MODULE 2:

MANAGING LANDSCAPES FOR CLIMATE-SMART AGRICULTURAL SYSTEMS

Overview

This module describes how a gradual transition to climate-smart agriculture (CSA) can take place. The first section describes the landscape approach and explains why this approach should be followed when moving towards CSA. In a landscape approach, the management of production systems and natural resources covers an area large enough to produce vital ecosystem services, but small enough to be managed by the people using the land which is producing those services.

The module's second section outlines different elements of the landscape approach and offers suggestions about how the approach could be implemented. The approach integrates many different sectors, engages multiple stakeholders and operates on a number of different scales. The second section also looks at multistakeholder negotiations and planning. It gives insights into policy and finance options for promoting integrated landscape governance and highlights the importance of monitoring landscapes. The third section presents case studies that illustrate what the implementation of a landscape approach looks like in practice.

Key messages

- Managing agriculture, forestry and fisheries at a landscape scale is key to achieving sustainable development.
- Appropriate land-use planning and decision making at the landscape level should be based on a participatory, consensus-based and people-centred approach.
- Production sectors are often managed in isolation from each other, and this can be counterproductive. Coordination at the landscape level facilitates the integrated management of production systems and the natural resources that underpin ecosystem services needed for all sectors. Climate-smart agriculture, which follows a landscape approach, can address the challenges involved in intersectoral natural resources management.
- Measuring and monitoring the multiple benefits of climate-smart landscapes is essential for tracking the impact of intersectoral efforts.
- Scaling up CSA and moving from pilot projects to large-scale programme and policies by applying a landscape approach requires a diverse range of strategies and practices. It is important to create awareness and partnerships between sectors, mainstream CSA into policies and build capacities at all levels. These activities must be supported by an enabling policy and market environment.

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2.1 Why is a landscape approach needed for achieving CSA?

Governing landscapes for the multiple objectives of CSA

CSA provides opportunities, but also presents considerable challenges. To seize these opportunities and meet these challenges, a more holistic, integrated approach in which all stakeholders participate actively is required. An integrated approach ensures greater efficiency in the use of resources and more sustainable management of natural and human-created processes in the landscape. Production systems must be incorporated into landscapes, in ways that capitalize on natural biological processes, recycle waste and residues and create integrated and diversified farming systems. This integration can greatly reduce the pressure on the natural resources and minimize the need for external inputs (e.g. energy, chemical fertilizers and pesticides) and other management interventions.

The landscape approach is key to achieving the multiple objectives of CSA. In a landscape approach, the management of production systems and natural resources covers an area large enough to produce vital ecosystem services and small enough so the action can be carried out by the people using the land and producing those services.

A landscape approach builds on the principles of natural resource management systems that recognize the value of ecosystem services to multiple stakeholders. The principles that underpin the landscape approach provide guidance on how to pursue different land-use objectives and livelihood strategies (MEA, 2005). More recently, the term 'landscape approach' has been redefined to include societal concerns related to conservation and development trade-offs. It also includes increased integration of poverty alleviation, agricultural production and food security. The approach puts the emphasis on adaptive management, stakeholder involvement and the simultaneous achievement of multiple objectives (Sunderland, 2012).

Experiences have shown that by managing natural resources in a way that ensures the resilience of ecosystems, it will be possible to reverse natural resource degradation, safeguard agricultural productivity and maintain ecosystem services (e.g. the provision of water, pests and disease control, pollination and climate regulation). Healthy ecosystems are the basis for sustainable agriculture, forestry and fisheries. To achieve healthy ecosystems, participatory and people-centered approaches and management structures are needed. This approach will simultaneously improve the resilience of production systems and people's livelihoods.

Current pressures and constraints of the natural resource base

All civilizations are based on human-managed farming, forestry and fishery systems. Converting land from forests to fields and pastures has on occasion created more diverse ecosystems. In many areas, however, it has also led to environmental degradation, loss of many vital environmental services and the loss of biodiversity. To date, agricultural expansion has cleared or converted 70 percent of grasslands; 50 percent of savannahs; 45 percent of temperate deciduous forest; and 27 percent of tropical forests (Foley *et al.*, 2011).

Many current agricultural production systems are based on vast monocultures that rely on a small number of plants and varieties with a very narrow genetic base. The cultivation of these monocultures depends heavily on the use fossil fuels. These systems also fail to close the nutrient cycles. Many production systems are not sustainable because of their environmentally-damaging soil management practices and their wasteful use of water resources. Also, in some agricultural production systems, there is a significant gap between the technical yield potential and actual yields. Because of this untapped potential, pressure to convert forest land to fields and pastures continues to increase.

Based on the current trends, food supply will need to grow by another 60 percent by 2050 to meet the demands of a more populous, more urbanized and more affluent world. At the same time, agricultural production systems will face increasing competition for resources with other sectors. In fact, expanding cities, infrastructure and human activities will infringe on fertile agricultural lands.

Climate change threatens ecosystems

Climate change is affecting production systems, disrupting the functioning of ecosystems and increasing the pressure on ecosystem services. In some areas, climate change may also lead to new production possibilities as the long-term impacts may open up new options for agriculture. The frequency of extreme weather events, such as droughts and floods, are predicted to increase. According to the Intergovernmental Panel on Climate Change (IPCC), the impacts of climate change and associated costs will fall disproportionately on developing countries and may undermine the achievement of the global goals of reducing poverty and safeguarding food security (IPCC, 2001). The 2011 drought in the Horn of Africa, which threatened 12 million people with malnutrition, disease and loss of livelihoods, is a recent example of an extreme weather event. As such events become more frequent, the number of vulnerable or directly affected people will increase.

Reversing trends through CSA

Large-scale environmental degradation is not inevitable and can be reversed (Bai *et al.,* 2008). The Global Assessment of Land Degradation and Improvement (FAO and ISRIC, 2008) established that while land degradation was still spreading between 1991 and 2008, the trend was not clear cut. There are areas where land quality has been declining (24 percent of the global land surface), but also areas where land quality has improved (16 percent) (Steenbergen *et al.,* 2011). The reversal from degradation to sustainable production has in some cases been very rapid, taking only a matter of years. In many cases, these reversals have been made in areas where populations have increased. There are many examples that illustrate that it is possible to realize the scenario: 'more people, more trees, more livestock, more water, better lives and better economies' (e.g. see Critchley, 2010 and Box 2.1).

Box 2.1
Positive dynamics: re-greening of the Sahel

In the 1970s and 80s, the Sahel region experienced disastrous droughts that caused widespread famine. However, over the past three decades, helped by moderate increases in rainfall, hundreds of thousands of farmers in Burkina Faso and Niger have transformed arid landscapes into productive agricultural land by modifying traditional agroforestry, water and soil management practices. This 're-greening' of the Sahel began when local agricultural practices were rediscovered and enhanced in simple, low-cost ways by innovative farmers and non-governmental organizations (NGOs). An evolving coalition of local, national, and international actors promoted the dissemination and continued use of these improved practices. Policy changes regarding land tenure, and changes in opportunities for off-farm employment also contributed to the progress.

To improve water availability and soil fertility in Burkina Faso's Central Plateau, farmers have sown crops in planting pits and built stone contour bunds. In southern Niger, farmers have developed innovative ways of regenerating and multiplying valuable trees. These lands now support increasing amounts of trees, crops, and livestock, which has enhanced the food security of about 3 million people. Water levels in wells has increased significantly, and some farmers can maintain small vegetable gardens near the wells, which adds to their incomes and improves nutrition. Although millet and sorghum remain the dominant crops, farmers working on rehabilitated land are also growing cowpea and sesame. With increased quantities of fodder and crop residues, farmers can keep livestock closer to their fields in more intensive and profitable livestock production systems. The manure can then be used as fertilizer to improve soil fertility. These innovations have also greatly improved the supply of fuelwood over the past 20 to 30 years, allowing women to reallocate the time once spent on collecting fuelwood to other activities.

Source: Reij *et al.*, 2009; World Bank, 2011

Sustainably increased productivity and income for better livelihoods

The ultimate aim of CSA is to improve livelihoods and sustainably increase productivity through the efficient use of resources. In management planning at the landscape level, diverse groups and institutions work together to increase farm incomes and diversify economic opportunities while ensuring that natural resources are used efficiently and that ecosystem functions and services are protected. One of the primary benefits of placing efforts on coordination at the landscape level is that sectors and production systems that had previously been managed separately and often counterproductively can be integrated in ways that maintain vital ecosystem services needed for all sectors.

To achieve food security and better livelihoods in the agricultural sector, ecosystems need to remain in a productive state. They need to deliver a variety of resources and processes that are crucial for crop, livestock, forest and aquatic production systems and rural livelihoods. Productivity depends on ecosystem functioning, which builds on the processes shaped by interactions among biological communities of both wild and domesticated species, and biophysical processes, such as water regulation and nutrient cycling. Ecosystem functioning ultimately ensures the delivery of ecosystem services.

Ecosystem services are generally classified according to the benefits that they deliver: provisioning services (e.g the provision of food, fiber, energy and water); regulating services (e.g. the regulation of pest and disease outbreaks, the cycling and purification of water or regulation of greenhouse gas [GHG] emissions and carbon sequestration); supporting services (e.g. pollination and nutrient recycling); and cultural services (MEA, 2005). The provisioning services depend upon a wide variety of supporting and regulatory services, such as soil fertility and pollination (MEA, 200) that determine the underlying biophysical capacity of agro-ecosystems. Biodiversity underpins all ecosystem services. A rich genetic base increases the likelihood that there will be species present in the system that have the traits necessary to fulfil different functional roles in the ecosystem and allow the continued delivery of ecosystem services in a changing climate (see also table 2.1 and more on genetic resources in Module 6).

Sustainable production intensification (SPI) is an important tool for increasing production in climate-smart systems. SPI saves natural resources, time and money by increasing the efficiency of farming systems. More is produced with less inputs by applying appropriate inputs at the right time and in the right amount, optimizing resource use and reducing waste. SPI uses knowledge-intensive approaches, such as conservation agriculture, integrated plant nutrient management, integrated pest management, water management and pollination management.

Similarily, organic agriculture is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity (FAO, 2009). It builds on many of the principles of SPI, but it covers the whole food system, from production to labeling and commercialization according to precise standards.

The ecosystem approaches to fisheries and aquaculture (EAFA) are holistic strategies for managing capture fisheries and aquaculture that integrate ecological, socio-economic and governance dimensions. These strategies facilitate the sustainable use of natural resources and the integration of fisheries and aquaculture with other production sectors in coastal ecosystems (also see Case Study 2.3 and Module 10 on fisheries and aquaculture).

