MANUAL 1

Introduction to Landscape Restoration and Water Resources Management

Part of a series of six manuals for Integrated landscape and water management training

SIWI

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Introduction

This manual is the first manual out of six that provides basic training on water management in multifunctional and productive landscapes (Figure 1). It is an abbreviated version of a manual developed by the Stockholm International Water Institute (SIWI) and the International Water Management Institute (IWMI) on Water Productive and Resilient Landscape Management Technologies and Approaches commissioned by the Sida-funded programme on Strengthening Water and Landscape Governance in Ethiopia implemented from 2018 to 2022.

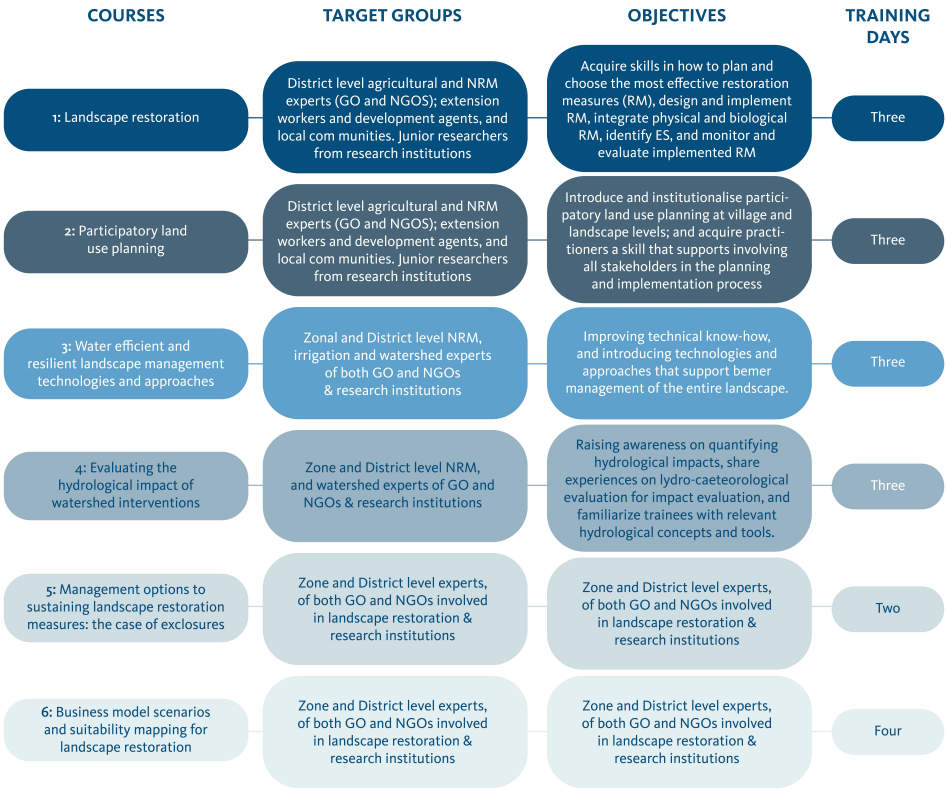


Figure 1. Integrated Landscape and Water Management Manuals developed by SIWI and IWMI.

1. Securing water through the landscape approach

Guiding questions

What is the landscape approach?

Why is it important to consider water in landscape management?

What type of ecosystem services can landscapes provide?

What are the key steps in assessing ecosystem services?

