and will inform any strategic planning processes that follow from the assessment. In addition, they will enable further analyses such as the cost-benefit-carbon modelling (described below) and complement the information provided by the analysis of finance options, as outlined later in this chapter. Naturally, the economic analysis results will need to be considered alongside the findings of these other analyses as the success of the potential restoration interventions will depend not only on the range and size of the benefits they offer, but also on for example the legal, institutional and policy arrangements in place (such as land-use policies, land tenure, forest-product markets, etc.).

Restoration cost-benefit-carbon modelling

While the valuation of restoration costs and benefits may have included some consideration of carbon benefits, it is useful to conduct a more thorough analysis of the potential carbon benefits to be achieved through different restoration interventions. The following guidance describes the techniques available and illustrates the kinds of outputs which an analysis can provide. The assessment team will need to select which element(s) are most appropriate, given the specific focus of the assessment and the kinds of data available.

Estimation methods

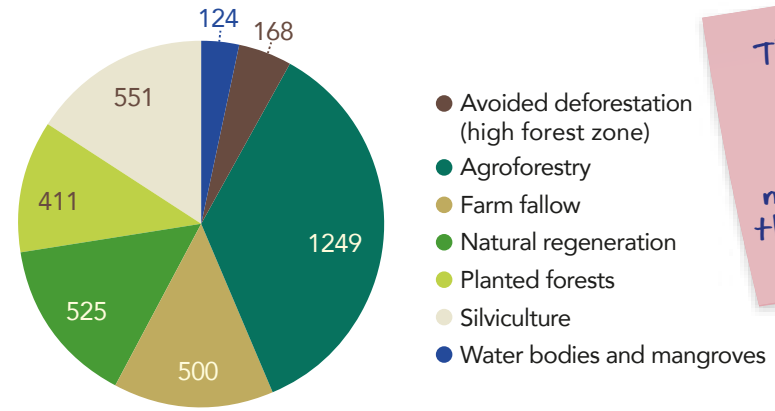
Carbon sequestration values can be calculated for each FLR intervention using the recommended methods of the IPCC Good Practice Guidelines (IPCC, 2003). The IPCC offers three types of methods for calculating carbon sequestration. The basic method (known as a 'Tier 1' method) tracks changes in carbon stored in biomass, based on default values. This method is quite straightforward and requires relatively little information. The more sophisticated methods (Tier 2 and Tier 3) are more complicated but produce more accurate results; they are appropriate when the scale of analysis is smaller or when more accurate figures are needed. For most national-level analysis of the carbon sequestration potential of restoration, the Tier 1 method will be sufficient. Guidance on using the Tier 1 method is provided in Appendix 1.

Using and reporting the estimates of carbon benefits

Once the carbon sequestration values have been calculated for different types of FLR interventions, the assessment team can use these values in their analyses and reporting. For example, Figure 18 shows how much carbon could be sequestered in Ghana with each type of restoration intervention. The values were calculated by first estimating how much carbon would be captured by each restoration intervention at the hectare level and then multiplying that value by the land area that could be restored by each intervention, as derived from the spatial analysis.

Putting monetary values on these carbon benefits requires the use of carbon price data. In the Ghana assessment, the price of carbon was assumed to be 13.63 Ghanaian Cedis (GHS) (or approximately US$7.5), which was the average price paid per ton of carbon on voluntary carbon exchanges during 2012 (Peters-Stanley et al., 2013). Table 19 thus shows carbon sequestration and carbon revenue values from the Ghana assessment. Carbon revenue was estimated by multiplying the tons of sequestered carbon by the price per ton carbon.

Figure 18.
Estimated carbon sequestration potential of different FLR interventions (millions tons CO_2e) from the Ghana assessment



This chart shows the carbon sequestration benefits on a national level, for the different types of restoration.

Conducting cost-benefit-carbon modelling

The greenhouse gas abatement cost curve was first published by McKinsey (2007) with a view to helping decision-makers understand, at a glance, how different climate mitigation actions ranked against each other in terms of mitigation potential (i.e. how much carbon emissions could be avoided) and what the average cost per ton of CO_2 stored or sequestered might be. In doing so, the abatement curve acts as a quantitative basis for discussions about what bundle of actions would be most effective in delivering the required emissions reduction to avoid dangerous climate change.

The McKinsey analysis provided quantitative confirmation that land-use activities (forestry and agriculture) constituted actions that, in theory at least, represented large gains for relatively modest investments.

The presentation of the analysis from the Ghana ROAM application borrowed the McKinsey idea of an abatement curve and adapted it to rank the proposed restoration interventions against their mitigation potential at the national level and the net value of anticipated additional benefits per ton of CO_2 sequestered. In other words, rather than looking at costs, the analysis aimed to tease out the so-called co-benefits that FLR actions should deliver. We call this analysis cost-benefit-carbon modelling.

It is important to highlight that, like McKinsey's abatement curve, the cost-benefit-carbon modelling needs to be used with caution. It does not, for example, address the fact that with each additional hectare treated under a particular restoration intervention there may be a diminishing marginal return as the cost of moving to the next degraded hectare becomes marginally more expensive and the benefits received become marginally less profitable. It should also not be interpreted as identifying the single best option. As McKinsey note for their abatement curve, it only serves as the basis of discussions about the right mix of interventions.

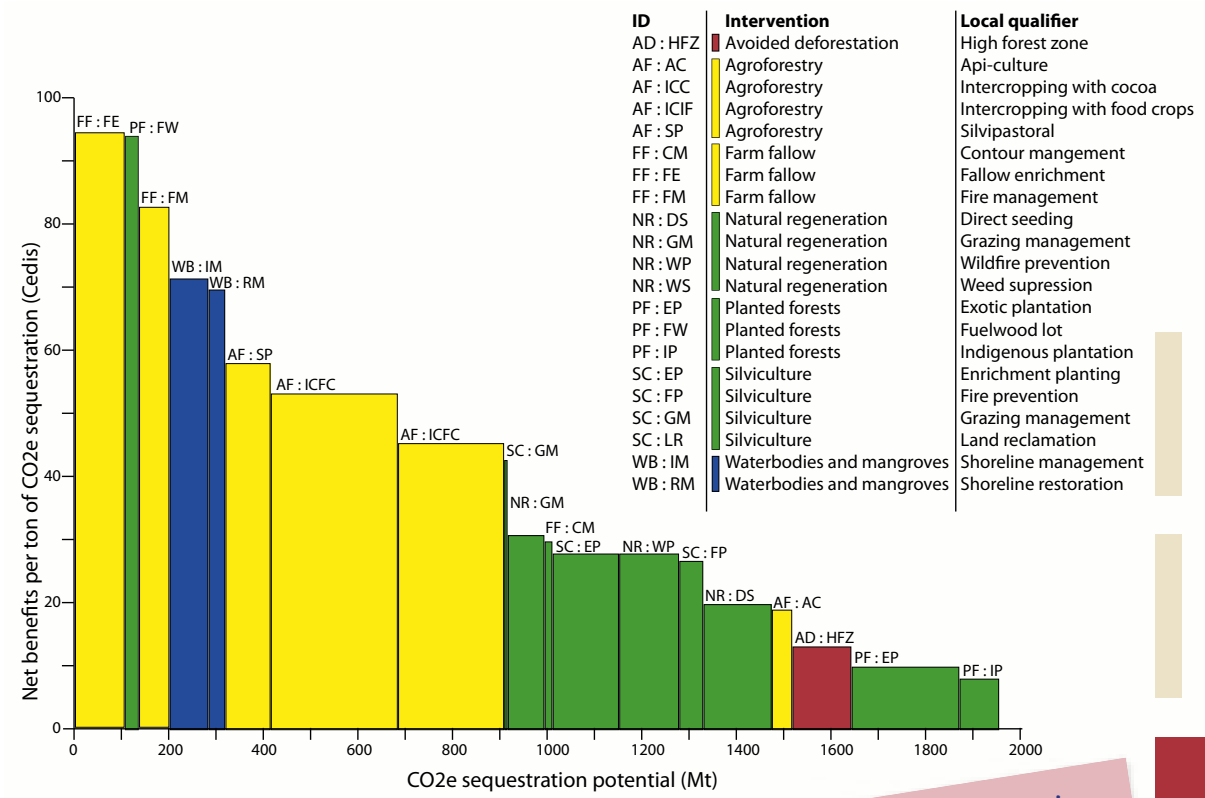
Table 19.
Carbon revenue estimates for different FLR interventions in Ghana