Table 2.1
Global status of provisioning, regulating, and cultural ecosystem services

Service	Sub-category	Status	Notes
Provisioning Services			
Food	crops	▲	substantial production increase
	livestock	▲	substantial production increase
	capture fisheries	▼	declining production due to overharvest
	aquaculture	▲	substantial production increase
	wild foods	▼	declining production
Fiber	timber	+/–	forest loss in some regions, growth in others
	cotton, hemp, silk	+/–	declining production of some fibers, growth in others
	wood fuel	▼	declining production

Service	Sub-category	Status	Notes
Genetic resources		▼	lost through extinction and crop genetic resource loss
Biochemicals, natural, medicines, pharmaceuticals		▼	lost through extinction, overharvest
Fresh water		▼	unsustainable use for drinking, industry, and irrigation; amount of hydro energy unchanged, but dams increase ability to use that energy
Regulating Services			
Air quality regulation		▼	decline in ability of atmosphere to cleanse itself
Climate regulation	global	▲	net source of carbon sequestration since mid-century
	regional and local	▼	preponderance of negative impacts
Water regulation		+/–	varies depending on ecosystem change and location
Erosion regulation		▼	increased soil degradation
Water purification and waste treatment		▼	declining water quality
Disease regulation		+/–	varies depending on ecosystem change
Pest regulation		▼	natural control degraded through pesticide use
Pollination		▼[a]	apparent global decline in abundance of pollinators
Natural hazard regulation		▼	loss of natural buffers (wetlands, mangroves)
Cultural Services			
Spiritual and religious values		▼	rapid decline in sacred groves and species
Aesthetic values		▼	decline in quantity and quality of natural lands
Recreation and ecotourism		+/–	more areas accessible but many degraded

Note: For provisioning services, we define enhancement to mean increased production of the service through changes in area over which the service is provided (e.g., spread of agriculture) or increased production per unit area. We judge the production to be degraded if the current use exceeds sustainable levels. For regulating and supporting services, enhancement refers to a change in the service that leads to greater benefits for people (e.g., the service of disease regulation could be improved by eradication of a vector known to transmit a disease to people). Degradation of regulating and supporting services means a reduction in the benefits obtained from the service, either through a change in the service (e.g., mangrove loss reducing the storm protection benefits of an ecosystem) or through human pressures on the service exceeding its limits (e.g., excessive pollution exceeding the capability of ecosystems to maintain water quality). For cultural services, enhancement refers to a change in the ecosystem features that increase the cultural (recreational, aesthetic, spiritual, etc.) benefits provided by the ecosystem.

[a] Indicates *low* to *medium* certainty. All other trends are *medium* to *high* certainty.

Source: MEA, 2005

Resilient systems

Greater frequency of extreme events, increased temperatures, changes in rainfall patterns and greater intensity of rainfalls that are expected to result from climate change will increase uncertainty and risk in agricultural production. Long-term changes in temperature will slowly lead to fundamental changes in the plant and animal species that can be used for agriculture in a particular location. The emergence of new pests and diseases as well as new trading patterns are likely. To cope with these changes, land users need to be flexible and develop a learning attitude. The diversification of production and the management of natural resources at the landscape level provides this flexibility and facilitates risk management.

Improving productivity and livelihoods in a sustainable way can only be achieved by safeguarding the productivity of the natural resource base on which these livelihoods and production systems depend. For this reason, the foundation of CSA is resilient livelihoods and ecosystems. Resilience is the capacity to adapt to changes and disturbances and, at the same time, maintain core functions. Key strategies for ensuring that agriculture can adapt to change include: sustainable soil and water management practices; the active promotion of biodiversity; and the diversification of income sources inside and outside the farms.

Climate change will have an impact, be it positive or negative, on all production systems. Every system will have to adapt. This can happen spontaneously by adjusting to the changes as they come or in a planned manner in which the potential impacts are assessed and actions are taken to improve short- and long-term resilience. Adapatation efforts must build the capacity to cope with increasingly difficult conditions and gradual changes in climate (FAO, 2011b).

Management approaches should aim to keep the system in a state that will allow it to continue delivering valued ecosystem goods and services, or if necessary to move towards more resilient, productive systems. Both risk management and change management form an integral part of these approaches. Disaster risk management focuses on preventing, mitigating, preparing for and responding to shocks in short- and medium-time scales. Change management adds a strategic, long-term objective to policy, legal and research frameworks (FAO, 2011b). Fisher *et al.* (2006) outline ten guiding principles for protecting biodiversity, ecosystem functioning and resilience in commodity production landscapes (see Box 2.2).

Box 2.2
Ten guiding principles for protecting biodiversity, ecosystem functioning, and resilience in commodity production landscapes.

Principles for protecting biodiversity, ecosystem functioning, and resilience in commodity production landscapes include: pattern-oriented management strategies, such as maintaining and creating large, structurally complex patches of native vegetation throughout the landscape; creating corridors, stepping stones and buffers around sensitive areas; and maintaining heterogeneity across environmental gradients. Process-oriented management strategies to target specific key species or environmental processes are recommended. Strategic activities include: maintaining key species' interactions and functional diversity; understanding the impacts that particular disturbances have on ecosystems; controlling aggressive, over-abundant, and invasive species; minimizing specific threats, such as chemical pollution or hunting; and maintaining species of particular concern.

Source: Fisher *et al.*, 2006

Water management and the efficient use of available water will be of fundamental importance in building resilient production systems and improving the management of climate change-induced risks (see also Module 3 on water management). The efficient and equitable management of water catchments is generally only possible when done in a landscape context and combined with farm-level water management practices. Water management requires common agreements on the modalities of use. These agreements will be best achieved through participatory governance processes related to integrated land-use planning. Large catchments, such as river basins, need layers of nested planning approaches, starting at the river basin scale, with implementation activities planned in detail on the landscape scale.

Maintaining high levels of genetic diversity is fundamental to decrease risk, ensure multiple needs are met and maintain stability. This is why many small-scale farmers continue growing traditional crop varieties even if improved varieties are available (Frison *et al.*, 2011). It is also widely recognized that maintaining crop diversity in production systems is crucial to avoid vulnerability and widespread crop loss resulting from particular biotic or abiotic threats (Wolfe, 2000). Likewise, the diversity of livestock and soil micro-organisms will improve the resilience of the farming systems. Promoting genetic diversity and diverse production strategies for risk management, including climate risks, is a crucial component of promoting CSA (see Module 6 on genetic resources). Equally important is the biodiversity in the production system and in the landscape. This is also critical, for example, for pollination services (see Box 2.3).

Successful integration of biodiversity conservation into agricultural production is fundamental to maintain functioning ecosystems. For this reason, protected areas are important tools in many landscape and ecosystem approaches. However, establishing protected areas is often not feasible, especially in densely populated areas.

Box 2.3
Climate change impacts on pollination services

Pollination is an essential ecosystem service for crop production. Over 75 percent of the leading global food crops are dependent on pollination services provided by animals. The global monetary value of this service has been estimated to US$ 214 billion per year. Pollinators, especially bees, affect 35 percent of world crop production. Many pollinators and the crops that are dependent on them are sensitive to high temperatures and drought. In the tropics, most pollinators are already living close to their optimal range of temperature tolerance. Temperatures are expected to increase from 1.1-6.4 °C in the course of the 21st century. Consquently, climate change may have detrimental effects on pollination. CSA implemented on the landscape level can help protect this vital ecosystem service by building the agro-ecosystem's resilience through the protection of the species, resources and processes that control ecosystem functioning.

Source: FAO, 2011a; IPCC, 2007a

Mitigation co-benefits

Many agricultural and land management systems and practices (e.g. sustainable land management, agroforestry and integrated food-energy systems) are climate smart. They increase the carbon content of the soils and aboveground biomass and enhance productivity and resilience. Mitigation co-benefits can be enhanced through integrated landscape management by seizing mitigation opportunities of any particular landscape through increased biomass production.

Sustainably increasing or intensifying productivity offers important opportunities for mitigating climate change by decreasing deforestation, rehabilitating eroded soils and reducing pressure on surrounding natural ecosystems. Similarly, holistic management of grassland ecosystems will help to regenerate degraded areas and improve vegetation cover. Grassland management can also be accompanied by the introduction of trees, which sequester carbon in the soils and biomass. Improved grazing management (management that increases production) can lead to an increase of soil carbon stocks (Conant, 2009) (more on livestock management in Module 8). If their biological processes are preserved, valuable ecosystems like wetlands and peatlands perform important water regulatory services and constitute a large carbon sink (see Box 2.4). Landscape-level land-use planning strategies need to identify these kinds of key ecosystems and protect the high value of the ecosystem services they provide in their natural state. Special attention should also be paid to the management of organic soils as their emission potential is significant.

Different sectoral policies may have different goals regarding land use. Climate change mitigation policies aim at reducing emissions from all sectors including land use. Agricultural and national development policies aim at food security and economic development. At landscape level these policy goals can conflict. CSA and landscape management help to solve these conflicst by aiming at increasing productivity on cultivated areas, to relieve pressure on forests through sustainable agricultural intensification and to increase the carbon content of the landscapes (see also Module 9 on forestry). A transparent, participatory governance system is vital for arbitrating between these different goals.

Box 2.4
Peatlands as climate change mitigation hotspots – towards wiser management

Rising the water levels on drained peatlands by blocking ditches can be done with low-cost techniques and local materials. Dam in a channel in Mentangai, Indonesia

Peatlands are ecosystems where GHG emissions can often be reduced in a cost-effective manner. Peatlands or organic soils have a substantial layer of organic matter near the surface. Unlike mineral soils, most pristine peatlands are wet during most of the year. Peatlands, which are found in almost every country in the world, contain 30 percent of the world's soil carbon but cover only three percent of the global land area (Joosten, 2009; see also Victoria *et al.*, 2012). Draining a part of a peat dome or excessive extraction of irrigation water lowers the water table in the entire peatland area and causes GHG emissions. Emissions from drained peatlands and fires in drained peatlands are responsible for almost one-quarter of carbon emissions from the land-use sector (Joosten, 2009; Victoria *et al.*, 2012). Over the last few decades, there has been a rapid growth in emissions from peatlands as they have been drained for forestry, food crops and cash crops, such as for palm oil and other plantations. The cultivation of peatlands has in many cases lead to their serious degradation, subsidence, and finally abandonment (e.g. Ukraine and South-East Asia). Abandoning peatlands significantly increases the risk of fires.

To reduce GHG emissions from peatlands it is essential to determine their status: whether they are pristine, drained, abandoned or in productive use. There are three main approaches for reducing emissions from peatlands:

- The undrained peatlands should be conserved to prevent emissions.
- The drained peatlands should be rewetted through blocking canals and grids.
- When there is pressure to drain peatlands for agriculture or forestry, the first step is to increase the productivity on the existing farmland. Secondly the land managers should target the conversion of mineral soils to agricultural land instead of organic soils. If the peatlands cannot be rewetted their management should be adapted to reduce emissions.

Rewetted peatlands can provide income and other benefits to people through agriculture, forestry and cultivation under wet conditions, a practice known as paludiculture. Paludiculture can be carried out wherever there are marketable plants and animals living in wet conditions. It can be used to produce biomass for bioenergy, feed for livestock, fibre, building materials (e.g. for construction) and food, such as berries. In South-East Asia natural rubber is collected from Jelutung paludicultures. Local communities are earning up to half of their income from raising fish in the blocked grids alongside the rubber production (FAO and Wetlands International, 2012). Paludicultures represent the only sustainable mode of agricultural production on peatlands. There are however, technical and socio-economic constraints that can prevent drained peatlands from being rewetted. In such cases, the negative environmental and socio-economic impacts of utilization should be restricted, for example, by choosing crops that are adapted to high soil moisture; minimizing drainage as much as possible to reduce peat oxidation and land degradation; and limiting the use of fertilizers.