1.1 The landscape approach

Water scarcity and water quality issues are increasingly threatening food security and nutrition. Approximately 3.2 billion people live in agricultural areas with high to very high levels of water shortages (rainfed agriculture) or scarcity (irrigated agriculture), while 1.2 billion people live in severely water constrained areas. Around 11% of rainfed cropland and 14% of pastureland experience severe recurring droughts, while more than 60% of irrigated cropland is severely water stressed[1]. Climate change will continue to exacerbate water-related challenges in agricultural landscapes. Recent predictions indicate that less water may be available and that more frequent droughts may occur in the coming decades, underlining the need to ensure productive, multifunctional landscapes – where a mix of trees, forests and agricultural lands co-exist and support the livelihoods of people, produce raw materials, strengthen biodiversity and maintain the water (hydrological) cycle. Restoring degraded landscapes is therefore becoming increasingly important.
There are many different definitions of the landscape approach, but all are based on a set of principles adopted by the Convention on Biological Diversity (Figure 2). Landscape-wide approaches that integrate the development of agriculture, forestry, energy, and water are considered key to addressing complex environmental problems and to balancing trade-offs between response options. Applying the landscape approach is particularly useful when integrated solutions are required to solve complex challenges related to sustainable development. Landscape approaches

[1] FAO. 2020. The State of Food and Agriculture 2020. Overcoming water challenges in agriculture. Rome.
https://doi.org/10.4060/cb1447en

can be a mechanism for dialogue and discussion among multiple stakeholders, particularly regarding benefits and trade-offs in mobilising better land use and water resource outcomes.

Figure 2. The principles of the landscape approach (Photo: Anna Tengberg, SIWI)

Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. Forest and landscape restoration addresses restoration on a landscape scale, which often encompasses several ecosystems and land uses. It also enables users to achieve trade-offs among conflicting interests, as well as to balance social, cultural, economic and environmental benefits.
The system boundary of a landscape is based on the challenge to be addressed. When the challenge is related to water resources, hydrological boundaries are used. Hydrological boundaries include different scales from river basins, sub-basins, catchments and riparian areas. Understanding the different benefits of landscape restoration, developing skills in planning, identifying, designing and implementing the most-effective restoration measures, as well as acquiring skills in monitoring and evaluation are all critical to ensuring sustainable water resources management in landscapes. These will also help to scale up the restoration measures that also strengthen the hydrological cycle.

1.2 Identification of ecosystem functions and services

A landscape constitutes a wide range of ecosystems including forests, cultivated lands, woodlands, grasslands, wetlands, bushlands and shrublands. Many times these form a mosaic of land uses. Ecosystem services are the set of ecosystem

functions that are useful to humans. The major ecosystems in a landscape provide humans with a range of important ecosystem services such as provisioning, regulating, supporting and cultural, as well as many water-related ecosystem services (Table 1).

Table 1. Ecosystem services provided by landscapes

Ecosystem services	Benefits to human wellbeing
Provisioning	
Food	Production of fish, fruits, livestock feed, grains, natural food products
Fresh water	Storage and retention of water for domestic, livestock, industrial, hydropower, and agricultural use
Fibre and fuel	Production of logs, building materials, carpentry, fuelwood, peat,
Biochemical	Extraction of medicines (medicinal plants), and other materials from biota.
Genetic materials	Genes for resistance to plant pathogens; ornamental species, etc.
Regulating	
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation	Groundwater recharge/discharge, surface water flows
Water purification	Retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	Retention of soils and sediments
Hazard regulation	Flood control and storm protection
Pollination	Habitat for pollinators
Cultural	
Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of lakes, streams, wetland and/or forest ecosystems
Recreational	Opportunities for recreational activities
Aesthetic	Many people find aesthetic value in aspects of different ecosystems
Educational	Opportunities for formal and informal education and training
Supporting	
Soil formation	Sediment retention and accumulation of organic matter (e.g., wetlands and forests ecosystems)
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients (mainly forest and wetland ecosystem).

Various tools and approaches have been developed to assess Ecosystem Services (ES) delivered by landscapes on different spatial and temporal scales. For example, sociocultural values can be assessed with participatory mapping, focus group discussions, household or expert surveys, whereas economic values can be assessed using cost-benefit analysis.