	FLR Intervention	Carbon sequestered (tons CO_2e/ha)	Carbon Revenue (Ghanaian Cedis)	Unit Cost (Ha) (Ghanaian Cedis)
Tree planting	Indigenous plantations	218	2,969	5,600
	Fuelwood	218	2,969	5,800
	Exotic plantations	251	3,426	5,800
Natural regeneration	Wildfire prevention	145	1,979	1,000
	Prevention of overgrazing	145	1,979	1,200
	Weed supression	145	1,979	1,500
Silviculture	Enrichment planting	91	1,237	1,800
	Restricted grazing	73	990	1,200
	Bush-fire prevention	109	1,484	1,000
Agroforestry	Silvi-Pastoral	73	990	300
	Inter-cropping	73	990	300
Improved farm fallow	Fallow enrichment	54	742	500
	Fire management	54	742	400

Notes: Carbon revenue values are based on carbon price of 13.63 Ghanaian Cedis/ton. Carbon sequestration is calculated over a 20-year time horizon and is based on an estimate of 1 ton of above ground biomass equaling 0.5 ton of carbon
All values are in nominal terms

Estimating the per-hectare costs and carbon benefits of FLR interventions, as shown here, will enable further analysis (such as the cost-benefit-carbon modelling shown on the following pages) and more informed comparisons of the different intervention types.

Figure 19.
Result of cost-benefit-carbon modelling undertaken in Ghana assessment



This analysis ranks the different restoration interventions according to the anticipated additional net benefits per ton of CO_2 sequestered and shows their mitigation potential at the national level. The analysis uses a twenty-year timeframe.

Figure 19 shows the result of the cost-benefit-carbon modelling undertaken in the Ghana assessment. The height of each bar in the chart represents the additional net benefits that accrue from the intervention for each ton of CO_2e that is sequestered. These estimates include only direct material net benefits of restoration that are expected to flow over a twenty-year time horizon. The width of each bar represents the total amount of CO_2e that could be sequestered by the intervention over a twenty-year time horizon.

In the case of the Ghana assessment, the chart was useful in illustrating the potential benefits, in terms of carbon co-benefits that FLR could help deliver on agricultural lands (shaded yellow) compared to more conventional REDD+ interventions such as avoided deforestation (shaded red) in the high forest zone – which had been the sole focus of attention in earlier REDD+ discussions. It is also interesting to note that investments in community woodlots (PF:FW) and watershed protection (WB:IM and WB:RM) yield significant livelihood benefits (albeit with modest carbon gains) and could be considered 'low-hanging fruits' in terms of restoration options.

Restoration diagnostic of presence of key success factors

This component involves a preliminary assessment of the extent to which key success factors are in place in the country to facilitate restoration at scale. These factors include: (1) the motivations of key actors; (2) the enabling conditions in the country; and (3) the capacity and resources for implementation. In particular the analysis examines how a country's policy, legal, market and institutional arrangements can help or hinder the development and implementation of restoration activities. The analysis can also look at the extent to which the ecological and social conditions in the assessment area are conducive to scaling up restoration efforts.

Again, this can be as simple or sophisticated an analysis as the situation warrants and resources permit. It is however a critical and often overlooked aspect of laying the groundwork for improvements in sustainable land management (including restoration) generally.

The results of this analytical component can then feed into more detailed consideration of these issues with a wider set of stakeholders, once all the assessment results have been compiled (see page 109).

A tool for looking at a wide range of 'key success factors' issues is currently being developed. This diagnostic tool helps identify which key success factors for forest landscape restoration are already in place and which are missing within a country or landscape being considered for restoration. Those that are missing are the most likely relevant barriers to successful restoration. When applied prior to launching a restoration effort, the tool can help decision-makers and restoration stakeholders focus their efforts on getting the missing key success factors in place – before large amounts of human, financial, or political capital have been invested. When applied periodically over time as a landscape is being restored, the tool can help decision-makers and implementers sustain restoration progress through adaptive management.

The tool, which is based on lessons learnt from over twenty forest landscape restoration 'case examples' around the world, classifies the key success factors into three themes:

1. **A clear motivation.** Decision-makers, landowners, and/or citizens need to be aware of the need for forest landscape restoration and inspired or motivated to support it. This means that the case for restoration must be presented in their terms and speak to their priorities.

2. **Enabling conditions in place.** A sufficient number of ecological, market, policy, legal, social, and/or institutional conditions need to be in place to create a favourable context for forest landscape restoration.

3. **Capacity and resources for sustained implementation.** Capacity and resources need to exist and be mobilized to implement forest landscape restoration on a sustained basis on the ground.

The tool involves three main steps (as shown in Table 20):

1. **Select the scope.**

2. **Assess status of key success factors.**

3. **Identify strategies to address missing factors.**

Table 20.
Diagnosing the key success factors

Step	1. Select the scope	2. Assess status of key success factors	3. Identify strategies to address missing factors
Activity	Choose the "scope" or boundary within which to apply the diagnosis. The selected scope will be the "candidate landscape".	Systematically evaluate whether or not key success factors for forest landscape restoration are in place for the candidate landscape.	Identify strategies to close gaps in those key success factors that are currently not in place in the candidate landscape.
End product	Candidate landscape for conducting diagnosis	List of missing (partially or entirely) key success factors	Set of strategies
Estimated time	A few days	1-2 weeks	1-2 weeks

Step 1 involves defining the boundaries of the diagnosis, to avoid unnecessary research and produce actionable results. This step might include, for example, defining the geographic scope of the landscape to which the diagnostic tool will be applied (i.e. the 'candidate landscape') and considering the potential timeframe and goals of the restoration of this landscape.

The core of the tool, Step 2, involves an evaluation of each key success factor, guided by a series of questions relating to these factors, in order to determine whether these factors are fully in place, only partly in place, or missing. For example, the policy-related enabling conditions are explored by examining issues such as:

- Whether land managers and land users have clear and secure (formal or customary) rights to the benefits that would accrue from restoration (e.g. land tenure, natural resource rights).

- Whether clear and enforceable regulations on land-use change (including clearing remaining natural forests) exist. Note, this is a particularly challenging factor. If land-use change regulations are too lax, restoration may become a zero sum game – in as much as gains made one year can be easily cancelled out the next, or high-quality multifunctional forest can be replaced by single-species stands. However, if land-use change regulations are too rigid or draconian, this can also act as a major obstacle to encouraging land owners to invest in restoration activities. For example in several Latin American countries where conversion of forest land to non-forest uses is prohibited, farmers continue to treat low-grade, unproductive pasture land with arboricides in order to prevent the establishment of secondary forest.