2.2 How can a landscape approach be implemented?

Setting the stage for a landscape approach

In the area of land use-planning and environment policy, there is widespread acceptance that integrating decisions across all land-use sectors (i.e. agriculture, forestry, aquaculture and their supporting ecosystem services) is crucial for sustainable development (Geerlinsg and Steed, 2003). This is why the landscape approach is recommended for implementing CSA. Combining the efforts from different land-use sectors, all of which are affected by climate change, will lead to greater progress towards reaching sustainable development goals. This will require a shift from single-objective production systems to the management of the entire landscape to meet CSA's multiple objectives. An integrated approach is particularly important as resources are limited and the demand for goods and services are high. CSA requires cross-sectoral planning and management to make the most efficient use of valuable natural resources.

In addition, integration across multiple administrative levels (local, subnational, national and international) is crucial for sustaining landscape interventions. Bottom-up approaches are necessary to ensure local stakeholders have ownership over landscape management, are accountable for the results and are able to reap tangible benefits. However, the climate-smart management of resources at the local level can only succeed if subnational and national governments are involved in the process and can create an enabling policy and institutional environment. Stakeholders at all levels must identify, negotiate, and manage the benefits and impacts of different land uses to ensure that the envisioned goals materialize at the local level (Scherr *et al.*, 2012). This process must also recognize the connections that link rural, peri-urban and urban communities, including peri-urban and urban forests, gardens, farms and open spaces that tie landscapes together in a mosaic of natural green spaces.

Although the landscape approach, which involves multisector and multistakeholder interventions across multiple scales, makes planning and management challenging, there are no other options for achieving CSA's goals (Holmgren, 2012).

Strategic steps towards a landscape approach

In a landscape approach, the management of production systems and natural resources covers an area large enough to produce vital ecosystem services, but small enough to be managed by the people using the land producing those services. However, there are many definitions of the term 'landscape' (see Box 2.5). It is important to delineate the common elements of a successful landscape approach and to describe how it can be a viable strategy for achieving CSA.

Box 2.5
Definitions of landscapes

The Council of Europe (COE) defines a landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (COE, 2000). Cultural landscapes have been defined by the World Heritage Committee as "distinct geographical areas or properties uniquely representing the combined work of nature and of man, illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal" (WHC 1996). Expanding on this, landscapes may be defined as the concrete and characteristic products of the interaction between human societies and culture with the natural environment.

Agricultural landscapes can be described in terms of the three elements: structure, which concerns the interaction between environmental features, land-use patterns and human-made objects; functions, which are the provision of environmental services for farmers and society; and the values society puts on agricultural landscapes and the costs of maintaining and enhancing landscape provisions by agriculture (Jongman, 2004). Because the underlying human and natural processes are subject to change and evolution, landscapes are 'dynamic systems' (Washer *et al.*, 1999).

People have been managing the world's natural resources and landscapes for generations to meet multiple needs, including food, fibre, fodder, fuel, building materials, medicinal products and water. Farming, forestry and fisheries systems have evolved and adapted to variable environmental conditions and population pressures. These systems have been influenced by other factors, such as settlement patterns, tenure arrangements, labour availability and resource, credit and market access. Because of these complex interactions, there is a huge diversity of natural, semi-natural and man-made landscapes that contain many differently sized livelihood systems.

Source: Reiche *et al.*, 2012

Integrated landscape planning and management is an umbrella term for natural resource management that recognizes the value of various ecosystem services to multiple stakeholders, and how different values can lead stakeholders to pursue different land-use objectives or livelihood strategies (MEA, 2005). More recently, the term has been re-defined to also include societal concerns related to conservation and development trade-offs, including increased integration of poverty alleviation goals, increased integration of agricultural production and food security with an emphasis on adaptive management, stakeholder involvement and multiple objectives (Sunderland, 2012). The common underlying philosophy of integrated landscape planning and management is to find and promote synergies among production systems, livelihoods, biodiversity conservation and ecosystem services, with the ultimate goal of ensuring sustainability.

This type of planning and management needs to be supported by governace structures, including policies and financial mechanisms that are all part of a multilevel governance process. This support would be incomplete without a comprehensive, participatory and user-friendly system for monitoring landscape management and assessing the progress being made towards reaching different objectives. Indicators in a landcape monitoring system could include biomass, income, and biodiversity .

Land use planning and decision-making processes

Managing landscapes demands an understanding of how the needs of local communities can be addressed without eroding biodiversity and dispurpting the functioning of ecosystems. To achieve successful outcomes, the people who have an impact on the landscape must come together to plan and negotiate acceptable practices and management actions.

Ensuring the participation of all stakeholders is key for sustainably managing landscapes and increasing the scale of CSA. Facilitating participatory decision-making processes is essential for fostering collaboration and sharing information among different stakeholders. Often, stakeholders have different visions and understandings of landscape planning and goals. The negotiation of the elements that are to be included in a landscape management planning process is vital to avoid conflicts and tension as well as create space for dialogue. Negotiation processes involve taking note of all stakeholders' interests in the formulation of land-use plans. They must follow procedures and rules that the stakeholders have agreed upon in advance and that are enforced by a credible and legitimized third party. The negotiation and planning process can be facilitated through the development of a database that integrates local and scientific sources of information on the state of land resources (e.g. soil, water and biological resources) and various drivers of change, including climate information (see Box 2.6 for an example of such an assessment).

Box 2.6
An example of the assessment approach for landscape planning and management

The Land Degradation Assessment in Drylands (LADA) project has developed a methodology and tools for assessing a number of factors relating to land management, including: the status and trends in land resources; the drivers of land degradation and sustainable land management (SLM); impacts on ecosystem services and livelihoods; and the effects of response measures adopted by land users and promoted by different stakeholders. The methodology shifts attention from the conventional focus, which assesses the biophysical aspects of land degradation, to a balanced assessment that looks at both negative and positive effects of land management, trends in land use and management of natural resources, as well as ecosystem services and livelihoods. The methodology integrates socio-economic aspects into land-use planning and management.

The main emphasis of the assessment is on the current status and dynamics of land resources (e.g. soil, water and vegetation) and the delivery of the main provisioning services for livelihoods (e.g. food, fodder, fuel, water, income). A second important consideration is the need to identify and evaluate the significant impacts of land management practices on the supporting and regulating ecosystem services that determine productivity and ecosystem resilience (e.g. soil nutrients and organic matter, carbon cycling, maintenance of the hydrological cycle and water supply and the conservation and sustainable use of biological diversity). Besides income and food security, other socio-cultural factors (e.g. knowledge management, the capacity of land users to organize themselves and adapt to change) are considered.

The LADA approach is intended to enhance the capacity of users to conduct integrated and participatory assessments of land degradation, and monitor the impacts of interventions or changes in land management. As it serves as a baseline diagnostic, the assessment should be undertaken at the beginning of the SLM investment planning for integrated landscape management. By identifying the most suitable SLM practices for preventing and mitigating degradation through participatory discussions with the communities and stakeholders, the assessment results can be used to inform SLM interventions and improve their design, planning and implementation. The assessment can be fed into national inventories and contribute to national agricultural and environmental strategies and reports to international conventions.

Source: Bunning *et al.*, 2011

Local stakeholders and institutions responsible for coordinating and facilitating landscape management activities need to be empowered to make informed decisions with a long-term perspective. Other stakeholders from the subnational and national level, and occasionally from the international level, will also participate in the landscape management planning process. It is essential to audit the state of land, water and other natural resources in a way that quantifies the impacts of climate change. Ideally this should be done at the river basin, watershed, or agro-ecosystem level. When the impacts of climate change are uncertain, no-regret options should be proposed based on existing experiences and research.

It is worth investing time and effort early in the participatory process in order to build trust and collaboration when planning landscapes. It may also be necessary to adopt new practices and ways of thinking at the farm level and modify governance structures (e.g. land tenure regimes and decentralization).

A participatory process can strengthen stakeholders' sense of ownership of the objectives of landscape management and encourage them to engage in defined activities. However, engaging in a participatory process is often time consuming. Results may not be perceived immediately as processes of social change can take generations. It is therefore important that stakeholders involved in the process, especially those that do not live in the area, tolerate uncertainty and see landscape management as a long-term activitiy. However, landscape management also needs to achieve some short-term results that can provide stakeholders with incentives to continue the process. In view of limitations in time and resources, external project interventions have to be catalytic in nature, triggering change while ensuring inclusiveness.

Carrying out interrelated actions at different levels also means making trade-offs. Managing natural resources and community needs at a landscape level involves linking actions undertaken on smaller land units to land-use management at the broader landscape level. For example, there are trade-offs that may need to be made between increasing productivity and reducing GHG emissions, and between different land uses (e.g. harvesting non-timber products and logging in forests). Defining, evaluating and balancing different legitimate interests and objectives to create a common vision is central to integrated landscape management. A shared vision ensures that there is alignment among the various local management and production strategies, national development strategies, climate and environmental strategies, as well as among policies, institutions and other enabling structures.

When discussions about change become the core of the planning process, they are expected to lead to behavioural changes and sustainable outcomes (Sangha Group, 2008). To ensure that they can participate actively in policy and decision-making processes, local stakeholders should receive the support they need to ensure that they can protect their rights and livelihood choices.

The contractual agreement emerging from this negotiated process is the result of a participatory process, which includes plans for local development activities or initiatives (short, medium, and long term) that are defined by different stakeholders in a given landscape. To implement this contractual agreement, external support may be required to build capacities and create opportunities to access resources. In addition to concrete agreement on activities, institutional arrangements and the distribution of resources, the negotiated process also leads to improved social cohesion within the communities in the landscape. The least powerful stakeholders gain increased bargaining power to defend their interests. The process also incorporates the diversity of stakholders' interests that might otherwise not be voiced and integrated in decision-making processes (more on local institutions in Module 12).

Both policy-makers and land users gain from organized and democratic planning that aligns land use with local and national goals. Ideally, land-use planning is a countrywide effort, from grassroot villages through districts and provinces, that harmonizes local needs with national priorities. Relevant stakeholders may include village and municipal authorities, private sector interests, district authorities and members of the country's planning ministry or national planning commission. At the local level, it is important that all community groups are represented, including men and women, young and old, wealthy and poor, farmers and herders (FAO, 2009).

Many of the factors that drive land-use change operate or interact in different geographic areas and at different time scales. It is necessary to apply a planning framework that links these diverse planning processes (for example see Case Study 2.8 in section 2.3). If planning is made at the national or regional level without the involvement of local stakeholders, the chances that the implementation of planned activities will not be successful or sustainable increase. Conversely, activities planned at the landscape or community level that are not supported by enabling policies or governmental authorities may struggle to succeed due to a variety of factors, including, insufficient land tenure, poor infrastructure, and inadequate institutional and market structures. Policies should be developed to support the planning processes at local levels and allow communities to manage and benefit from the resources on the land where they live.

Planning for sustainable management of transboundary resources, such as water and animal species, requires coordination among stakeholders with competing claims, and among the institutions, laws and policies intended to create incentives for the sustainable use of resources. When land-use planning takes place at both macro- and micro-levels, national and local goals can be harmonized.

Landscape management and implementation

Adaptive capacity is the key to implementing landscape management plans and strategies. Since landscapes change and evolve over time, the objective of sustainable management is not to maintain the *status quo* but to ensure the continued and growing supply of goods and services by practicing adaptive management (Sangha Group, 2008). Institutional structures and approaches, and the mindset of the stakeholders, need to acknowledge the fact that landscapes are dynamic systems: stakeholders come and go, weather and climate patterns change, markets fluctuate.

