

*FAO, working with countries to tackle climate change through sustainable forest management*

# Managing forests for climate change



## FOREST MANAGEMENT: A KEY INGREDIENT IN THE CLIMATE CHANGE TOOLBOX

Forests, when sustainably managed, can have a central role in climate change mitigation and adaptation. By strengthening forest management practices, FAO supports countries to achieve sustainable forest management, which is an effective framework for forest-based climate change mitigation and adaptation. Sustainable forest management also contributes to food security, poverty alleviation, economical development, and sustainable land use, in the wider context of sustainable development.

Good forest management secures the survival of forest ecosystems and enhances their environmental, socio-cultural and economic functions. It can both maximize forests' contribution to climate change mitigation and help forests and forest-dependent people adapt to new conditions caused by climate change. Improved forest management practices for climate change mitigation and adaptation should be planned and implemented in tandem, as they are closely linked.

Forests are, of course, managed not only for climate change, but for multiple, usually complementary, objectives: production of goods, protection of soil, water and other environmental services, conservation of biodiversity, provision of socio-cultural services, livelihood support and poverty alleviation. Accordingly, climate change mitigation and adaptation efforts must provide synergies and be balanced with other national and local forest objectives.

**Forests are much more than timber and much more than carbon**

“A narrow focus on ... the role of forests as carbon sinks at the expense of the other forest values would be unsustainable.”

*Strategic framework for forests and climate change.*  
Collaborative Partnership on Forests, 2008

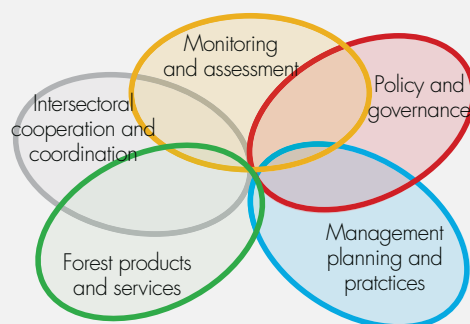


### Key terms and concepts

**Forest management** is the process of planning and implementing practices for the stewardship and use of forests and other wooded land aimed at achieving specific environmental, economic, social and/or cultural objectives. [FAO, Global Forest Resources Assessment 2005]

**Sustainable forest management** is a dynamic and evolving concept that aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations.” [Description adopted by UN Resolution 62/98, establishing the Non-legally Binding Instrument on All Types of Forests]