- Whether regulations that require forest restoration or that clearly regulate the conversion of natural forest are adequately enforced.

Table 21 shows the results of Step 2 of the tool applied in the Rwanda assessment.

The third step of the tool is to identify strategies that address the missing key success factors – those deemed "not in place" or only "partly in place" – and that ensure that those that are already in place remain so. During this step, users brainstorm, propose, and record a portfolio of policies, incentives, practices, techniques, and/or other interventions. The purpose is to identify strategies that maximize the likelihood that forest landscape restoration at scale will be successful. See pages 111 and 115 for example outputs of this step, from the Rwanda assessment.

Detailed guidance on how to undertake an effective policy and institutional analysis is currently being prepared, led by WRI, in partnership with IUCN, for the GPFLR. More details on this upcoming publication are available from: restore@wri.org or gpflr@iucn.org

Table 21.
One output of the diagnostic of key success factors in the Rwanda assessment

Theme	Enabling condition	Key success factor	Current status
Motivate	Benefits	Restoration generates economic benefits	In place
		Restoration generates social benefits	Partly in place
		Restoration generates environmental benefits	Partly in place
	Awareness	Benefits of restoration are publicly communicated	In place
		Opportunities for restoration are identified	Partly in place
	Crisis events	Crisis events are leveraged	Partly in place
	Legal requirements	Law requiring restoration exist	In place
		Law requiring restoration is broadly understood and enforced	Not in place
Enable	Ecological conditions	Soil, water, climate, and fire conditions are suitable for restoration	In place
		Plants and animals that can impede restoration are absent	In place
		Native seeds, seedlings or source populations are readily available	Not in place
	Market conditions	Competing demands (e.g., food, fuel) for degraded forestlands are declining	Not in place
		Value chains for products from restored area exists	Not in place
	Policy conditions	Land and natural resource tenure are secure	Partly in place
		Policies affecting restoration are aligned and steamlined	In place
		Restrictions on clearing remaining natural forests exist	Partly in place
		Forest clearing restrictions are enforced	In place
	Social conditions	Local people are empowered to make decisions about restoration	Not in place
		Local people are able to benefit from restoration	Partly in place
	Institutional conditions	Roles and responsibilities for restoration are clearly defined	Not in place
		Effective institutional coordination is in place	Not in place
Implement	Leadership	National and /or local restoration champions exist	Partly in place
		Sustained political commitment exist	In place
	Knowledge	Restoration "know how" relevant to candidate landscapes exists	In place
		Restoration "know how" transferred via peers or extension services	Not in place
	Technical design	Restoration design is technically grounded and climate resilient	Not in place
	Finance and incentives	Positive incentives and funds for restoration outweigh negative incentives	In place
		Incentives and funds are readily accessible	Not in place
	Feedback	Effective preformance monitoring and evaluation system is in place	Not in place
		Early wins are communicated	In place

In place Partly in place Not in place

Restoration finance and resourcing analysis

This component involves the identification and analysis of the types of finance and resourcing options available to support national FLR strategies or programmes and, more precisely, which types of funding options would be most suitable and feasible for the different types of restoration interventions emerging from the assessment.

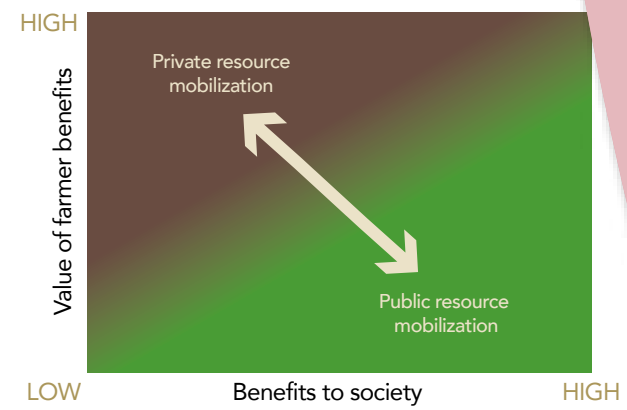
The main categories of finance mechanisms for FLR include:

- **Private for-profit:** restoration that produces marketable goods and services can attract private sector financing;
- **Private not-for-profit:** including local communities, international foundations and NGOs;
- **Financial incentives paid for the delivery of ecosystem services:** this could include market-based Payment for Environmental Services (PES) though up to now these types of financial transfers have more typically relied on public sector resourcing;
- **Public sector expenditure:** increasing expenditures on forestry activities, removing harmful subsidies and discouraging degrading land-use practices;
- **Multilateral and bilateral donor funds:** FLR is becoming increasingly popular amongst policy-makers and heads of international development agencies; and
- **Transfer of FLR support services from public to private sector:** for example, nursery production.

In general, the more a restoration intervention will benefit individuals, the more opportunities there will be for attracting private finance, and the more an intervention provides broader societal benefits, the better the chances are for attracting public sector finance mechanisms (as illustrated in Figure 20).

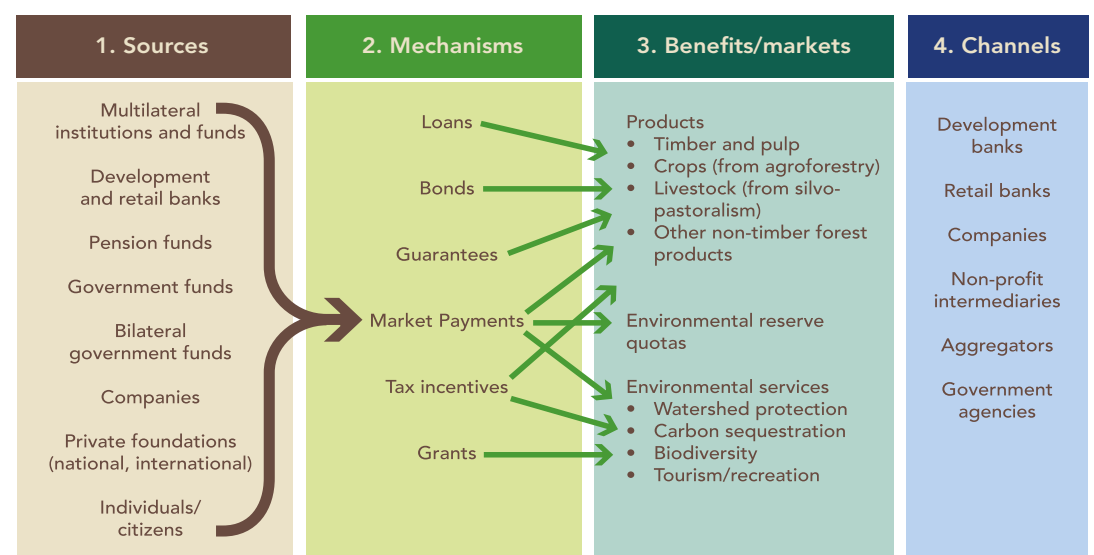
When considering how to fund landscape restoration, it is important to distinguish between: (1) the source of the money; (2) the mechanism of the funding and the terms by which the money is allocated to those involved in implementing the restoration strategy (e.g. land managers); (3) the channels through which the money physically reaches those implementing the restoration strategy; and (4) the benefits that the restored landscape generates or the markets it serves (see Figure 21). A single source might be able to provide money through one or more mechanism and channel. It is often the case that the market viability, or lack thereof, will determine the most appropriate financing mechanism. For instance, non-marketable services are typically not well-suited for loans since the service does not generate a tangible revenue stream that can pay back the loan.