Adaptive management for climate-smart agricultural landscapes should be characterized by a sound understanding of ecosystem dynamics and take a flexible approach to governance that considers policies as works in progress and management actions as experiments that encourage learning and adjustments. As changes become apparent, new information is gained and incorporated into management processes. This allows for the review and revision of objectives and management strategies. The monitoring of drivers of change in the landscape is crucial for generating the data that can enable robust learning and adaptation.

Gathering information is all the more important considering that local stakeholders face high uncertainties about the impacts of environmental processes. They are also facing rapid economic and technological changes that can have dramatic effects on their livelihoods. In addition, local communities may have to react to new institutional and governance processes, such as more decentralized government administration or the increased involvement of the private sector. Social processes change with economic and institutional change. Box 2.7 presents a case where local citizens became involved in the discussions and the decision-making process regarding ecosystem and landscape management in an urban context.

Box 2.7
Ethekwini Municipality: governance of the ecosystem management

The Ethekwini Municipality, which governs the city of Durban, is located in southeast part of South Africa. For the past 25 years, it has been undergoing a sustainable development transformation that has sought to improve the local environment and develop plans to establish more open space within the city. Natural open spaces sustain goods and services, such as water, erosion control, food production, and the raw materials for fuel and building. Citizens have engaged with the local government through the Local Agenda 21 Programme to guide the city towards an environmentally sustainable path. Having a diverse range of citizens with disparate interests, varying socio-economic and environmental backgrounds involved in discussion has made the development process challenging, but it is necessary to ensure that all stakeholders are held accountable.

Source: ICLEI, 2013

Gender relations, demographic trends (e.g. urban-rural migrations, southern-northern migrations) and cultural identities vary widely. These social factors need to be taken into account when considering how to adapt to complex changes. Understanding how individuals and households support themselves and try to secure and improve their well-being in the face of this complexity is a major challenge. If these social factors are not acknowledged and monitored in the management system, they may cause profoundly negative consequences for long-term sustainability. Empowering rural communities by facilitating their organization at the landscape level, through citizen groups or productive institutions (e.g. watershed committees and rural producers associations), can help these communities plan and manage land use more sustainably. It also allows them to improve their livelihoods by harnessing new technologies and knowledge.

Landscape management is an iterative and evolving process. Over time, key assumptions underpinning the work and new elements will need to be re-examined. The participatory process should be a learning process in which social dialogue is constantly being renewed to bring about negotiated agreements involving all stakeholders. For the process to be easily understood and to allow stakeholder involvement in all phases, it needs to be coherent and feasible given the available resources. The process should also be simple and practical and ensure transparency and accountability, so that all stakeholders can meet their responsibilities.

There can be many reasons why conflicts may arise during policy, programme and project implementation. Some factors that can lead to disputes include: policies that are imposed without local participation; conflicting interests among land users; lack of harmony and coordination between legal bodies and procedures; poor identification of and inadequate consultation with stakeholders; and uncoordinated planning. In addition, poor information sharing, limited institutional capacity, inadequate monitoring and evaluation of programmes, and a lack of effective mechanisms for conflict management are all potential sources for conflict when negotiating and planning climate-smart agricultural activities at the landscape level with multiple stakeholders. It is essential to have in place effective conflict management mechanisms that have been agreed upon by stakeholder groups, that are based on rule of law and supported by institutional structures that everyone recognizes as legitimate.

Promoting landscape governance through policy and finance options

Expanding landscape management approaches so that they become significant on a global scale will require sharing and expanding the knowledge-base regarding the uses of natural resources and strengthening institutional capacities. An enabling policy and market environment is also needed. As mentioned, achieving multiple objectives at the landscape level will require harmonizing sectoral policies so that different planning frameworks are aligned. So far, many policy, legal and institutional frameworks are based on implementing separate actions for ecosystem management, agricultural productivity, forestry and rural livelihoods. This situation creates problems for interventions that follow a cross-sectoral approach.

A good example of a harmonized approach is the development of the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism. REDD+ policies address different drivers of deforestation both within and outside the forestry sector. When designing national REDD+ strategies, policies, laws and action plans, consideration should be given to agricultural and rural development goals, and an integrated landscape approach should be adopted.

There is a need for a more supportive policy environment for landscape. In some cases, major policy barriers will need to be removed (see also Module 13 on policies). Joint planning and coordinated interaction between ministries is essential and can be fostered through mechanisms for cross-sectoral consultations. Core policy needs, at the local, national and international level are:

- compatibility and coordination of policies for agricultural development, forest, water, climate and biodiversity conservation;
- environmental legislation that acknowledges the potential and rights of farming communities; and
- the removal of public subsidies and incentives that harm biodiversity.

Achieving financial viability for development initiatives that operate at the landscape level requires that the incomes of all stakeholders are sufficiently high to prevent them from engaging in activities detrimental to local ecosystems and sustainable livelihoods. Several possibilities exist for creating these conditions and they are explained in more detail in Module 14 on financial instruments. Payments for environmental services (PES), a mechanism for compensating farmers and farming communities for maintaining ecosystem services, is an example of a market-based innovation for scaling up SLM and sustainable forest management. Economic incentives are effective when they provide financial benefits to producers for their contribution to environmental stewardship. These can come in the form of payments for conservation efforts, tree planting or improved agricultural management. These incentives have the added advantage of increasing the financial attractiveness of alternative practices. Several examples of these incentive mechanisms already exist in developing countries, such as the Pro-poor Rewards for Environmental Services in Africa Programme and the Rewards for, Use of and Shared Investment in Pro-poor Environmental Services in Asia. In addition, eco-certification systems for major agricultural commodities, such as coffee and cocoa, provide economic incentives for investments in agricultural initiatives that protect environmental services.

For climate finance in rural landscapes to be effective, the interventions need to be coordinated with local rural development activities. For example, REDD funds can be utilized to support CSA and the needed institutional development.

There are several opportunities for securing private and public climate finance, such as domestic and foreign direct investments, and bilateral and multilateral climate change funds and programmes, including carbon markets (see Module 14). Policy makers are now faced with the challenge of developing institutional and funding environments that support integrated landscape climate projects. In light of harmonizing sectoral approaches, climate finance should be linked to agricultural development finance. Nationally Adaptation programmes (NAPAs), NAPS (National Adaptation Plans) and Nationally Appropriate Mitigation Actions (NAMAs) and REDD+ are all relevant for landscape interventions, as they provide the flexibility to fund policy development in support of climate change adaptation and mitigation on a large scale. Another option is to use REDD+ funds for creative agricultural investment strategies. The redesign of the clean development mechanism (CDM) and other carbon markets mechanisms could also expand the scope of REDD projects to include integrated landscape carbon projects.

Measuring and monitoring landscapes for multiple objectives

It is necessary to measure and monitor the multiple benefits of interventions designed to establish climate-smart landscapes. Monitoring objectives must be locally defined, and cover livelihoods, biodiversity and ecosystem services. The principles and processes of monitoring should be agreed upon at the beginning of a consultative, participatory process when embarking on a landscape plan addressing multiple objectives. Right from the outset, all stakeholders should have a common understanding about the objectives to be met. The monitoring process also needs to be user-friedly.

Monitoring becomes especially important if the multiple objectives within the landscape and close relationships among different users leads to conflict. For example, agriculture is an important driver of deforestation and needs to be treated in REDD+ policies to address the multiple objectives of the land users. No single strategy can both protect forest cover over the long-term and support agricultural development. Plans dealing with these closely related issues must be made on a case-by-case basis and require site-specific analysis to predict the impact of forest and agricultural interventions.

A landscape approach for measuring and monitoring biodiversity, climate change mitigation, ecosystem health and local livelihoods, which focuses on large, ecologically and agriculturally diverse areas, can help to ensure that impacts are truly being felt on the ground and that the tradeoffs being made are acceptable to all stakeholders. The results of this monitoring, particularly on the status of compensation, the distribution of benefits, and the impacts on rights and conflict resolution, will need to be transparent and easily accessible to all stakeholders (Shames *et al.*, 2011).

For more details on monitoring CSA in landscapes, see Module18.

2.3. Examples of landscape approaches

Different landscapes will require different approaches, depending on the state and nature of the resources, land use dynamics, and social and economic contexts. The following case studies illustrate some aspects of a holistic landscape approach in different contexts.

Case Study 2.1
Pastoralism in Laikipia, Kenya

Two Maasai livestock owners

Introduction

The Laikipia Wildlife Forum is a 500 member organization that includes pastoralists, commercial ranchers, and small- and large-scale farmers spread over 10 000 square kilometers in the area surrounding Mt. Kenya. In 2008, the Laikipia Wildlife Forum initiated a 10-year Rangeland Rehabilitation and Management Programme, which has been implemented by Natural Capital East Africa. The Programme's emphasis was on rehabilitating bare land across the district as part of a strategy to build the region's resource base and reduce competition for natural resources, which has at times led to fatal conflicts over pasture and water.

The *Il Ngwesi* Group Ranch is approximately 200 square kilometers (20 000 hectares or 48 000 acres) of acacia grassland in northern Kenya, evenly split between the hills of the Mukugodo Forest and flat lowlands. It is jointly occupied by some 550 Maasai families, but there is movement in and out by Maasai neighbours and other groups (e.g. Somali, Turkana and Samburu).

The landscape approach

The Rangeland Rehabilitation and Management Programme focuses on capacity-building (defined as 'competence, confidence and commitment') and makes use of two well-developed tools: planned grazing and vision setting. Planned grazing is a technical solution to land degradation while vision setting provides the human or managerial context for improved practice.

Technical demonstrations proved the value of properly managed animal herds as plant regenerators and led to community planning and the successful implementation of a grazing plan for 6 000 cattle and 3 000 sheep and goats in their dry season reserve. The plan's most important elements involve dividing a controlled area into blocks; calculating the number of grazing days for the herds in each block based on community-informed forage assessment; and combining animals into as few herds as possible, which move through the blocks by a pre-determined sequence according to water availability, grazing competition, distance, and other factors. Most importantly, animals are gathered into tight herds as they graze to maximize soil disturbance and graze a different section of the block in use each day to eliminate overgrazing. The immediate results included: improved land health, livestock survival and productivity, youth involvement and community unity. The successful land restoration can be attributed to the focus on enhancing the four ecosystem processes that together determine ecosystem health and productivity: water cycle, mineral cycle, energy flow and plant and living communities. Much of the training focuses on 'eco-literacy', combined with techniques for low-stress handling of large herds. This has restored the traditional value of herding and herders in the eyes of the community. Not only does this process reverse land degradation, it is also reversing a long-term trend of carbon release from soil to atmosphere. Given their expanse, the planet's grasslands hold massive potential for climate change mitigation.

However, the above approach does not guarantee success, as there are a number of social factors that present barriers to adoption. A major challenge arose when community members resisted their leaders' decision to adopt the plan throughout their lands. The goal-setting and future visioning component of the programme was then introduced to the leadership. This component requires an articulation of the quality of life desired: what needs to be produced or created (tangible and intangible) to attain that quality of life; and what future resource base is needed to meet these needs. The value of this exercise is two-fold; it allows deep self-reflection and it guides and encourages more socially, ecologically and economically-sound decisions.