### FAO's integrated approach to sustainable forest management

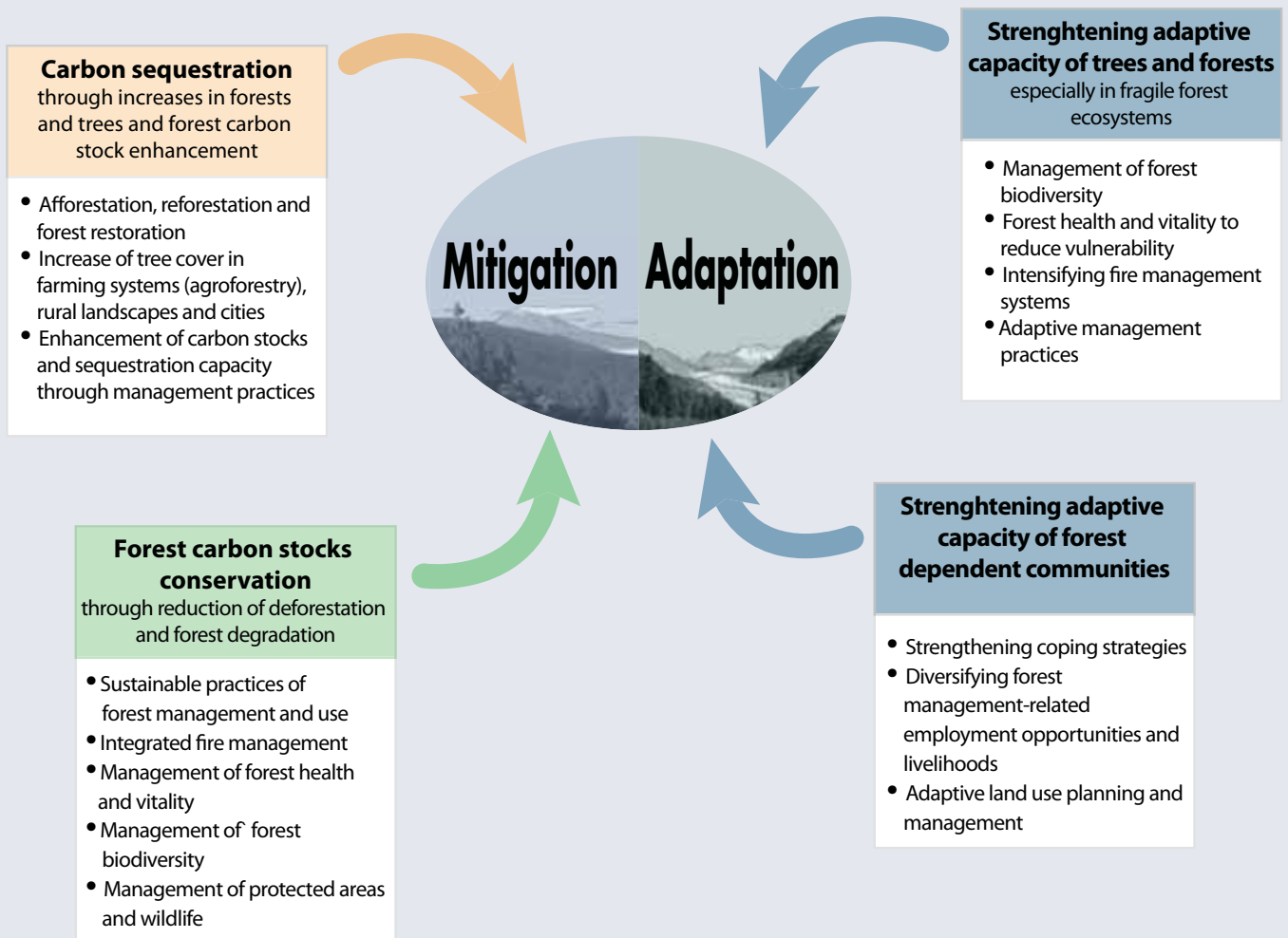


## WHAT WE DO

FAO works in supporting countries to strengthen the management of forests in a changing climate and for increasing the extent of forests as carbon stocks, while still considering the multiple forest functions and dimensions. This publication describes the many ways in which FAO works to promote good management practices for climate change mitigation and adaptation, as outlined in the figure below.

When facing new challenges such as climate change, FAO emphasizes the importance of innovative approaches, best practices and international partnerships, but also building on existing knowledge and long experience in forest management (including community-based forest management).

### How forest management helps tackle climate change



Adapted from: *Strategic framework for forests and climate change*. Collaborative Partnership on Forests, 2008

## PEOPLE AT THE CENTRE OF FOREST MANAGEMENT

FAO's work focuses on supporting developing countries, where important forest ecosystems are located and where many people depend on forests. Forest loss means not only increased carbon emissions, but also high costs in terms of diminished services, livelihoods and cultural values. Billions of people depend on the services provided by the forests for their livelihoods. Adaptation should be centred on the needs of these people.

As poverty is one of the drivers of deforestation, adaptation for and mitigation of climate change must be addressed in unison with the fight against poverty and actions towards sustainable development and achievement of the Millennium Development Goals.



### Community forest management

Important carbon stocks in many forests around the world have been maintained and enhanced thanks to the management practices of local communities, which range from conservation to reforestation to community fire management. Successful forest management related initiatives to mitigate and adapt to climate change, including REDD+, must take into account the experiences and lessons learnt in community forest management.

Community forest management – embracing various degrees of community involvement, including arrangements such as participatory forest management, joint forest management, co-management and community-based forest management – can significantly contribute to reduce forest emissions and increase forest carbon stocks, while maintaining other forest benefits. Forest-dependent communities are also at the centre of climate change adaptation efforts, which must focus on strengthening people's adaptive capacity and resilience.

Payments for ecosystem services may be useful in preserving, acknowledging and rewarding good community forest management practices. However, such schemes require the establishment of transparent and fair benefit-sharing arrangements and exploration of possible aggregation mechanisms to reduce transaction costs.

Active participation of communities in all aspects of forest management, taking into account people's needs, aspirations, rights, skills and knowledge, will contribute to the efficiency, sustainability and equity of forest-based measures to tackle climate change.

## FINANCING FORESTS' CONTRIBUTION TO CLIMATE CHANGE MITIGATION AND ADAPTATION

Sources of financing have emerged to support forest-related mitigation efforts, including the Clean Development Mechanism (CDM) under the Kyoto Protocol and voluntary carbon markets, and, more recently, the REDD+ Partnership, the Forest Carbon Partnership Facility (FCPF) and the Forest Investment Program (FIP) of the Strategic Climate Fund. REDD+ activities are also actively supported by bilateral and NGO funding.