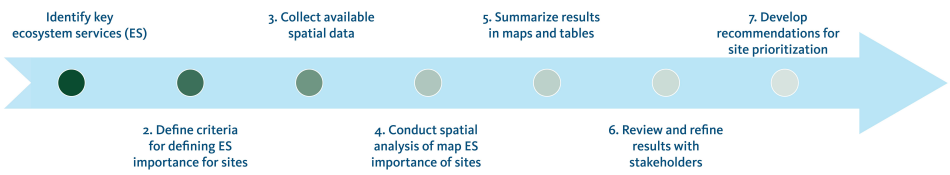


Figure 3. Steps for rapid ES assessment for site prioritization (adapted from Neugarten et al. (2016)

Step 1 - Identifying key ES

Specific ES relevant to a target area or landscape are identified using a combination of different methods such as literature reviews, expert workshops, key informant interviews, focus group discussions and transect walks, as well as field observations.

For example, rainfed crops such as maize and wheat are highly dependent on infiltration of water into the soil, which is regulated by adequate soil and tree cover. Provision of water for rainfed crops through soil moisture is therefore a key ecosystem service delivered by well managed mosaic landscapes.

The drivers of change in landscapes, such as change in land use, cover and climate change, impact the hydrology of the landscape and the ecosystem services it provides. Critical water ecosystem services include provisions of clean water for both agriculture and human consumption, regulation of water supplies, cultural ecosystem services (e.g. recreation), and general support of the hydrological cycle. Water management is critical for addressing tipping points for deforestation and land degradation processes (Figure 4).

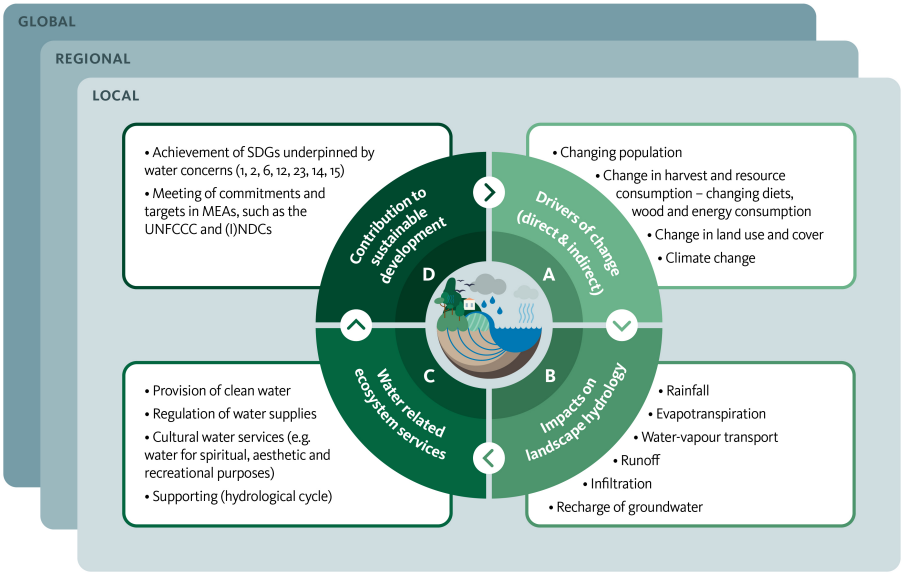


Figure 4. Water-related ecosystem services (source: Tengberg et al. (2021)

Step 2 - Define criteria for assessing ES importance of sites

At this stage, the most relevant ES are identified and criteria for detailed spatial analyses are developed in consultation with stakeholders and experts. Mapping of areas of importance for each ES is based on the level of supply of the service, the level of demand for the service, or both. Table 2 summarizes a few examples of ES and criteria for importance.

Table 2. Selected ES and criteria of importance

ES	Criteria of importance (or why we need to protect an ecosystem in a landscape providing the desired services)
Small scale fisheries	Lake ecosystems are relatively susceptible to pollution compared to other ecosystems.
Provision of fresh water	Areas providing high levels of water storage (both surface and groundwater), located upstream of areas with high demand for water for domestic consumption (per capita water demand multiplied by population), vegetable production (per hectare water demand multiplied by hectares of vegetables).
Climate mitigation	Forests containing relatively high levels of biomass carbon stock and vulnerable to deforestation, compared to other sites.
Nature tourism	National parks with relatively high numbers of visitors, compared to other parks.