One startling result of applying the visioning tool was that the leadership realized that current management structures were producing opposite results than what they desired. It was decided that a reorganization of the community management structure was necessary. This process resulted in the formation of 'village' management forums written into their constitution, whereby primary responsibility for all management actions was placed in the hands of a Village Forum, with the overall community management bodies playing a supporting rather than directing role as they had previously tended to do. This resulted in a shift from a top-down to a bottom-up structure and a pooling of the previously separate management committees for different issues (e.g. water, education, grazing) under the single village management body. It all came about when the community identified that the separation of activities that were in fact closely connected, resulted in activities that were undermining each other.

These changes allowed members to adopt improved practices while the programme continued to focus on facilitating building capacity of the new Village Forums, with each village forming its own 'future-vision' to guide social, economic and environmentally-related decisions. Challenges (mainly social) constantly arise, but discussions using the visioning tool usually facilitates appropriate solutions; a process which communities have found empowering. As many elders have commented: "we never thought we had a choice about our future."

Lessons learned and recommendations

The following are the most fundamental lessons from Laikipia:

- Land degradation is primarily a social issue rather than a technical one.
- Creating the 'transformation process' involves a number of key, interconnected elements that have at least four different characteristics: personal; relational; collective, and systemic (structural). Not enough effort is put into the social aspects and their synchronization with the technical issues.
- Social transformation is not something someone else can do for you. This changes the role of interventionists from solution-providers to problem-posers and also requires that the intervention staff connect psychologically with communities. In pastoralist settings, it makes sense to have pastoralist intervention staff.
- No one issue can be sustainably tackled in isolation. Each situation compromises a complex 'whole' composed of interconnected social, environmental and economic dimensions. Only alignment of all aspects can bring lasting, positive results: aligning the 'what' with the 'who', 'how', 'when' and 'where.'
- Every situation is unique. Common sense principles and processes, rather than off-the-shelf 'fixes', put in the hands of managers rather than experts give the flexible application necessary to respond to each unique situation based on willingness and ability.

Case Study 2.2
Preserving the Kihamba agro-forestry system, Mt. Kilimanjaro

Introduction

The Kihamba system covers 120 000 hectares on the southern slopes of Mt. Kilimanjaro. The 800 year-old system stands out among agroforestry systems as one of the most sustainable forms of upland farming. Without undermining sustainability, it has been able to support one of the highest rural population densities in Africa, providing livelihoods for an estimated one million people. In the world's other upland areas expanding populations have caused serious deforestation and soil erosion. Only recently, when people started to abandon their ancestral farming systems, did this type of land degradation become a problem in this area.

The Kihamba system has a multilayered vegetation structure similar to a tropical montane forest and is composed of four main vegetation layers. The uppermost layer consists of sparsely spaced trees which provide shade, medicine, fodder, fruits, firewood and timber. These trees also fix nitrogen. Under these trees, multiple varieties of bananas are grown as a staple crop. Under the bananas there are coffee shrubs and under these, vegetable plots. This multi-layer system maximizes the use of limited land and provides a large variety of foods all year around. The Kihamba is irrigated by a traditional irrigation system complemented by water storage ponds (Nduwas) which help overcome water shortages in the dry season. The Chagga people who inhabit the Kihamba maintain a high plant biodiversity (higher than the native forest) with over 500 species, including 400 non-cultivated plants. Farm animals (cows, pigs, chicken and rabbits) provide valuable proteins and contribute to nutrient cycling. The agroforestry system also provides substantive environmental services beyond the areas where it is practiced. Because of the high quantities of biomass it produces and its capacity to recycle organic matter on farms, the agroforestry system contributes significantly to carbon storage, above and below ground. The trees and dense vegetation help considerably to ensure that Mt. Kilimanjaro can remain the 'water tower' for the region. Urban communities and commercial flower and seed farms in the lowlands surrounding Mt. Kilimanjaro critically depend on this service.

Coffee was incorporated at the end of the 19th century. As an ecologically compatible cash crop, it allowed the Kihamba system to adapt successfully to the emerging cash economy. However, in the 1990's, coffee prices on the world market plummeted at the same time as pests and diseases were increasing. Additionally, many coffee shrubs had reached an age (over 50 years) when they produce less beans. These factors led to a sharp decline in productivity and profitability in the Kihamba. Although food security was still not an issue, farmers were unable to meet their cash needs, mainly for the school fees of their children. As a consequence, farmers began to cut down trees to earn money from timber. They then grew maize for a couple of cycles until the soil nutrients were depleted. Finally they stopped managing their plots altogether and the soil was left to erode. It is estimated that 20 percent of the farms in the area have been abandoned. If this process is allowed to continue, it will have massive environmental and socio-economic implications in the landscape around Mt. Kilimanjaro in terms of food security, carbon storage, water catchment and soil erosion.

The landscape approach

Under FAO's Globally Important Agricultural Heritage Systems Initiative, activities were piloted in the 660 households of Shimbwe Juu village to enhance farmers' cash income while preserving the ecological and social integrity of the *Kihamba* system. The project implemented an action plan, formulated together with the community, with the following key activities:

- Rethinking sources of cash income.
  Most Kihamba farmers only have 2-3 acres at their disposal. High value, knowledge intensive niche crops that did not demand much water and land were needed. Three interventions were agreed on:
  - Conversion to certified organic coffee farming. Organic coffee is not only a more stable commodity today, but organic farming also helps farmers avoid vulnerability to fluctuating agrochemical prices. This activity includes replacement of ageing coffee trees and establishment of coffee tree nurseries.
  - Introduction of vanilla as a high value additional cash crop since Vanilla grows as a vine, and fits well into the Kihamba agro-forestry system.
  - Introduction of trout aquaculture along the canals of the irrigation system, which can be sold to hotels in the region.
- Rehabilitation of the irrigation system to reduce water loss and expansion of the capacity of storage ponds to cope with longer dry seasons due to climate change.
- Training in sustainable land management.

The interventions in coffee management alone are expected to increase farm cash income by 25 percent in three years. If the analysis of the project is correct concerning the drivers of change, the expected increase in farm income should be able to sustain the *Kihamba* and its environmental services for many years to come.

Since the participation in the project was intended to be a long-term choice for the maintenance of the *Kihamba*, the community needed to make an independent and informed choice to ensure its sustainability. Opting to participate meant that the community, while expecting benefits from such a choice, had to forego other development options, such as the conversion to less sustainable, but perhaps more immediately profitable uses. To facilitate an informed and independent decision by the community, the project organized a Free Prior Informed Consent (FPIC) process. All project documentation was made available to the community. Preparatory consultations were held with local government officials, traditional elders, and women's representatives, where the the pros and cons of different development options were discussed. Local and traditional leaders held internal consultations, in accordance with their local customs. Following this, a day-long assembly was organized for all community members to raise concerns and reach a decision. During the assembly, representatives of all project partners were present to respond to queries. Finally, the participation in the project was put to a vote to all community members. The FPIC process, though time consuming, helped all the stakeholders to align their goals.

Lessons learned and recommendations

Raising awareness and acceptance among policy makers of the importance of the Kihamba system for the region, and its future viability, was essential at the beginning of the project. This took nearly a year, partly due to prejudices against 'backward' farming practices. A crucial step to build support in the government was to engage focal points in a Project Facilitating Committee (PFC). Four ministries (agriculture, livestock, natural resources and heritage, and environment), the district and local authorities, NGO's, farmer cooperatives, businesses and community leaders were involved in the planning and execution of the project. To support the Kihamba, it was essential to work across sectors and levels, with agents with different expertise and government mandates. Because an intervention in one part of the system is likely to have repercussions in other parts, a sectoral view cannot encompass the full ecology and the human aspects of the farming system. For example, the choice of coffee variety for replanting affects tree cover and microclimate, which affects other crops. The various interventions need to be continuously harmonized. This process requires high levels of information sharing, discussion and cooperation. Frequent joint field visits and community consultations by the PFC proved to be very effective in creating a common understanding of the linkages in the farming system.

Case Study 2.3
Implementation of the ecosystem approach to fisheries and aquaculture in Estero Real, Nicaragua

©Doris Soto

Introduction

The EAFA contains holistic strategies for managing capture fisheries and aquaculture that includes ecological, socio-economic and governance dimensions. The approach facilitates the sustainable use of natural resources and integrates fisheries and aquaculture with other uses of coastal ecosystems (see also Module 10 on climate-smart fisheries and aquaculture). These strategies build on three core principles: fisheries and aquaculture should be developed in the context of ecosystem functions and services with no degradation of these beyond their resilience capacity; fisheries and aquaculture should improve human well-being and equity for all relevant stakeholders; and fisheries and aquaculture should be developed in the context of (and integrated with) other relevant sectors, policies and goals. Other important principles guiding the EAFA are the participation of stakeholders all along the development and implementation of the management plans and the use of the best available information. The EAFA is considered a relevant strategy to enhance adoption and implementation of the Code of Conduct for Responsible Fisheries.

The tropical mangrove estuary Estero Real is located along the north Pacific coast of Nicaragua and forms the southernmost part of the Gulf of Fonseca. Despite the fact that the estuary was declared a protected site in 1983 and recognized by the Ramsar Convention in 2003 as area of international interest, it is at high risk of degradation partly due to shrimp fisheries and aquaculture. The Estero Real is also home to some of the country's poorest communities who depend on local natural resources for survival and livelihoods. Local communities rely on fishery resources, mangrove products such as lumber, mangrove clearance for small-scale agriculture and aquaculture activities. Shrimp farming, which has increased significantly in the area, generates livelihood opportunities but also creates social conflicts and raises environmental concerns. Large-scale shrimp farming coexists with small-scale farmers organized in cooperatives and small-scale fishers, some of whom use unsustainable fishing practices, such as the use of fishing bags in the mangrove area. These bags collect not only small shrimp but also many kinds of fish larvae, which are mostly discarded. The estuary is also coping with other significant environmental impacts, mainly as a result of agricultural practices, urban waste and deforestation in the higher parts of the basin. Climate variability and climate change are putting additional pressures on the estuary. Heavy sedimentation from poor watershed management, the increased use of pesticides and the loss of mangrove forests are also threatening coastal aquaculture, fisheries and biodiversity in the mangrove ecosystem.

The landscape approach

Implementation of the EAFA through participatory planning and management with an ecosystem perspective, can allow fishers and fish farmers to maintain and increase food and income from fish products in the Estero Real, while preserving ecosystem services and increasing community resilience to climate change and other factors. Implementation of the ecosystem approach in Estero Real has been led by national and local fisheries and aquaculture institutions, with FAO technical support.

The first stage of the pilot project involved the following steps:

1. Discussions were held with government authorities to make a first estimate of the goals and scope of the project.
2. Field visits and participatory workshops were conducted in the closest locality to the Estero Real. They included fisheries and environment authorities at the national and local level, representatives of fishers, fish farmers, local municipalities, NGOs, universities and the Ramsar area management authority. The discussions had the following goals:
   - introduce the EAFA's concepts and methodology to the relevant stakeholders;
   - review information and establish consensus on what are the current social, environmental and governance issues that need to be addressed in the Estero Real in the fisheries and aquaculture sector and other external factors affecting the sector.
   - perform a risk-based prioritization exercise using a participatory process based on a description of the key issues to identify the highest priorities.

The second stage of the pilot implementation involved gathering relevant inputs for the development of an EAFA implementation plan based on the agreed priorities. This involved collecting the information and resources needed to address issues identified in the workshops (e.g. clarifying concepts and methodologies to assess the environmental status of Estero Real). Some of the most important activities in this stage included: carrying capacity estimates of the estuary for shrimp culture and other fishery activities; designing an improved integrated environmental monitoring programme; and developing a hydrodynamic model of the estuary. During the second stage, support programmes and instruments were elaborated. For example, a programme was set up to help people who are practicing unsustainable bag-fishing engage in other economic activities, such as aquaculture, apiculture and mangrove planting.