Figure 20.
Public/private financing options for FLR



When identifying finance options for different types of restoration intervention, consider who the likely beneficiaries would be and what capacity they have of contributing either financially or in kind (e.g. providing labour or growing seedlings).

Figure 21.
Typology of financing strategies for restoration



Evaluation of potential for private investments in restoration

It is worth looking in some more detail at how to evaluate the potential for private investments in restoration, since these investments represent a new and growing pool of funds for supporting developing countries' goals of restoring landscapes and improving livelihoods.

The assessment team can evaluate the potential for private investments in FLR in the assessment country on a number of different levels. At its most basic, the evaluation could consist of brainstorming sessions among the assessment team and key informants from the private sector while more in-depth evaluations could take the form of discussion sessions during the analytical workshop(s), secondary research on the investment climate in the assessment country and consultations with financial experts.

A comprehensive evaluation could examine:

1. the **role** and **entry point** for additional private sector investment;

2. the extent to which **barriers** to private investment exist in the country and how they might be addressed in order to promote such investment opportunities;

3. the **investment potential** of the restoration interventions emerging from the assessment so far; and

4. sources of **funds** and **risk mitigation** instruments available for restoration in the country.

Guidance on the first two elements is provided below (more details on this evaluation process can be found in Durschinger et al, in press). The outcomes of such an evaluation can then be further discussed during the validation workshop(s) (see pages 111 to 113) with a view to drawing up a roadmap for constructing investment packages to address the barriers identified and recommendations for mobilizing investment capital.

Evaluating the scope for new private sector investment
Private sector financing is usually thought of in terms of either direct investment in landscape restoration (e.g. acquiring land to plant trees or contracting farmers to grow trees) or in the creation of specific supply chains that stimulate the incentive for certain products (e.g. a milk processing plant that stimulates local dairy markets that require the production of woody legumes through agroforestry). Using the spatial, economic and carbon analyses, and building on advice from key informants, it should be possible to identify potential opportunities (backed up by facts and figures) that would be worth investigating further. For example, Ghana has large tracts of very degraded, publicly-managed forest land that will be difficult to recover using improved silviculture and natural regeneration. The Ghanaian government is actively exploring the possibility for some of this land to be used to attract private sector investments in commercial plantations. On the other hand, Rwanda has many small farms on relatively steep slopes; the country also has a progressive scheme to ensure that poor families have at least one cow per household and livestock managed under these circumstances needs a supply of on-farm woody legumes. There may be a possibility that centralized milk processing units could incentivize milk production on these small farms which in turn would see the growth of on-farm fodder trees and the establishment of fodder banks across the landscape.

In addition to looking at direct investments and stimulating supply chains, this scoping step should also consider whether there are functions which support FLR that are now fulfilled by government support but which might be more efficiently and effectively delivered by private sector interests. For example, seedling production in several countries tends to be managed by government-run nurseries. These nurseries are often under-resourced and produce a very limited selection of planting stock. Attracting the private sector to take on such a function could result in more capital investment in this sector and production prices driven down. New technologies and production techniques could expand the range of species on offer and government savings could then be directed at acquiring high-quality seedlings for national planting programmes, communities and small farmers.

Evaluating barriers to private investment in restoration
Successfully attracting private investment in FLR will require overcoming a number of barriers that are inherent in funding these activities, including the fact that some restoration activities may never be commercially viable. These activities should be identified and either funded with public money or where possible be integrated into other investment-worthy opportunities even at the risk of diluting returns.

Investors cite a number of barriers to investing in developing country agricultural, agroforestry and forestry. Table 22 presents a non-exhaustive list of these barriers, all of which are potentially relevant to FLR. The challenges represented by these barriers are further compounded by the fact that candidate landscapes for restoration are generally managed primarily by small-holders.

Being aware of these barriers and designing strategies to overcome them is imperative because most investors will not have the time or patience to wait until investment opportunities can meet standard requirements of commercial viability. They may however be willing to make smaller-than-typical investments, when there is a clear path to scalability.

While some of these barriers can be overcome by applying technical financial expertise and involving local commercially-oriented restoration initiatives, other barriers are harder to address and could take significant time and investment on the part of governments to overcome.

Table 23 summarizes the results of an evaluation of Rwanda's investment barriers, relative to other countries in the region that would compete for investment capital.

Evaluating private investment potential of restoration options
The assessment team can look at the list of top priority restoration options identified so far and consider the investment potential of each, using the following set of questions:

- Is there established demand and a competitive advantage for the revenue-generating activities (cash crops, value-added, domestic growth crop)?

- Can the activity expand the trees on the landscape?
- Does the downstream value chain support growth?
- Is there evidence of commercial viability somewhere in the value chain and does it provide a return profile?
- Are activities biophysically appropriate for the landscape/ecosystem?
- Are there positive social implications (improved livelihoods, food security)?

The more these questions can be answered positively, the more likely it is that the restoration intervention will be able to attract private investment for restoration.

Table 22.
Some potential barriers to private investment in restoration in developing countries

Barrier	Description
Investment opportunities	A lack of sufficient profitable opportunities in which to invest (returns, breakeven years, scale of a specific investment and scale across the country as a whole).
Supply chain connectivity	Disconnected supply chains (which may be an opportunity or a cost inefficiency).
Infrastructure	Insufficient 'hard' infrastructure (such as roads and other transportation networks, power, and irrigation systems) and 'soft' infrastructure (such as customs procedures or government cooperation).
Land rights	Undefined land and water rights that are needed to incentivize land owners to promote investments in enhancing land productivity.
Adoption effectiveness	Low adoption due to inadequate human capital.
Regulatory and political risk	Heavy regulation and excessive red tape undermine investment by increasing costs and delays for investors and result in higher corruption levels among public officials, as shown by the World Bank's 'Doing Business' reports.
Macro economics	A lack of supportive macro-economic environment, in which inflation is contained and exchange rates are stable.
Capital markets	Underdeveloped capital markets, limiting investors' exit options for equity-type investments.

Table 23.
Results of an evaluation of Rwanda's barriers to private investment in restoration

Barrier	Assessment score	Rationale
Investment opportunities		• Rwanda is a small country and setting up local operations/partners and gaining local knowledge may not yield a large enough investment opportunity given the size of the country.
		• Landholdings are very small, making gaining scale for a given investment and the need for aggregation a challenge.
Supply chain connectivity[1]		• Limited information shows that Rwanda has comparatively fewer supply chain challenges for staple crops.
Infrastructure		• While landlocked, Rwanda's transport times and costs compare favourably with many of its neighbours.
		• Between Mombasa-Kigali is the second-shortest import/export time in the region.
		• Within Rwanda there are a few key highways running primarily north-south in the centre of the country and these are primarily paved.
		• Only 9.4% of the population has access to electricity, which is the 3rd lowest of it 6 neighbouring countries.
Land rights		• Land rights are clear and major investments are in place for a cadastral system with millions of land holders recorded.
Adoption effectiveness[2]		• Adoption of marketable high-value fruits, medicine and timber has been found in Rwanda highlands.
		• Contract farming is having some success, which supports aggregation, providing rural finance for certain high value and export crops.
Regulatory and political risk		• Rwanda's "Doing Business Rank" for 2014 was 32, up from 54 last year and well ahead of the average for Sub-Saharan Africa of 142.
		• Based on the Worldwide Governance Indicator, Rwanda has the best ranking over the past 5 years across all 6 indicators when compared to its neighbouring countries.
		• Perception of civil unrest risk, may prevail with investors from prior historical events.
Macro economics		• Rwanda is listed as one of the World's top 10 fastest growing economies in 2013.
Capital markets		• Rwanda is active in capital markets, with Eurobond issuance and an OTC market that was launched in 2008.
		• The size of the OTC market relative small at 2.2% of GDP.