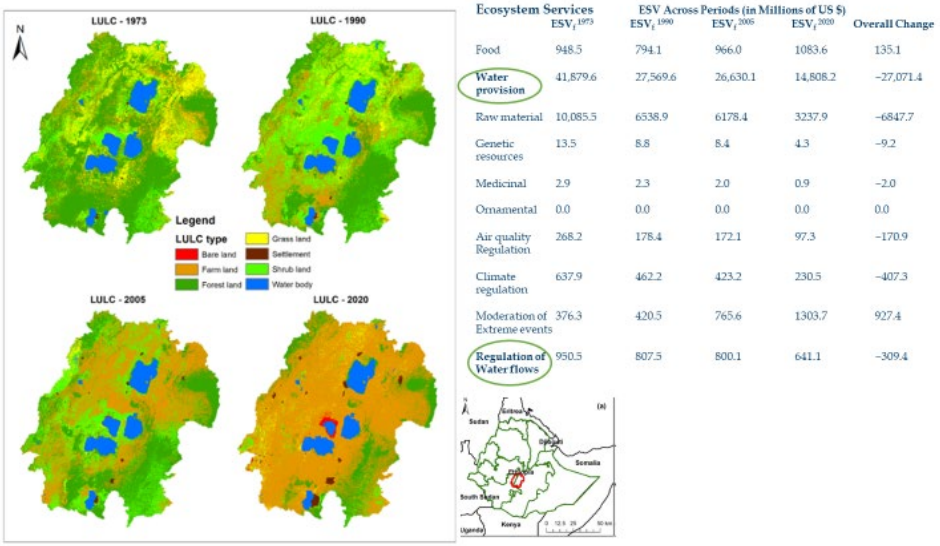
Steps 3-5 – Data collection, analyses, and presentation of results

These steps focus on the following:

- collecting available data for selected ES for spatial mapping
- conducting spatial analyses using different products such as a landcover map, population data, and other global and national data (data on biomass carbon stock, hydrological flows (such as precipitation and groundwater flows), lakes storage capacity and water levels, national forest cover data, deforestation rate (current and future), people vulnerable to flooding, and park visitation data)
- and overlaying the different maps and producing a map describing the different ES in a landscape.

Figure 5 below provides an example of an analysis of changes in land use and cover in the Central Rift Valley in Ethiopia from 1973 to 2020 and resulting losses in ecosystem services values. A major driver of losses in ES values is the ongoing reduction of forest cover, from around 46% in 1973 to 15% in 2020. In this

example, water provision is the biggest loss, with serious consequences for both rainfed agriculture, ecosystem functioning and human well-being.



Ecosystem Services	ESV Across Periods (in Millions of US $)				
	ESV_t^{1973}	ESV_t^{1990}	ESV_t^{2005}	ESV_t^{2020}	Overall Change
Food	948.5	794.1	966.0	1083.6	135.1
Water provision	41,879.6	27,569.6	26,630.1	14,808.2	−27,071.4
Raw material	10,085.5	6538.9	6178.4	3237.9	−6847.7
Genetic resources	13.5	8.8	8.4	4.3	−9.2
Medicinal	2.9	2.3	2.0	0.9	−2.0
Ornamental	0.0	0.0	0.0	0.0	0.0
Air quality Regulation	268.2	178.4	172.1	97.3	−170.9
Climate regulation	637.9	462.2	423.2	230.5	−407.3
Moderation of Extreme events	376.3	420.5	765.6	1303.7	927.4
Regulation of Water flows	950.5	807.5	800.1	641.1	−309.4

Figure 5. Analysis of changes in land use and land cover (LULC) and loss of ecosystem services in the Central Rift Valley Basin, Ethiopia (source: Mekuria et al., 2021(a))

Step 6-7 - Review and refine results with stakeholders and develop recommendations

These steps focus on presenting the results from the spatial analyses to stakeholders. This activity supports the analyses and where possible, validates the maps and other results. For example, the sites indicated by the spatial analyses as vital for water and climate regulations could be verified by experts and foresters.