The third stage of the project involves the development of the EAFA implementation and management plan and road map that has been validated with stakeholders. At this stage, a set of indicators is agreed and monitored and human and economic resources are made available. This is required, for example, to implement the alternative livelihood programme for fishers. This stage is the most challenging because it requires a profound local engagement, political will and commitment on the part of national and relevant authorities. There is also a need for negotiations between different institutions and political will to recognize the social value of the fisheries sector. Often this stage requires external donor support. It is advisable to streamline such support to capacity development and technical strengthening of relevant stakeholders. The EAFA in Estero Real is currently going through this stage.

Lessons learned and recommendations

- An ecosystem approach to watershed management is needed to address landscape issues, such as sedimentation and pollution from tributaries. This approach must include and integrate fisheries, aquaculture, agriculture and forestry. Fragmentation of institutions has so far been an obstacle. The implementation of an EAFA often opens an opportunity for wider ecosystem approach management in coastal zones and watersheds. The social role of fisheries and aquaculture must be recognized, especially considering their role in poverty alleviation and food security. This will become particularly important as the impacts of climate change (e.g. droughts) become more pronounced.
- The involvement of national and local authorities and stakeholders from the beginning is fundamental. Establishing ownership of the process among the stakeholders, building trust among all parties and promoting relevant decision-making power at different levels is the best way to move forward in implementing an ecosystem approach to fisheries and aquaculture.
- Coastal fishery and aquaculture communities have become better informed and more resilient to the impacts of climate change and other threats.
- Better integration is needed between fisheries, environment, agriculture and resource management institutions.

Case study 2.4
Preserving forest resources and improving livelihoods through communal tenure rights in the Maya Biosphere Reserve, Guatemala

Introduction

Before 1990, the largest economy in Guatemala's Petén state was the extraction of latex (the raw material for the manufacture of chewing gum) from the sapodilla tree (*Manilkara zapota*) and logging of precious wood (cedar and mahogany). The timber industry had unique access to the forested areas.

In 1990, the government created the Maya Biosphere Reserve, which at 2.1 million hectares covers over 50 percent of Petén state. Connected with other protected areas in Belize and Mexico, the Maya Biosphere Reserve is one of the largest areas of tropical forest north of the Amazon. The Reserve is divided into three types of zones with different levels of protection, according to the United Nations Educational, Scientific and Cultural Organization (UNESCO) criteria for the Biosphere Reserve Model. It has three core areas of state-owned national parks and wildlife reserves, which are restricted from harvest activities. One of these areas, the Tikal World Heritage site, now brings many national and international tourists each year and generates significant revenues to the state. Multiple-use zones under state ownership are dedicated to regulated harvest of zate palms, chicle gum, allspice and timber. A less regulated buffer zone covering privately owned land has been rapidly changing from a forested landscape with scattered agricultural patches to an agricultural landscape with an increasingly fragmented forest.

The landscape approach

Before the creation of the Biosphere Reserve, logging companies operating under concessions for selective harvesting of timber and aggressive colonization programmes, neither of which had proper management plans and safeguards, were causing severe degradation of the tropical forest ecosystem. With the establishment of the Maya Biosphere Reserve, these activities were suspended, pending the development of a Master Plan, and rules and regulations for the use and management of natural resources.

The early management phase of the multiple-use zones was complicated and conflicted. The logging industry was reluctant to lose its exclusive rights to the land, and local communities fought hard to prove their management capacity and gain secure tenure rights. A long-term model had to be found that could both improve local production systems and, at the same time, guarantee the protection and sustainable management of the natural resources. Even though the creation of the Biosphere Reserve and the Master Plan, which was approved in 1992, paved the way for the allowance of concessions to communities, the process remained difficult. The first community concession was granted in 1994. This cleared the way for other concessions and presented a new alternative of communitarian development. The allocation of management rights to land-use stakeholders was based on renewable 25 year contracts. The ownership of the forest land within these models remains with the government, while communities are given management rights.

The communities that lie within the 800 000 hectare multiple-use zones have the possibility to sustainably harvest wood and non-timber forest products. However, to do so, community operations are required by law to be certified (the Forest Stewardship Council system has been widely used) and retain the certification throughout the duration of the contract, proving that they are managing the forests to conserve the integrity of the ecosystem. Currently, 13 forest concessions covering 500 000 hectares have been granted to local communities, which are organized under different legal configurations depending on their interests and type of technical support. Two concessions have been granted to the forestry industry.

This system of community forest concessions is unique in the world. It has enhanced the interest of forest resource users to protect and manage the forest; led to better forest governance; created jobs; increased income from non-timber forest products; and generated training and technical and organizational revenues. This has encouraged the concession holders to act as protectors of the forest. By shifting the emphasis on wood products to a combined valuation of timber and non-timber products and services, the system strengthens the links between forest ecosystem services and the needs and livelihood strategies of the people.

Lessons learned and recommendations

The community forest concession system has significantly changed the organizational and institutional landscape in northern Petén and has brought a higher level of sophistication and capability to the forest management regime. Key challenges for the future include simplification of the certification process and the harmonization of the requirements between different certification systems.

Case study 2.5
Addressing forest fires by improving livelihoods in the forest-agriculture interface in Syria

Farming woman with her cows on small holding

Introduction

The forest lands of Syria cover approximately 500 000 hectares, of which 232 000 are natural forest and 268 000 are plantations. Despite their relatively minor extent, the forests play a significant role in regulating water supply, controlling desertification, preventing soil erosion and flooding, and providing habitats for biodiversity. Because of high population pressures and resource use, the forests have become increasingly degraded, particularly by fire. Land tenure plays a large role in the process of land degradation. All forests have traditionally belonged to the state, with no access rights granted to the local population. As productivity of agricultural land has decreased due to erosion, and grazing resources are limited, forests have been illegally exploited and degraded. The key activities that have brought about forest degradation are burning to promote pasture inside the forest, overgrazing and the extraction of fuelwood. Key underlying drivers of forest degradation are the lack of legal access rights to resources and the limited number of viable livelihood options in the farming areas surrounding the forest.

More than timber harvesting, the forest provides economic benefits in the form of grazing land, fuelwood, and the harvest of non-timber forest products, such as mushrooms, wild herbs and medicinal plants. There is also increasing recognition among citizens and authorities alike that forests deliver valuable indirect economic benefits by safeguarding the water supply and protecting against soil erosion. The Participatory and Integrated Forest Fire Management Plan Project promotes more sustainable uses of the forest, including: controlled grazing; bee-keeping; harvesting of non-timber forest products; employment of local people in forest management activities, such as pruning; and ecotourism. Controlled grazing allows a stable source of feed for livestock and has the additional benefit of reducing fuel load in the forest near villages, which mitigates fire risks.

The landscape approach

In Syria, there is a strong political will to support afforestation and other forestry activities. The main goal of the forestry policy, which has been committed to at high political levels, is to preserve the existing natural forest and establish new plantations so that 15 percent of the country's land area is covered by forest. Currently, forest covers only about 2.7 percent of the land. Between 2004 and 2012, the Participatory and Integrated Forest Fire Management Plan Project was conducted in four provinces, an area that included 50 percent of the country's forest. The project was designed to address the key underlying drivers of forest degradation and create a greater awareness that forests cannot be managed in isolation from activities on adjacent land and in a manner that excludes local people. Only by enhancing the perceived value of the forest to local communities, and supporting livelihood options that do not encourage forest degradation, will forest management improve and fire regulation be possible.

The project worked on several different levels to build capacities to implement a participatory and integrated fire management plan for the Syrian forest-agriculture landscape.

- **National policy**
  Policies, laws, regulations, strategic and management plans, operational practices and institutional capacities of the Ministry of Agriculture and Agrarian Reforms were reviewed. There was a particular focus on expanding the forest access rights of local communities. These rights were strenghtened in Forestry Legislation No. 25, adopted in 2007. Through the project, community-based approaches were also recognized and incorporated into a national Integrated Forest Fire Management Strategy. The Strategy was developed by a multidisciplinary team with thorough consultation among different stakeholders, including numerous government agencies, local NGOs, (e.g. Peasants Union and the Womens Union) and academic institutions. As this strategy has been signed at the ministerial level, foresters are now mandated to take local communities into consideration and involve them in wild fire management. The Strategy can be considered as a substantial step forward for the protection of Syria's forests and biodiversity.
- **Capacity development of central and decentralized authorities**
  In the past, due to local communities' lack of legal rights to forest resources, staff at the Forestry Department did not have a collaborative relationship with forest users. Technical forestry staff of the Forestry Directorate, as well as agricultural extension staff involved in project activities at central and provincial levels, required greater capacity for developing and implementing integrated management plans together with communities. In addition, the Forest Fire Management Units were provided with technology, training and institutional strengthening to better address both fire suppression and fire prevention. The establishment of a Fire Incident Management System was important for improving the technical execution and coordination of the different stakeholders involved in fire suppression activities. Previously, fire suppression was disorganized and ineffective, and therefore dangerous.
- **Strengthening communities**
  Starting in pilot areas, communities were given support to diversify their livelihood options, increase the empowerment of women and rehabilitate agricultural land. As mentioned above, suitable forest uses were encouraged. Organic agriculture was promoted to improve income through the production of high value crops, such as herbs and medicinal plants. Women were given training in activities that could generate income, including the marketing of handicrafts and the packaging of cash crops. First aid training was also provided, which was welcomed due to the lack of access to medical services, which are especially important during wild fires. Villagers were supported in gaining access to resources in order to create or modernise small enterprises (e.g. small businesses near tourist spots).

Lessons learned and recommendations

By acknowledging the root causes of forest degradation and addressing these drivers in the forest-agriculture landscape in an integrated way, the project has been able to create a foundation for sustainable forest managment in Syria. At the same time, it has been able to contribute meeting CSA's objectives. Fire was a problem due to deliberate burning in the forest and the negligence of fire control on agricultural land. By giving local communities a stake in the well-being of the forest, the fires could be prevented and not merely suppressed once the damage was already done. The project directly targeted local communities to improve their capacity for self-reliant economic development and independence. This was achieved through education, better access to health services and care, and creating greater awareness in the country of the importance of resource access rights, rural employment and the role of women as agents for development and social change.

Ongoing processes for reform as a result of the project include: the development of community-based watershed management programmes; the strengthening of land tenure laws; and additional institutional development.

Case study 2.6
Ecosystem services of peatlands of the Ruoergai Plateau


Photo: Chen Kelin

The Ruoergai peatland pastures on the Tibetan Plateau: a major milk and meat producing area in China

Introduction

The extensive Ruoergai peatlands on the eastern Tibetan Plateau are a major link between the Tibetan uplands and large lowland rivers. These peatlands, which serve as grazing lands, contain an estimated carbon content of 750 megatonnes (Björk, 1993); a significant proportion of Chinese peat carbon resources. Home to numerous endangered and endemic species, the peatlands are important reservoirs of biodiversity (Tsuyuzaki *et al.*, 1990; Ekstam, 1993; Schaller, 1998).