Key: *No barrier* *High barrier*

[1] *This is very supply chain specific.*
[2] *This will be site and subsector specific and highly dependent on the design of restoration activities.*

Phase 3: **Results to recommendations**

By this stage, the ROAM process has gone through several iterations of data collection and spatial and non-spatial analyses and has generated an overall picture of the opportunities for forest landscape restoration at the national (or sub-national) level. The results obtained are based on the best data the assessment team could access and the best local insights and expertise they could draw on. Nonetheless, the outputs are still of a preliminary nature and remain largely untested. Furthermore, for the assessment to be more than just an academic exercise, i.e. if it is to generate realistic recommendations and lead to concrete follow-up actions, it needs to be presented and discussed with a wider set of stakeholders and experts than have been involved in the work thus far.

This final phase of ROAM therefore plays a critical part in ensuring its credibility and impact. The specific aims for this phase of the assessment are to:

- Test the validity and relevance of the assessment results;
- Analyse further the policy and institutional implications of the results;
- Build support for the assessment results among decision-makers; and
- Draft policy and institutional recommendations and plan for next steps.

While key decision-makers should have been kept abreast of developments from the outset, it is now particularly important that they are involved in this phase in order to strengthen their ownership of the assessment results and help set the stage for policy uptake of the recommendations that emerge. In Ghana, for example, the assessment team needed to be very proactive in ensuring that the key people in government were kept apprised of the process at all times and engaged in validating the outcomes; this proved instrumental in achieving the high level of follow-up and interest in the assessment results and recommendations (as outlined in Box 2 on page 28).

This final phase needs to be targeted and managed towards tangible inclusion of the assessment results in the implementation of national policy priorities. The ultimate indicator of a successful assessment will be that the key actors move forward with preparing policies, programmes or strategies on FLR that complement and help deliver national priorities on economic development, natural resource use, food, water and energy security, climate change mitigation, etc.

Organizing the validation workshop

In practical terms, this phase will require that senior-level departmental staff, leading national 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. This tends to be most efficiently done through one validation workshop in the capital city.

This validation workshop is of a rather different nature to the preceding district or thematic analytical workshops. A lot less time should be spent on methodological and process issues and much more focus should be given to assessing whether the overarching conclusions and recommendations make technical, political and institutional sense – in other words to validate whether these proposed ways forward are feasible in the prevailing national circumstances. The workshop outcomes should either allow the assessment team to move forward with final documentation and reporting or highlight specific elements of the spatial and non-spatial analyses that need to be repeated using either redefined assumptions or additional data.

The validation workshop will most likely need to cover the following elements:

- A brief description of the key assessment parameters, specifically the final assessment criteria, the main restoration interventions, the main data sources and the main underlying assumptions;
- Presentation of assessment process so far;
- Reporting and validation of the main conclusions from the spatial analyses and the economic and cost-benefit-carbon modelling;
- Discussion on policy implications and policy and institutional 'readiness' for a national FLR strategy/programme;
- Identification of gaps in the 'restoration readiness' and recommendations to address these;
- Stock-take of whether the assessment recommendations adequately address national priorities and commitments; and
- Discussion on next steps.

Prior to holding the validation workshop, it will be important for the assessment team to prepare the results in a clear and compelling way – and in formats appropriate for facilitating discussions with the participants. This is important because it helps to build understanding and also because some stakeholders may request to use the results right away. The team should be careful not to overload the workshop discussions with too many detailed findings, but rather present the headline results, the top priority restoration interventions identified and the major implications of these interventions.

The process should also allow workshop participants to challenge the assumptions of the assessment. The assessment team might consider producing alternative sets of results under different assumptions and then collecting feedback on the most appropriate scenario, during the validation workshop. This feedback process improves the output of the assessment and should reduce the number of areas open to criticism.

In selecting participants to invite to the workshop, the team should aim to include:

- Senior technical and policy staff from key land-use ministries;
- Similar level staff from finance and economic planning ministries;
- Potentially staff from the head of government's office;
- Representatives of associations of key primary stakeholders, such as:
  - Chambers of commerce;
  - Farmers' associations; and
  - Indigenous peoples' associations;
- Civil society organizations;
- NGOs:
  - Key private sector representatives; and
  - Bilateral donor representatives.

Table 24 shows some of the main discussion points that should be addressed in the validation workshop. In addition to raising these specific questions, the assessment team should encourage the participants to:

- Raise any concerns about confusing, contradictory or unclear results – and request clarification;
- Identify any other pieces of work that may be relevant to the assessment; and
- Request tangible refinements to existing analyses.

Table 24.
Main points of discussion in validation workshop

Elements of assessment	Questions/topics to discuss
Priority FLR interventions identified (i.e. top 5 or 6 interventions)	• Are these the real priorities? • What land uses do they implicate? • Does the potential geographic scale of these interventions make sense? • Which areas or districts might offer potential opportunities for early action on FLR? • How do these priority interventions align with existing plans and programmes of key ministries?
Economic analysis (i.e. costs and benefits of priority FLR interventions)	• Do the anticipated returns from the landscape restoration interventions make sense? • How does this compare with the established costs and benefits of other interventions aimed at improving similar categories of land use? • Do those who bear the costs receive a proportionate amount of benefits?
Carbon analysis	• Discuss the carbon benefits from the priority FLR interventions • Do the estimated carbon benefits make sense both at the per ha and national level? • How do the priority interventions relate to national REDD+ strategies?
Finance/resourcing analysis*	• How can the priority FLR interventions be financed using: o existing investment mechanisms? o new sources of funding? • What are the main financing priorities to promote the FLR interventions?
Policy, legal and institutional analysis*	• What national policies and other measures would stimulate restoration? • What knowledge, tools, capacity and finance are most needed to promote FLR? • How can the demand for restoration be strengthened: o Improved market conditions? o Improved capacity at district level? o Direct payments to land owners? • Awareness raising campaign? • How can coordination across different land-use ministries be improved?

** See following pages for discussion of these issues*

Before finalizing recommendations (see pages 113 to 117) there are two additional pieces of work that the team may wish to pursue. These may not be considered absolutely necessary at this stage but if time and resources permit they can contribute additional insights that can further strengthen the final recommendations. These are:

- Testing the perceived relevance of strategic institutional and policy options with local-level government; and
- Identifying finance options for implementing the restoration opportunities.

Both of these analyses could be run concurrently with other analytical work during Phase 2 but as the scope and content of these two pieces of work depend strongly on the other analyses as well as the conclusions from the validation process, it is advisable to schedule these two concluding analyses just before the final recommendations are prepared.

Testing the perceived relevance of strategic institutional and policy options with local-level government

While some district-level staff will have attended the validation workshop, it is unlikely that many will have had the opportunity to participate due to logistical constraints. Indeed, it may be more likely that district-level staff have been engaged more systematically through analytical workshops – particularly if these have been organized on a sub-national basis. This presents a dilemma, for district officials do not only have technical insights to share but they also operate at the point where centralized government programmes and policies have to be turned into on-the-ground implementation action. This means that local government staff tend to have a particularly pragmatic understanding of what types of policy and institutional interventions are more likely to work under current circumstances. Unfortunately this professional cadre is rarely given the opportunity to share their opinions and insights before final policy recommendations are formulated.