Recommendations for landscape restoration and site prioritization should be developed based on consultations with all stakeholder groups in the landscape. Stakeholder engagement is a process that is described more in detail below.

2. Socio-economic considerations in landscape restoration

Guiding questions

Why is stakeholder engagement important in landscape restoration?

How can landscape restoration best involve women and youth?

Which other groups should be engaged?

2.1 Stakeholder engagement

For restoration of a landscape to occur, alliances between different stakeholders must be forged based on common understandings of what must and can be done. The first step is to undertake a stakeholder analysis: identifying and characterizing stakeholders, grouping the stakeholders based on their influence and interest, mapping the relationships between stakeholders, and understanding their potential for developing alliances. Stakeholders include all actors or groups who affect and/or are affected by policies, decisions, and actions of an intervention. In the context of natural resources management in Ethiopia, the key stakeholder groups vary from formal or informal groups of male or female farmers (Figure 6) to government bodies or non-governmental organizations (NGOs), international agencies and multinational companies.

Figure 6. Community meeting at Tachignaw Kechema watershed, Netera Kechema Kebele, Wondo Genet district (Photo: Wolde Mekuria, IWMI)

2.2 Gender and youth

A gendered perspective should be included at all stages of landscape restoration and should be considered not in isolation, but as an integral part of each stage in the development process: in needs assessments, planning, implementation, monitoring and evaluation of landscape restoration activities. Involving the youth in landscape approaches is also important, and can create opportunities for income and employment in rural areas. While assessing needs:

- Discover which resources are available in the community, and who has access and control over them.
- Find out who makes various decision in the community, and how. This helps you approach the right people for each decision.
- Identify the different preferences of men, women, children and youth.

During the planning stage of forest and landscape restoration initiatives, men and women should be equally represented. Encourage all members of the community to be involved in making decisions, not just in providing information or agreeing to what was proposed.

At this stage:

- Try to create an atmosphere that encourages women and youth to participate in planning. That can include forming the right grouping for discussion and considering if specific discussion groups for women, men and youth are needed. Find out when in the year and at what times of day women, men and children can attend meetings or actively do land management work.
- Help the community develop a plan based on the needs of the different members of the community, not biased to any gender or age.
- Try to anticipate the negative impacts of a proposed activity on men, women and children.

At the implementation stage, mainly focus on making sure that there are equal numbers of men and women in the group. If women are not free to participate in a mixed group, help form women-only groups.

Monitoring involves gathering and analyzing information as an activity is occuring and making adjustments as needed. Evaluation includes analysing the impact of the activity after it is implemented. In both monitoring and evaluation, data should be gathered on men and women separately, so that they can be compared.
Collect information that ensures:

- Men, women and youth are involved in all activities – both in planning and implementing new activities and maintaining existing ones.

- Men, women and youth participate in management and decision making.
- Benefits are equally distributed to all men, women and youth.
- Project activities meet the needs of men, women and youth.
- Projects do not produce unintended negative effects, such as additional workloads, on women and girls.
- Men, women and youth have equitable access to essential inputs.
- The extra time needed to contribute to the activity does not affect the other responsibilities women or youth have.
- The activity improves both women and youth access to, and control over, resources.

2.3 Engaging Indigenous Peoples

To best include Indigenous Peoples in all areas of landscape restoration, partnerships must exist between government, private sectors, civil societies and indigenous people, and require the full and effective participation of indigenous peoples at every level of the process. This includes allowing Indigenous Peoples the opportunity to identify concerns, which must then be prioritized, alongisde proposing solutions that are community driven. Representation of Indigenous Peoples, including traditional or customary authority structures, must be supported, while recognizing the cultural diversity that exists within Indigenous Peoples and between communities. Accordingly, partnerships must be tailored to the specific characteristics of indigenous communities and development programs (e.g., forest and landscape restoration) must also be responsive to the specific needs of individual communities.