Throughout history, the peatlands on the Ruoergai Plateau have acted like sponges. They absorbed and retained water during periods when water supplies were abundant and slowly released water when it was scarce. In this way, the peatlands slowed down peak discharge, prevented erosion, reduced downstream flooding and guaranteed a steady supply of water to the Huanghe (Yellow) River, a water source that millions of people depend on.

The introduction of livestock grazing 5 000 years ago completely changed the peatlands on the Ruoergai Plateau. Sedimentation of clay, silt and sand from the grazed mineral uplands combined with the continuous passing of yaks caused the peatlands to lose their spongy character. As a result, the peat has become more compact and is much more susceptible to erosion (Joosten *et al.*, 2008). At the same time, herders developed a complex system of land management, which included sharing grazing lands and their rotational use to prevent overgrazing and erosion. This system of resource management is part of the unique cultural heritage of communities on the Ruoergai Plateau. Not only in Ruoergai but in the entire high altitude of the Himalayan region, peatlands still function as grazing pastures for nomadic herders, especially when the peatlands are frozen or not completely waterlogged. Eighty percent of the peatlands on the Tibetan Plateau are grazed or browsed by domestic animals in winter and early summer. The herders prefer peatlands because of the early plant growth, the higher productivity of forage, the better nutrient availability due to the diversity of forage species, and the availability of water for watering and cooling the livestock.

Peatland degradation increased dramatically with the construction of roads in the 1970s and the rising demand for food, fuel and rangeland. Overgrazing and the resulting decrease in the quality of pasture fuelled the demand for new rangeland. This led to increased pressure on untouched peatlands (Wiener *et al.*, 2003; Wang *et al.*, 2006; Gao *et al.*, 2009), of which almost 50 percent were drained (Yang, 2000).

To increase milk and meat production, traditional husbandry was replaced by a more market-oriented economy. Collective livestock and pastures were divided and allocated to individual households (Yan and Wu, 2005). Pastures were fenced and more infrastructure was developed. Livestock numbers increased dramatically and migration routes of animals were blocked (Li *et al.*, 1986; Long and Ma, 1997), which aggravated overgrazing, peatland degradation, erosion and desertification. Peatlands in Ruoergai were leased to individual Tibetan herders, and this led to long-term conflicts between nature conservation and livestock grazing (Yan and Wu, 2005). The more sedentary managing system brought about new challenges not only for pastoral development but also for peatland conservation. Currently, the peatlands provide irreplaceable grazing ground for thousands of yaks, horses and sheep that are central to the livelihoods of local herder families and provide the country with animal products. Healthy peatlands can also create employment in other areas, such as tourism.

During the last forty years the area of degraded peatlands has almost doubled, and less than 20 percent of the peatland remain in good condition (Schumann *et al.*, 2008). Peatland degradation leads to increased GHG emissions. On the other hand, more moderate grazing may reduce methane emissions and carbon sequestration (Chen *et al.*, 2008 and 2009). For this reason, peatland restoration is considered an effective low-cost mitigation tool.

The landscape approach

At the farm level, herders fenced parts of the winter pastures near their winter houses to create hay meadows to supply supplementary fodder to animals and decrease grazing pressures on the peatlands in spring. Some core zones of protected areas and peatlands that are important as black neck crane habitats were also fenced to prevent direct grazing.

On the community and local level, pilot projects by national and international organizations supported peatland restoration by replanting vegetation (forage cultivation), rewetting (ditch blocking) and establishing comanagement systems that involved multiple stakeholders in the planning and decision making regarding the diverse uses of rangeland resources.

On the regional level, the Provincial People's Congresses of Gansu and Sichuan approved Wetland Conservation Regulations in 2007 and 2010 to promote the conservation of biodiversity and enhance the livelihood of local communities. These regulations prohibit drainage and peat mining, promote the reclamation of peatlands and encourage local people and organizations to get involved in peatland restoration. The Provincial People's Congress of Sichuan allocates 0.3 percent of its yearly budget to peatland restoration. Since 2008, the Chinese government has been working to establish a PES mechanism to compensate local herders for reducing the number of livestock.

On the national level, during the last decade the government of China has encouraged the ecological restoration of degraded rangelands and forage cultivation in winter pastures to reduce grazing pressure on peatlands in winter and spring. Since 2009 the programme 'Returning grazing to grasslands' (*Tui Mu Huan Cao*) in the eastern Tibetan Plateau has provided local herders with payments for ecosystem services when they decrease the number of livestock and fence pastures for hay making or restoration.

Lessons learned and recommendations

Human influence on the peatlands and rangelands of the Ruoergai Plateau started long before intensified land use directly affected the peatlands. Today most peatlands on the Ruoergai Plateau show moderate to severe degradation. Prevention of any further degradation and strict protection of the hydrologically important untouched peatlands should be the highest priority.

When they were not backed up by adequate management of grazing intensities, technical approaches to restore peatland functions showed only minor and ephemeral success. This important precondition for restoration and sustainable peat and rangeland use can only be achieved by actively involving local people in decision-making processes. Furthermore, the global benefits for biodiversity conservation and climate change mitigation and the national and regional benefits of water regulation must be directly linked with the local benefits of sustainable livestock production. Awareness raising and educational activities are needed to ensure that local communities understand how these different benefits are inter-related.

The development of an integrated peatland management regime has to respond to the demands of the local population. The management approach must be acceptable to local communities and be communicated in a comprehensible and consistent way. In Ruoergai County, for example, peatland conservation is the responsibility of the local forestry bureau, whereas rangelands (including grazed peatlands) are managed by the animal husbandry bureau. To achieve optimal landscape management that integrates the interests of all stakeholders, communication and cooperation between the different responsible organizations should be optimized.

The Ruoergai example shows how sound peatland management may serve multiple goals. By keeping groundwater levels high, the peatlands support the productivity of the upland rangelands. By reducing the speed of water flow, the peatlands retain sediments and provide a supply of good quality, well-filtered water. In addition, untouched and restored peatlands provide important soil carbon storage, whereas reduced degradation leads to significantly less carbon dioxide emissions.

Case Study 2.7
Assessing ecosystem services at a territorial scale – options for policy making, planning, and monitoring in the Kagera river basin

Lake Burera in Rwanda

Introduction

The goal of the Transboundary Agro-ecosystem Management Project for the Kagera River Basin (Kagera TAMP) (described at http://www.fao.org/nr/kagera/), which is funded by the Global Environment Facility (GEF) and implemented by FAO, is to adopt an integrated ecosystem approach for the management of land resources in the Kagera River Basin. The Basin is shared by Burundi, Rwanda, Uganda and the United Republic of Tanzania. Interventions are being monitored in terms of the local, national and global benefits that are generated. These benefits include: restoration of degraded lands; carbon sequestration; climate change adaptation; sustainable use of agricultural biodiversity; and improved agricultural production and rural livelihoods. Indirect benefits that are being monitored are the project's contribution to the protection of international waters and enhanced food security. In the project's monitoring framework, a participatory multisector process for assessing and mapping of land degradation and sustainable land management was undertaken for the entire basin.

The landscape approach

There are various land assessment tools that are suitable for application at a landscape scale for planning and management of natural resources and ecosystems and for supporting CSA interventions. The land degradation and SLM appraisal was based on a method jointly developed by the LADA project (www.fao.org/nr/lada/). The LADA project was executed by FAO and supported by GEF/United Nations Environment Programme (UNEP) in collaboration with the World Overview of Conservation Approaches and Technologies Secretariat. The assessment was conducted across the entire river basin: at the national level in Burundi and Rwanda, where the basin covers more than 60 percent of the national territories; and in relevant parts of the Kagera basin in Uganda and the United Republic of Tanzania. A series of participatory meetings were held that included selected multisectoral experts. Also carried out was an assessment and mapping of the extent, severity and intensity of various degradation types or processes encountered in the basin, as well as the extent and effectiveness of various SLM measures that were applied by diverse land users in the basin. The results, built up through consensus among groups of experts from multiple sectors, provided the baseline information and a harmonized territorial estimation of the tangible elements of the ecosystem's good and services (e.g. impacts of land use and management practices on soil, water, biomass, biodiversity, and its social and economic implications).

The method, which takes into consideration biophysical, social, economic, and ecological dimensions (see Table 2.2), is cost-effective and can be conducted in a relatively short amount of time. For the Kagera Basin, which covers nearly 60 000 km2, the entire assessment cost around US$ 150 000. Included in these costs was capacity development in methods for the participatory expert assessment with multiple sectors, quality control, and the validation and finalization of the database and maps. In this case, six months were sufficient to complete a first draft set of maps. One year should be sufficient to complete the entire validation process and make available the data set and maps for future planning by districts and technical sectors.

Table 2.2
The various dimensions used by the LADA questioinnaire for mapping method

<table>
<tr><th>Biophysical</th><th>Use of the land</th><th>Ecological</th><th>Socio-Economic</th></tr>
<tr><td>Elevation, slope, hydrology, land cover soil, soil fertility
Climate: temperature, rainfall</td><td>Livestock density, crop type, land use</td><td></td><td>Population density, poverty</td></tr>
<tr><td colspan="3">Direct causes of land degradation or SLM due to land use and management practices</td><td>Indirect causes of land degradation (driving forces) or SLM</td></tr>
<tr><td colspan="4">Trend in land-use change and intensity of trend variation
Type, rate, degree, and extent of land degradation
Type, extent, effectiveness of SLM technologies</td></tr>
<tr><td></td><td></td><td>Impacts on ecological services (water, soils, biomass, biodiversity, climate): negative or positive impact due to land degradation or SLM</td><td>Impacts on productive and socio-economic services: negative and positive impact due to land degradation or SLM</td></tr>
</table>

After finalizing the collection and validation process, the data and maps are used to guide the cross-sectoral interventions at the landscape level so that multiple goals, including those that address specific climate threats, can be reached. In this way, LADA can be used to promote sustainable and climate-smart land resource management.

Lessons learned and recommendations

An important lesson that has been learned is that the data and maps can be used to: inform the project intervention strategy; identify best SLM practices for scaling up; and guide effective and responsive interventions at various scales. This is backed up by SLM implementation at the farm and catchment levels, field assessments of SLM performance and impacts, and an analysis of constraints to wider uptake.

This process will in turn inform policy making, planning and budgetary allocations by technical sectors at the district and transboundary levels and will establish a baseline for more integrated landscape management approaches. A handover and ownership building process is under way to transfer the results to select governmental institutions. Decision makers in the four countries will be assisted in analysing what type of land degradation processes are occurring, including those exacerbated by climate change; where they are happening; what are the trends and why; and what are the expected ecological and socio-economic impacts. An example of the type of issue that could be analysed would be how changes in carbon storage in soil and biomass resulting from certain land-use practices would affect the supply of food and energy and agro-ecopological resilience. Decision makers will also be informed about how to analyse current SLM technologies and approaches in terms of extent and trends, and their effectiveness in reversing land degradation and improving SLM. For example, a comparison of maps showing degradation (Figures 2.1 and 2.2) and SLM effectiveness (Figure 2.3) will allow decision makers to identify areas requiring interventions, select good practices that can be scaled up, and choose additional SLM measures that are needed to address specific degradation problems (see figure 2.1). Policy makers should be informed on the causes of land degradation (as distinct from poor quality land) such as poor cropland management, the removal of natural vegetation and deforestation, over-exploitation of vegetation for domestic use, overgrazing, and climate-related factors (e.g. changes in temperature or seasonal rainfall, extreme rainfall, floods or droughts) (see Figure 2.2).