Drawing on the validated diagnosis of key success factors present in the country, it is quite easy to come up with a brief survey of local government officials: take the key conclusions for improved policy and institutional measures that have emerged from the diagnostic, insert these in a table format and ask district officials to rank these in order of:

- Priority (with 1 being the most essential measure they feel needs to be in place, 2 the second-most important measure, and so on); and
- Ease of implementation (with 1 being the easiest to implement from a local-government perspective).

Space can be provided in the survey form for local government staff to give further comments, although the real value of this exercise is the cumulative ranking of what local government officials consider to be the most important and feasible policy and institutional measures. While individuals do not need to identify themselves by name, it is useful to ask respondents to identify their region or district and the department in which they work. This allows for further analysis (if necessary) by geographic location and sector.

The survey should be sent out electronically if possible. If district offices are not connected to the internet, the survey can be done during sub-national analytical workshops although the results will be less precise as the individual policy measures being assessed will not have been subject to validation. Once the results come in, they can be collated on a simple spreadsheet. A cumulative ranking can be calculated by taking an average score and then ranking these 1, 2, 3, 4,…n from the lowest value to the largest. However averaging non-parametric values has its risks so it is also advised to identify the most popular responses. Simply count how many times a policy or institutional measure has been ranked as one of the top five priorities by individual respondents and then rank the measures 1, 2, 3, 4,…n with 1 corresponding to the most popular response.

Armed with these two simple sets of analyses it should now be possible to ascertain what policy and institutional measures the district officials consider most important and which ones they see as the easiest to achieve.

As this is not an exact science, there is no need to be precise. The assessment team may want to simplify the presentation further by converting the overall cumulative rank into a simple colour code as illustrated in Table 25, which shows the summary of survey results collected from over 75 district officials in Rwanda. This Table illustrates the value of this exercise particularly when comparing 'policy priorities' and 'ease of implementation'. It highlights that not all priorities are necessarily difficult to achieve. In this case, three out of the five policy priorities were also judged to be relatively easy to deliver. In other words, these are potentially low-hanging 'policy and institutional' fruits – at least from a local-government perspective.

Table 25.
Some key changes needed to improve institutional and policy enabling conditions for restoration in Rwanda (local-government perspective)

Policy or institutional measure	Priority	Ease of implementation
The economic case is understood at district level		
Better local planning processes		
Better coordination between government agencies		
A Government supported campaign		
More government finance and incentives		
Better district level technical extension		
Performance targets for restoration		

Priority
First-level priority Second-level priority

Ease of implementation
Easy Relatively easy Difficult

Identifying finance options for implementing the restoration opportunities

This is still an emerging area of the assessment methodology and the ROAM applications to date have not gone as far as proposing detailed recommendations for matching restoration opportunities with clear finance and investment packages. However the assessment team may wish to test the validated results with local finance specialists, ideally from both the public and private sectors.

A general set of strategies for attracting private investment in restoration is outlined in Table 26; the assessment team may wish to refer to this Table when compiling a list of recommended finance options to pursue. The preliminary set of recommended finance options drawn up in the Rwanda assessment is shown in Table 27.

Table 26.
General recommendations for attracting private investment for restoration

Recommendation	Core activities
1. Identify investment-worthy practices and partners	
Find the specific value chain (set of business) activities in a geographic region that are already being implemented at some scale and can deliver priority restoration activities and improve livelihoods but that have the potential to attract new sources of private investment.	• Identify how to leverage government strategies and investments. • Align with economic realities of area. • Meet basic requirements for a good restoration investment. • Identify a limited number of activities to focus (i.e. keep business models simple). • "Follow the money", both public spending and other private investments to find opportunities. • Develop an initial set of potential investment opportunities aligned by type of value chain/ business, target type of funding source.
2. Provide support for commercialization and making the business case	
Provide support to potential investment opportunities to address some of the main barriers to attracting private investment which include: setting up of aggregation entities, execution of operational agreements between partners, development of financial projections for investment returns, developing operational and financing management expertise.	• Establish aggregation approaches that will deliver enough scale (so total size is large enough for target investor). • Develop high quality financial projections with sensitivities to demonstrate cost effectiveness, risk and return profile. • Define key implementation partners and execute contractual arrangements with communities, technical specialists, and government. • Determine transparent and efficient funds flow mechanisms.
3. Identify and secure private investment	
For attracting investments from private equity funds, development finance institutions, regional/ international banks and institutional investors, it is necessary to use qualified financial specialists who can represent the investment opportunity, target the appropriate investors and structure/execute the transaction.	• Review each set of investments for suitability for each type of investor and develop target prospect list. • Develop professional quality investment pitch materials. • Perform initial screening of prospects. • Plan 'roadshows' and targeted meeting with engagement of key implementing partners. • Support due diligence and structuring/negotiation of transaction documents.
4. Maintaining investment worthiness and promoting scale	
Securing investments is not enough. It is imperative that the management oversight systems and reporting mechanisms are put in place to ensure the success of the investment and identify new business opportunities, expand best practices and communicate regularly with the investors.	• Establish performance reporting requirements for investment entities and key implementing partners (leveraging existing systems and extension services, mobile and remote sensing technologies). • Ensure programs are in place for on-going training and motivations are aligned to promote higher and broader adoption among new small holders. • Provide quarterly performance reports to investors and share success stories more broadly. • Oversee financial and operational practice of investment entities.

These options were proposed as potential finance sources for three of the priority FLR interventions in Rwanda.

Table 27.
Recommended finance options for some of the priority FLR interventions in Rwanda

FLR intervention	Recommended finance option
Agroforestry and farmer-managed natural regeneration	Co-investment programme where farmers provide farm labour in exchange for seedlings and inorganic fertilizer could compensate for crop risk.
Improved management of woodlots	Extension programme to encourage better tree-spacing practices, financed with carbon revenue.
Natural regeneration and protective forests	Primarily benefits society. Could be financed through tourism revenues, carbon sales, carbon tax, or hydropower tax depending on situation.

From recommendations to implementation

Again, this is an area where experience is still emerging, so the guidance provided here is relatively brief. As ROAM applications increase and extend into implementation follow-up, further guidance will be developed and made available.

By this stage of the process, the assessment team should have sufficient analysis, insights and opinions to pull together a coherent set of strategic recommendations. These inputs for the recommendations should include:

- The potential area of land that could benefit from an FLR programme of work;
- A shortlist of 5–12 key interventions most suited for implementing a national FLR programme, and the potential contribution each intervention could make in terms of area;
- A national map showing the extent and approximate geographic location of specific potential FLR opportunities;
- A robust cost and benefit analysis of each intervention type and a general idea of who the main beneficiaries are and how the costs would be distributed;
- An estimation of the potential carbon sequestration value of implementing these interventions, an idea of how much carbon could be sequestered nationally by intervention type and an estimation of the value of so-called co-benefits that should accrue per ton of CO_2 sequestered; and

- A relatively comprehensive assessment of the country's restoration readiness (from the diagnostic of key success factors), with particular insights on how existing policy and institutional arrangements, legal processes and research and technical capacity can help or hinder successful landscape restoration. If there is time it should also be possible to analyse how these options are viewed and what priority they are given from the local government structures that will often be in charge of implementation.

Table 28 shows the key policy and institutional recommendations identified by the assessment team and validated by key stakeholders in Rwanda.