For effective engagement of Indigenous Peoples, the UN has developed guidelines[2]. These guidelines include mechanisms for representation and engagement; design, negotiation, implementation, monitoring, and evaluation; and capacity building. The UN guidelines related to representation and engagement stress that governments and the private sector should establish transparent and accountable frameworks for engagement, consultation and negotiation with indigenous peoples and communities. Further, Indigenous Peoples and communities have the right to choose their representatives and the right to specify the decision-making structures through which they prefer to engage with other sectors of society.

[2] https://unsdg.un.org/resources/united-nations-development-groups-guidelines-indigenous-peoples-issues

3. Sustainable land and watershed management

Guiding questions

What is sustainable land management (SLM)?

What effects can SLM have on water in the landscape?

3.1 Sustainable land management

Sustainable land management (SLM) is defined as the adoption of land use systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources. SLM includes management of soil, water, vegetation and animal resources. SLM also includes ecological, economic and socio-cultural dimensions. SLM measures prevention, mitigation, rehabilitation of land degradation, and restoration of ecosystem services.
These measures can be classified into four categories:

- **Agronomic measures** – measures that improve soil cover (e.g. green cover, mulch), enhance organic matter/soil fertility (e.g. manuring), soil surface treatment (e.g. conservation tillage), and sub-surface treatment (e.g. deep ripping)
- **Vegetative measures** – include plantation/reseeding of tree and shrub species (e.g. live fences, tree crows), grasses and perennial herbaceous plants (e.g. grass strips)
- **Structural measures** – include terraces, bunds, dams, pans, ditches, walls barriers, palisades
- **Management measures** – include change of land use type, change of management/intensity level (e.g. from grazing to cut-and-carry), major change in timing of activities, and control/change of species composition.

Applied appropriately in a landscape and watershed, SLM measures can contribute to improved infiltration and water retention in soils, which can enhance green water availability and rainfed agriculture. They can also improve the recharging of groundwater, as well as regulation of water flows, enhancing the availability of blue water. Overall, they strengthen the hydrological cycle, improve the water exchange with the atmosphere and can enhance rainfall locally as well as downwind. For

example, in the norther highlands of Ethiopia, landscape restoration has brought increased fresh water for human and livestock consumption. The interventions implemented in four watersheds in Tigray province, located on the northernmost tip of Ethiopia, resulted in large and small dams full of clean water, productive boreholes and even waterfalls. Figure 7 shows how forest landscape restoration, such as planting trees in the right places with the right spacing, can enhance the water cycle and contribute to improved availability of both green and blue water in the landscape.

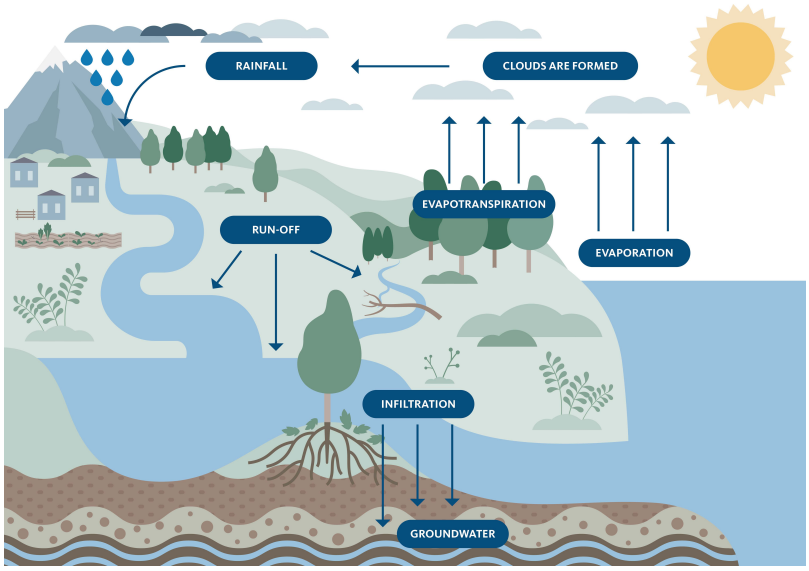


Figure 7. The forest-water nexus in the landscape (source: Gustafsson et al. (2019))