The participatory assessment could be repeated at the basin level (at the end of the project) or preferably at the farm and catchment level at regular intervals (e.g. mid-term and end of project). These would monitor the impacts of the project in terms of specific SLM interventions, their impacts at field and farm level, and their combined effects at a wider catchment and territorial scale.

The method could also be used during project implementation to help identify required improvements to SLM interventions, determine potential areas for scaling up specific SLM measures and analyse the best practices that deserve wider investment.

The process can be used by communities and districts to justify and develop proposals for catchment level interventions and develop more substantive investment programmes requiring external support for landscape or basin-scale interventions. Information gathered will allow for landscape and territorial management among the various sectors and contribute to achieving multiple objectives, including sustainable productivity, enhanced resilience to climate variability and change, and climate change mitigation. This will contribute to the development of more effective synergies among sectoral interventions and identify trade-offs that need to be addressed by all stakeholders.

Figure 2.1
Land degradation severity in the Kagera river basin

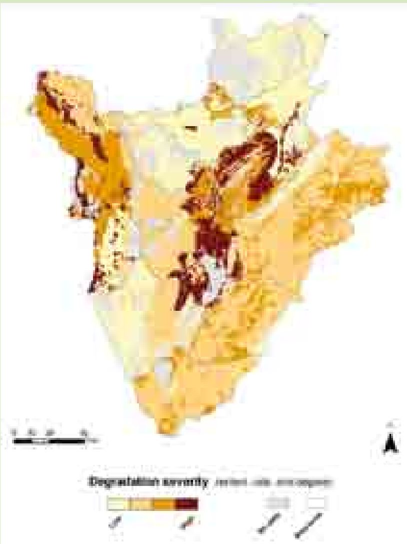
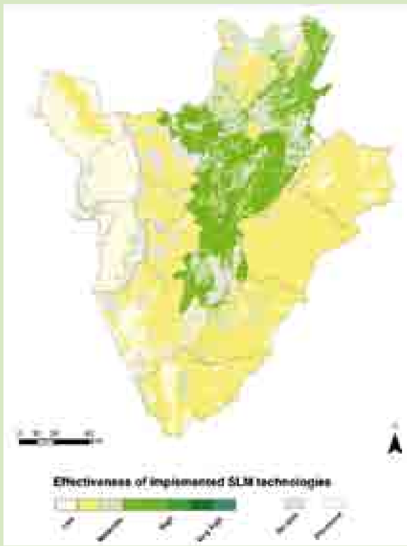


Figure 2.2
Land degradation caused by climate in the Kagera river basin

Figure 2.3
Effectiveness of SLM in the Kagera river basin



Case study 2.8
Planning and management for the hydrological balance of the South American continent – the role of the tropical Andes

Contour terraces in the Peruvian Andes

Introduction

Most of the watersheds of the South American continent, including the Amazon and La Plata river basins, originate in the tropical Andes mountain range. Water places the tropical Andes in a position of strategic importance for the environmental stability of the entire South American continent.

Climate change is a significant threat to the functioning of the tropical Andes' ecosystems. Throughout rural Latin America, and particularly in the tropical Andes and its related continental watersheds, agriculture and livestock production are the main livelihoods of most rural populations. As they are currently practiced, agriculture and livestock production have a huge impact on the hydrological regime and water quality downstream.

The landscape approach

At the farm level, shifting to climate-smart practices, improving market access, and protecting vegetation cover on the landscape level to stop soil erosion, are some of the key measures that need to be taken across the tropical Andes to avoid environmental damage and strenthen rural livelihoods.

Policy and institutional reforms are needed to ensure that the high-altitude ecosystems of the topical Andes are managed to ensure hydrological stability. Planning, development and management of water resources must be governed by an integrated local and continental perspective, and encompass climate change adaptation, disaster risk management and natural resource management. Institutions should be adapted to serve the resource, not the other way around.

On the continental scale, a South American plurinational agency that works to clarify roles and responsibilities in relation to the sustainable water management of the region´s watersheds could be an important positive force for long-term water security of the region.

On the national level, a basin perspective is often lacking. State authorities usually work in isolation, and there is a repeatedly acknowledged absence of national policies for water resources in the region. To a large degree, the solutions involve public policies that encourage the adoption of environmentally sustainable agricultural practices. These practices should be measured by their ability to achieve high yields per hectare and supported by public investments in physical infrastructure that is built by local populations. Institutional strengthening is needed especially at the municipal level to improve services. This could be addressed by municipal taxes. Currently, citizens only pay national taxes, and funds to municipalities are allocated by the central government. This situation leads to a lack of accountability by municipal officials towards local populations. Policies for municipal strengthening can enable the active involvement of local populations in policy design, implementation, monitoring and evaluation, which is important to ensure the effectiveness of efforts on the national scale.

On the subnational level, municipal structures, families, farmers, rural producers and community organizations are key institutions that need to be engaged to restore the Andean highlands and prevent hydrometeorological emergencies. Because farmers determine land use and land-use change, they need to play an influential role in constructing institutional arrangements at all levels of government. This can be done by establishing producer cooperatives (large and small) that can give farmers a voice and a collective market influence. Cooperatives need to be supported by municipalities. Municipal government is the appropriate institution to provide a link between the government and civil society organizations in the region, as they are the only public institutional figures in many remote locations and have a cross-sector organization.

For communities, the key determinant for improved livelihoods is a strong physical connection to markets. Good road access to nearby rural towns and cities is paramount. Once road access is available, communities can participate in markets with products for which they have a competitive advantage. A second important intervention that needs to be planned and organized on the landscape scale is technology and knowledge transfer for more climate-smart and profitable practices. The adoption of modern sustainable agro-ecological practices (e.g. drip irrigation and micro irrigation systems, soil fertilization with organic manure, production of food for domestic use in home orchards) and the revival of traditional sustainable practices (e.g. pre-Hispanic terrace rehabilitation, construction of water infiltration ditches, insect repellent plants, native Andean crops) contributes to the resilience of landscapes and family farms. These practices are also part of successful strategies for managing disasters (e.g. protection against soil erosion and soil recuperation, prevention of hydrometeorological emergencies). Communities are better positioned to ensure that sustainable practices are undertaken, as it is only through the full participation of all community members that damage to the vegetation cover can be avoided.

Planning processes for watershed management involving multiple stakeholders, including municipal and regional governments, can be institutionalized in the tropical Andes using an integrated watershed perspective. This was done in Peru, where the National Plan for climate change adaptation and disaster risk management (2012-2021) was developed jointly with regional governments using a watershed approach. Watershed committees (comisiones de cuencas), inter-municipal commissions (mancomunidades de municipios) and watershed users' organizations involving rural populations as well as urban and industry stakeholders can play key roles in such processes. At the landscape level, watersheds can be favourably managed by intermunicipal commissions that create a chain of municipalities following the flow of water.

Previously, lack of public funding was a major issue for local governments in South America. Money is now flowing in, but it usually comes with constraints set by the funding source. Most local governments in Latin America heavily depend on fiscal transfers from central governments that exercise substantial influence over how finances are distributed. Funding is also commonly available from other sources, such as conditional cash transfer programmes, but these funds are not targeted to promote sustainable rural livelihoods and natural resources management. Fiscal autonomy of municipal governments would empower them to finance their own development and should be a long-term goal.

PES schemes (for more information see Module 14 on financing) is a financial mechanism that is playing a leading role in the improvement of livelihoods of upstream smallholders in the tropical Andes. An example is the Napo Province in Ecuador where a GEF project is supporting the implementation of a water fund that is operating a PES scheme for the appropriate management of páramos and catchment areas upstream so that downstream users have enough water for drinking and producing hydroelectricity. Another financial instrument that can empower citizens and focus public funds on sustainable natural resource management is participatory budgets, which allow citizens to participate in the planning and allocation for all or part of the municipal budget. Community involvement in municipal planning and budgeting strengthens local institutions and can overcome administrative inertia and improve the transparency and accountability of the elected officials.

Lessons learned and recommendations

1. Water is the linking thread which connects the tropical Andes to most watersheds in South America, not only those flowing west to the Pacific Ocean that provide water for cities, such as Lima, Quito and Guayaquil, but also east to the Atlantic Ocean, by way of the Amazon river basin and the La Plata River basin. As such, the hydrological stability of most of the continent depends on services provided by micro-ecosystems located above 4 000 metres above sea level (páramos, wetlands and glaciers).
2. A strategy for adaptation to climate change, risk management and natural resource management (in the case of South America) must be addressed with a regional approach that goes beyond national boundaries to become a strategy for natural resource management in the subcontinent of South America as a territorial unit. The territorial unity of the continent of South America is determined by hydrological dynamics which, according to the law of gravity, has its origin in the higher elevations of the Andes, downstream to the Pacific and Atlantic oceans.
3. Watershed committees allow for the governance of natural resources beyond the political boundaries that may run through the basin. However, watershed committes have sectorial limitations, as they act in matters only directly related to the basin. For that reason, it is essential that, whenever posible, watershed committees establish a close partnership with local government authorities, including municipalities. It is also important that municipalities establish intermunicipal alliances to overcome the administrative limits imposed by political borders and allow them to cover the entire transnational watershed.
4. Supranational feedback must begin from the communities located in the Andean plateaus, since they act as true guardians of the water recharge areas that feed the subcontinent's watersheds.
5. The focus on existing practices and local knowledge for adaptation to climate risk and conservation of agricultural biodiversity is the best guarantee for the sustainable management of Andean watersheds. Andean traditional farming practices, such as the construction of terraces, are well adapted to the conservation of soil organic content and water retention. The local knowledge of conservation practices in situ and the resilience of some crops and livestock products should be valued and included in the development of modern institutions.
6. The creation of synergies between producer organizations and local government institutions is a fundamental element because it provides the link between local governments and civil society organizations.

Conclusions

The landscape approach has an important role to play in transitioning to CSA. It is an integrated approach that aims at the sustainable management of natural and human-maintained processes in the landscape. Instead of separate and often counterproductive management of various sectors, it calls for the alignment of sectoral policies and their coordinated implementation. Adoption of participatory and people-centred approaches and management structures contributes to improving the resilisence of the agro-ecosytem and the livelihoods of the people who depend on it. Scaling up the landscape approach requires an enabling policy and market environment, adequate governance structures as well as improved knowledge management and heightened institutional capacity. Different landscapes require different approaches that will depend on the state and nature of the resources, current land-use dynamics, and social and economic conditions.

Notes

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Acronyms

CDM	clean development mechanism
COE	Council of Europe
CSA	climate-smart agriculture
EAFA	ecosystem approach to fisheries and aquaculture
FPIC	Free Prior Informed Consent
GEF	Global Environment Facility
GHG	greenhouse gas
ICIMOD	International Centre for Integrated Mountain Development
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
ISRIC	International Soil Reference and Information Centre
LADA	Land Degradation Assessment in Drylands
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plans
NAPA	National Adaptation Programmes of Action
MEA	Millenium Ecosystem Assessment
NGO	non-governmental organization
PFC	Project Facilitating Committee
PES	payment for ecosystem services
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SLM	sustainable land management
SPI	sustainable production intensification
TAMP	Transboundary Agro-ecosystem Management Project, for the Kagera River Basin
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEP	United Nations Environment Programme
WHC	World Heritage Committee

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