If deemed desirable it should also be possible to illustrate how these various pieces of analysis come together in one landscape. Figure 22 illustrates how the Rwandan analysis was brought together to illustrate how a comprehensive restoration strategy might be applied in one landscape – Gishwati – which underwent severe deforestation and degradation, with forest cover declining from about 25,000 ha in the 1970s to only 600 ha in 2005, and is a key focus of the Rwandan government's plans for countrywide restoration (forest cover has already increased to about 1,500 ha). It is critical to point out that the only function of this type of map is to illustrate what might be possible. It should under no circumstances be used to assign actual project interventions on the ground. For that to happen, consultation, dialogue, information-exchange with, and ultimately consent from, local farmers and communities would be essential.

These recommendations produced from the Rwanda assessment address the most urgent 'gaps' in the enabling conditions (shown in Table 21).

Table 28.
Strategic recommendations generated in the Rwanda assessment

Theme #1: Improve coordination among government agencies.
Ensure that ministries work together, provide guidance to one another in their respective areas of expertise and identify ways to collaborate with the private sector and civil society. This includes district level engagement.

- Utilize the Joint Sector Working Group to coordinate government agencies and help them prioritize and promote implementation of landscape restoration activities.
- Relevant authorities share and communicate those aspects in their Master Plans that are relevant to Forest Landscape Restoration with a particular emphasis on identifying immediate synergies.
- Responsibility and mandate to promote, coordinate and provide technical guidance on agroforestry be assigned to one (existing) authority.

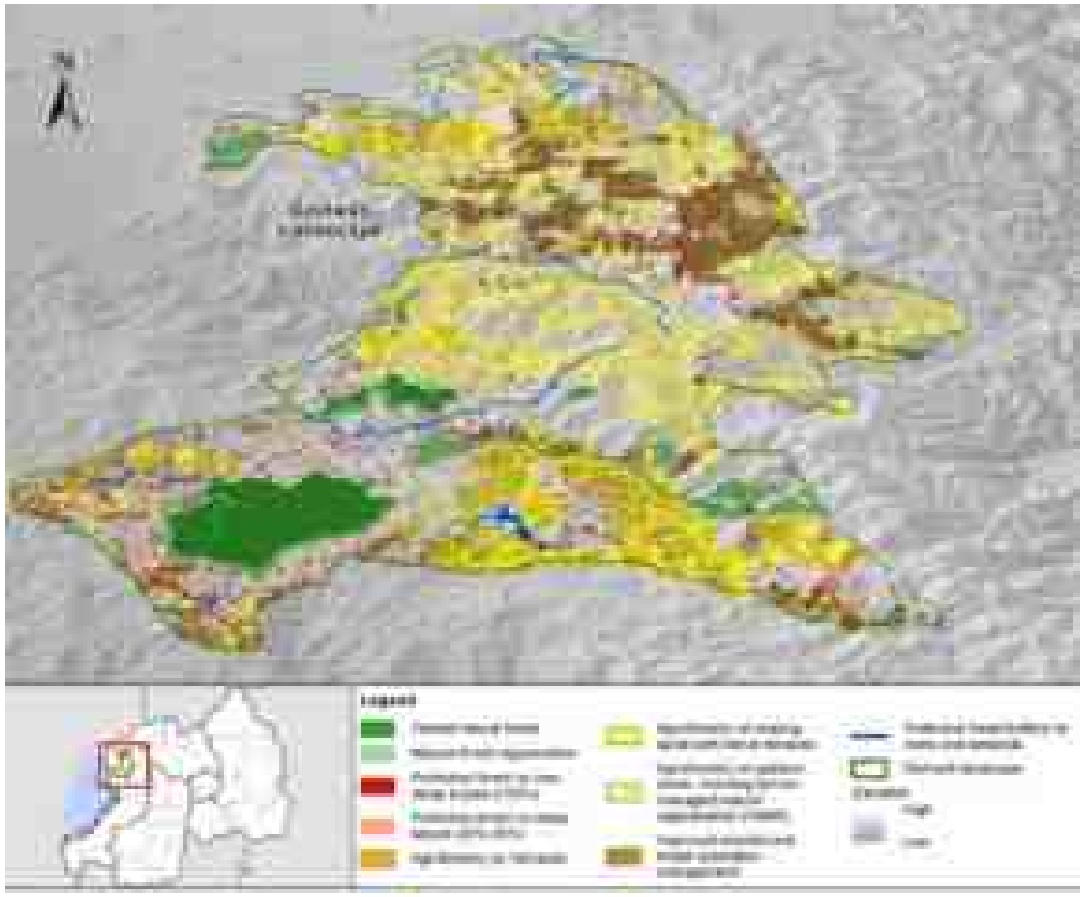
Theme #2: Stimulate supply of trees.
Enhance the capacity of existing seed and nursery assets by increasing funding and creating positive incentives for long-term capital investment, particularly from the private sector.

- Build capacity of the Tree Seed Center to meet increasing demand for quantity, quality and diversity of seeds, especially for native species.
- Stabilize and strengthen network of tree nurseries, in particular encourage increased investment by creating conditions that enable them to plan and operate on multiple-year time horizons.
- Introduce target of at least 20% planting of native species, primarily with respect to protective forests and restoration of degraded areas of natural forests.

Theme #3: Stimulate demand for trees.
Increase the use of trees, especially native species, on agricultural landscapes by supporting species that are most likely to benefit farmers.

- Improve existing district and sector level extension services by aligning performance targets of agriculture and forest staff with restoration goals.
- Improve understanding among ministerial and district staff of how small-scale land-owners manage their woodlots with a view to identifying acceptable measures for improving production.
- Launch a public awareness campaign to highlight the benefits of a diverse range of trees, especially native species.

Figure 22.
An assessment map produced for one area of Rwanda (Gishwati forest reserve) showing the opportunities for different FLR interventions



This map shows the opportunities for the priority restoration interventions identified for Rwanda, within a highly degraded forest reserve.

A ROAM process does not finish with the development of strategic recommendations. It is critical that the assessment report and results are not only disseminated to all those who participated at various stages of the work and any other key stakeholders in the country, but are also translated into briefings and presentations for senior-level decision-makers.

Now that the validation workshops have put restoration opportunities on to the national agenda, the team needs to work closely with 'restoration champions' – i.e. influential stakeholders who have shown a high level of support for the assessment and who can help move forward the policy, legal and institutional changes recommended. These champions can also play a key role in feeding the assessment results into other national-level initiatives and processes.

Indeed, having helped produce the analysis and recommendations, the assessment team – or the institution or agency within which the assessment team sits – needs to proactively push the restoration opportunities with other partner institutions. This should not be difficult if the assessment has been planned and properly located with existing national priorities (as discussed on page 31). It may even be that the next step is to take this type of analysis down to the next level and apply it as part of a consultative process to support the landscape-level design of national FLR pilots.

To sum up then, this last phase will ideally conclude with the assessment team identifying entry points and strategic partners (individuals or organizations) to take forward the assessment results and recommendations. If at all possible, the team members should stay up-to-date with developments and keep in regular contact with the key actors, to support efforts to set in motion the next steps – whether these are on a policy, programme or project level.

Do you have experiences to share on turning results into recommendations? Write to gpflr@iucn.org to let us know how we can improve this aspect of the methodology.

Moving forward

Undertaking a national assessment of restoration potential involves a significant step forward in providing solutions to national challenges through forest landscape restoration. Those taking part in such assessments will have contributed, not only to the identification of restoration opportunities, but also to the opening up of longer-term opportunities, such as new national options for meeting international commitments under the global conventions of CBD, UNFCCC and UNCCD. They may also have helped define or refine a national commitment to the Bonn Challenge goal to restore 150 million hectares globally by 2020.