The most comprehensive global data base for SLM best practices is provided by WOCAT (World Overview of Conservation Approaches and Technologies; www.wocat.net). It was established in 1992 as an informal global network of soil and water conservation specialists. Since 2014, WOCAT's database for reporting on SLM best practices has been used by to the United Nations Convention to Combat Desertification (UNCCD). Box 1 provides a case study with an impact assessment of SLM on the Jemma Major Watershed in Ethiopia.

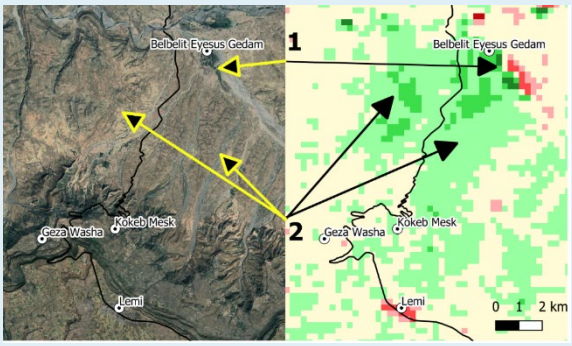
3.2 Case study on sustainable watershed management

Proper management of landscapes and watersheds enhances the ecosystem services they provide that support nature, including the hydrological cycle, while generating socio-economic benefits for local communities. Box 1 provides a case study from Ethiopia where SLM was scaled up across a watershed.

Box 1: Successful landscape and watershed management in Jemma Major Watershed, Ethiopia

The Jemma major watershed is located in Amhara region, Ensaro Woreda (District) approximately 150 km north of Addis Ababa. Elevation ranges from 1 400 m to 2 600 m and it falls under four agroecological zones with a very steep gradient. A field assessment in May 2019 covered three micro-watersheds – Bereku, Bera and Amba-Ras – located in the upper, middle and lower parts of the Jemma major watershed. Area closures documented by WOCAT have been implemented in the upper area, including enrichment plantations and natural generation due to exclusion of livestock and human interference.

Implementation of area closures for restoration begins with the selection and demarcation of the area chosen by land users. After identifying the area to be closed, ditches and terraces are established using stones combined with multipurpose grasses or shrubs. Depending on the site conditions, species of enrichment trees that can further rehabilitate the land and restore the soil are planted. Significant land cover improvements were observed since the implementation of area closures, which was confirmed by the field assessment, as well as positive trends in NDVI (Normalized Difference Vegetation Index) between the year 2001 and 2018 using Trends.Earth (http://trends.earth/docs/en/). NDVI is often used as a proxy for productivity. Positive trends in NDVI aer seen at point 2 in the in the satellite images below, as a green spot where area closures include implementation of terracing and soil conservation. Point 1 in the map below shows (in green) where small-scale irrigation has been implemented for production of fruits and vegetables.



Trends in NDVI between the year 2001 and 2018 using Trends.Earth for the area visited in the Jemma major watershed (courtesy César L. Garcia, WOCAT, Argentina).

Grass from the area closures via the cut and carry system, also called zero grazing, is used to increase the forage quantity and quality, measured by the fodder and grass biomass production per unit area. This generates the socio-economic benefit of equitable sharing of biomass for all user groups. The cut and carry system is then normally expanded to adjacent watersheds and villages through sharing of experiences at field days and visits by experts and leaders.

The middle portion of the watershed also exhibits area closures as well as forest development. Communities benefit from the collection of wood, used as construction materials for social services, such as schools and community social events. The foothills and flat portion of the watershed is covered by vast farmlands that utilize soil and water conservation structures. Hillside terraces accommodate tree seedlings, help retain runoff and sediment on steep sloping land, and are usually combined with area closures. Little management is needed for their maintenance, except for caring for the trees planted, and correcting damage that may be caused by livestock grazing.