With continued momentum, these new opportunities can translate into restored productive and multifunctional landscapes across the country.

For those contemplating or planning a national assessment, it is very useful to see how others have undertaken this task. So please consider sharing your experience and results with the global FLR community. The easiest way to do this is to join the Learning Network facilitated by the GPFLR, which connects partners and collaborators from around the world and allows new ideas and solutions to be freely exchanged.

The Learning Network (at www.forestlandscaperestoration.ning.com) now has over 500 members and provides not only information and guidance but also a discussion platform for members to debate specific issues. Online learning modules – organized by IUCN and other GPFLR members – are also available. Membership of the Network is open to anyone interested in following or participating in FLR-related happenings.

Finally, if you would like to obtain specific advice or information – such as documentation on FLR templates and examples from ROAM applications (e.g. workshop agendas, spreadsheets, etc.), or news on upcoming global events where FLR will be presented and discussed – please visit www.iucn.org/forest or www.forestlandscaperestoration.org, or email gpflr@iucn.org.

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Appendix 1. Estimating carbon sequestration benefits using the IPCC Tier 1 method

For the Tier 1 method, it is important only to know how much carbon degraded land uses store in above and belowground biomass and how that number would change if the land were restored. Estimates of biomass, especially in forests, are often reported in terms of standing volume (cubic metres), but since carbon is reported as a weight (tons) the standing volume estimates have to be converted. First, standing volume (cubic metres) is converted to weight (Kg) using a biomass conversion expansion factor appropriate for the climate zone and forest type:

$$\text{Above ground biomass}_i\ (ABG) = M^3 * BCEF_S^i \qquad [1]$$

Where i indexes the growing stock level and BCEF is the Biomass Conversion Expansion Factor.

Table A1 shows a standard IPCC table of biomass conversion expansion factors.

Table A1.
IPCC biomass conversion expansion factors (BCEF) for growing stock levels

Climate zone	Forest type	BCEF	Growing stock level (m^3)							
			<10	11-20	21-40	41-60	61-80	81-120	121-200	>200
Humid tropics	conifers	$BCEF_S$	**4.0** (3.0-6.0)	**1.75** (1.4-2.4)	**1.25** (1.0-1.5)	**1.0** (0.8-1.2)	**0.8** (0.7-1.2)	**0.76** (0.6-1.0)	**0.7** (0.6-0.9)	**0.7** (0.6-0.9)
		$BCEF_I$	2.5	0.95	0.65	0.55	0.53	0.58	0.66	0.70
		$BCEF_R$	4.44	1.94	1.39	1.11	0.89	0.84	0.77	0.77
	natural forests	$BCEF_S$	**9.0** (4.0-12.0)	**4.0** (2.5-4.5)	**2.8** (1.4-3.4)	**2.05** (1.2-2.5)	**1.7** (1.2-2.2)	**1.5** (1.0-1.8)	**1.3** (0.9-1.6)	**0.95** (0.7-1.1)
		$BCEF_I$	4.5	1.6	1.1	0.93	0.9	0.87	0.86	0.85
		$BCEF_R$	10.0	4.44	3.11	2.28	1.89	1.67	1.44	1.05

Source: IPCC (2006).
Notes:
$BCEF_S$: Biomass Conversion Expansion Factor for aboveground biomass
$BCEF_I$: Biomass Conversion Expansion Factor for net annual increment
$BECF_R$: Biomass Conversion Expansion Factor for aboveground biomass removal

Belowground biomass, or Root Biomass Dry Matter (RBDM), is calculated using an equation that converts aboveground biomass to RBDM:

$$RBMD = e^{(-1.805+0.9256*\ln(AGB_i))} \qquad [2]$$

Where AGB is aboveground biomass for growing stock level i.

Once the standing volume of biomass has been converted, the weight of carbon is estimated by assuming biomass is 49% carbon by dry weight.

The total carbon sequestered per hectare is found by:

$$C\ (tonnes) = (AGB+RBDM)*0.49 \qquad [3]$$

Where 0.49 is the conversation factor for tons of dry matter to carbon (IPCC, 2003). The estimate could be converted to units of CO_2e by multiplying it by 3.67, which is the ratio of the atomic mass of CO_2e and C, respectively.

About IUCN

IUCN, International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges.

IUCN's work focuses on valuing and conserving nature, ensuring effective and equitable governance of its use, and deploying nature-based solutions to global challenges in climate, food and development. IUCN supports scientific research, manages field projects all over the world, and brings governments, NGOs, the UN and companies together to develop policy, laws and best practice.

IUCN is the world's oldest and largest global environmental organization, with more than 1,200 government and NGO Members and almost 11,000 volunteer experts in some 160 countries. IUCN's work is supported by over 1,000 staff in 45 offices and hundreds of partners in public, NGO and private sectors around the world.

www.iucn.org

About WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

Count It
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

Change It
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

Scale It
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

www.wri.org

About the GPFLR

The Global Partnership on Forest Landscape Restoration (GPFLR) is a worldwide network that unites restoration practitioners, policy-makers and supporters from government, international and non-governmental organizations, businesses and individuals with a common cause.

The Partnership works from the grassroots level upward to increase awareness of the many benefits of restoration and share knowledge on best practices for restoration success. The GPFLR mobilizes expert support and increased capacity to implement forest landscape restoration. With the IUCN as its Secretariat, the GPFLR also builds support for restoration with decision-makers at both the local and international level, and influences legal, political and institutional frameworks to support forest landscape restoration.

www.forestlandscaperestoration.org

About the Bonn Challenge

The Bonn Challenge is a global aspiration to restore 150 million hectares of the world's deforested and degraded lands by 2020. It was launched at a ministerial roundtable in Bonn, Germany, in September 2011. Numerous countries and organizations have made pledges to the Bonn Challenge or are in the process of preparing pledges – to date 20 million hectares of degraded lands have been pledged for restoration, with another 30 million being considered for additional pledges. The Bonn Challenge is not a new global commitment but rather a practical means of realizing existing international commitments, including the CBD Aichi Target 15, the UNFCCC REDD+ goal, and the Rio+20 land degradation neutral goal.

www.bonnchallenge.org

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WORKING PAPER
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Are you working on land-use or conservation policies? Or landscape-level programmes? Perhaps you are involved in the forest, agriculture or energy sector?

Are you interested in exploring the potential for restoration and carbon sequestration in your country? Maybe you have been asked to take part in an FLR assessment? Or maybe you are simply curious to learn more about what this is all about.

This handbook presents the Restoration Opportunities Assessment Methodology (ROAM) and offers practical advice and options to bear in mind when considering or conducting an FLR assessment using ROAM, as well as real-life examples of the kinds of outputs you can expect. It will enable you to commission or design a tailor-made process to meet your specific needs – from a quick scoping exercise or a preliminary assessment using what scarce information is available to a full-blown assessment based on large quantities of spatial data.

A ROAM application can help you answer questions such as "what is the total extent of restoration opportunities in my country/region?", "where is restoration socially, economically and ecologically feasible?" and "what is the value of the benefits, including carbon, from the feasible restoration strategies?"

The results of such an assessment – maps and analyses, and a shared understanding among decision-makers, technicians and other key groups – can help build a strong foundation for the development of national restoration strategies and policies.

The ultimate goal is to foster multi-stakeholder, cross-sector support for restoration and a common vision of how degraded and de-forested landscapes can be transformed into healthy and productive systems able to contribute to national development priorities.