(Source: Tengberg et al, 2020)

4. Landscape and water governance

Guiding questions

How are landscape and water governance linked?

How could integrated landscape and water management be financed?

4.1 Governance approaches

Landscape restoration requires good governance of natural resources, including water. Governance relates to power and decision making. Governance challenges in forest and landscape restoration include deciding the following questions: how to reconcile human wellbeing, ecological integrity and economic sustainability? Who decides what should be restored? Who finances the restoration, and who benefits from it? Who has which rights and how are they to be respected during the process? How can stakeholders best be engaged in the process? How can capacity for local stakeholders be increased so that they can be the stewards of the landscape? How are trade-offs negotiated among landscape stakeholders? What policies support or hinder the restoration process? How are they enforced? How is transparency communicated?

Landscape governance can be integrated into water governance approaches, such as Integrated Water Resources Management (IWRM) and Source-to-Sea (S2S) governance. The S2S approach helps to prioritize and identify intervention strategies that target a key flow threatening the system, such as sediments flows. When the common concern in a landscape is water, the S2S approach can help identify key entry points as well as appropriate stakeholders to address the water-related issue. The S2S approach can thus add a water and flow lens to the landscape approach, as can be seen in Figure 8 below. It provides a model for linking different sectors along S2S segments and flows, as well as multistakeholder groups needed for negotiating agreements.

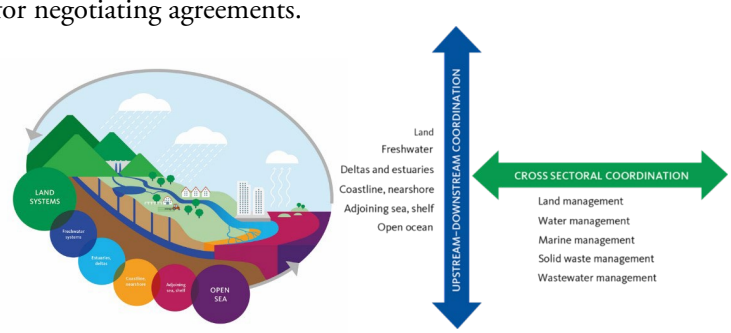


Figure 8. Governance system for Source-to-Sea approach (Source: Mathews et al. (2019))

4.2 Financing

A core governance function that must be implemented is providing access to financing to ensure resilient landscapes and sustained provision of important water-related ecosystem services. Potential sources of finance for forest and landscape restoration measures include NGOs, government agencies and private enterprises. NGOs can provide financial support to local communities in the form of credit or subsidies. Government agencies provide financial support in the form of subsidies or revolving funds for lending through cooperatives or microfinance institutions (MFIs).

In recent years, the need to promote the conservation of natural resources and ecosystems has led to the development of Payments for Ecosystem Services (PES) schemes that offer incentives to farmers or landowners in exchange for their agreement to manage their land in a particular way, or to maintain ecosystem services. PES could provide an additional revenue stream for forest and landscape restoration measures, as they provide significant ecosystem services, such as watershed protection, soil and biodiversity conservation, carbon sequestration, and the minimization of climatic and financial risks by increasing the resilience of the environment to natural disasters. Multilateral funding from REDD+ (Reducing Emissions from Deforestation and forest Degradation) and, for example, from the Green Climate Fund (GCF) and the Global Environment Facility (GEF) could also be accessed in some circumstances.

5. Recommendations

Addressing water challenges is often a key entry point to the restoration of degraded landscapes, which in turn enhances landscape resilience and people's livelihoods. Strengthening multi-level governance arrangements that allow for genuine stakeholder participation in landscape management and decision making is key. This should be accompanied by the identification and use of best management practices that provide practical on-the-ground solutions for sustainable management and monitoring of landscapes and their water resources. Finally, to sustain ecosystem services that are important for long-term productivity, sustainability and resilience of landscapes, adequate and long-term financing from both public and private sectors need to be identified for scaling up successful practices.

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