Various funds managed by the Global Environment Facility (e.g. the Adaptation Fund), as well as other support – through multilateral, bilateral and NGO channels, provide financial assistance for climate change adaptation of forests, forestry and forest-dependent people. The need for funding for adaptation measures is growing, as recognized in the Copenhagen Accord, which places equal weight on mitigation and adaptation.

### Forest management in REDD+

Under UNFCCC, countries are negotiating REDD (reducing emissions from deforestation and forest degradation in developing countries) as an instrument that would provide incentives to developing countries to carry out forest-based climate change mitigation actions. Many countries support an instrument that provide incentives for essentially all land-based forest mitigation measures, referred to as "REDD+"; this includes reducing emissions through reducing deforestation and forest degradation, forest conservation, sustainable management of forests and enhancement of forest carbon stocks.

Thus far, REDD+ negotiations and national preparations have mainly focused on defining transparent monitoring, reporting and verification (MRV) systems, and on forest governance and national policies and strategies for REDD+. While these are key pillars for REDD+ construction, improving forest management practices will also be of fundamental importance to reach the desired objective of curbing emissions from deforestation and forest degradation and to conserve and enhance forest carbon stocks on the ground. Forest management will be fundamental to the successful implementation of national REDD+ strategies.

Good forest management planning and practices are essential for the success of REDD+ and must be addressed from the outset.

Forests can be net sinks or net sources of carbon, depending on their age, health and susceptibility to wildfires and other disturbances, as well as on how they are managed. Forest management interventions that result in carbon emission reductions or increased carbon sequestration could potentially be rewarded by REDD+.

While most sustainable forest management projects may have a positive impact on climate change mitigation and adaptation, only some forest ecosystems have high potential for REDD+, when the opportunity costs of other alternative land uses, the main drivers of deforestation and degradation, the additionality of REDD+ and the tenure issues and institutional framework are taken into account. Sustainable forest management must also be promoted and supported for forest ecosystems with low potential to benefit from REDD+ incentives, as they may still have important environmental, economic and social functions.

## Supporting countries to **INCREASE CARBON SEQUESTRATION BY FORESTS AND TREES**

Forests and trees are important carbon sinks. They absorb carbon dioxide from the atmosphere and store it as carbon. Carbon sequestration by forests has attracted much interest as a mitigation approach, as it has been considered a relatively inexpensive means of addressing climate change immediately.

Around 13 million hectares of forest were converted to other uses or lost through natural causes each year between 2000 and 2010. The world has an estimated 850 million hectares of degraded forests, which could potentially be restored and rehabilitated to bring back lost biodiversity and ecosystem services, and, at the same time, contribute to climate change mitigation and adaptation.

Forest management practices that increase carbon sequestration include:

- afforestation, reforestation and forest restoration;
- increase of tree cover through agroforestry, urban forestry and tree planting in rural landscapes;
- enhancement of forest carbon stocks (in both, biomass and soils) and sequestration capacity through the modification of forestry management practices.



## Afforestation, reforestation and forest restoration

Increasing forest area and density through afforestation, reforestation and forest restoration results in increased absorption of carbon dioxide from the atmosphere. Once the trees are harvested, new trees can grow in their place and continue to sequester carbon. Planted forests today cover around 264 million hectares and absorb an estimated 1.5 gigatonnes of carbon from the atmosphere each year.

The rates of carbon sequestration on forest land depend on the management practices adopted, the tree species involved, and the geographic area covered. For the conversion of agricultural land to forests by way of afforestation, for example, sequestration rates will vary considerably depending on the region and species involved. In accordance with tree growth, carbon sequestration rates share a standard pattern of initially rising rates followed by gradually declining rates. On average, a planted forest in a temperate zone can sequester about 4 tonnes of carbon per hectare each year.

### FAO'S SUPPORT

FAO is an information hub for the sustainable management of planted forests and the promotion of reforestation, afforestation and forest restoration practices that contribute to combating climate change. FAO's voluntary guidelines for responsible management of planted forests set a normative framework for establishing and managing planted forests according to economic, environmental and social principles.

FAO also supports field projects in a number of countries that serve as role models for the use of forests and trees in mitigating and adapting to climate change. Here are two examples:

- In China, FAO's International Poplar Commission has supported large-scale reforestation with poplars in smallholder woodlots, agroforestry production systems and watersheds. The plantings have helped to stabilize river banks, mitigate soil erosion, lessen the impact of sand- and windstorms, enhance wildlife habitat, support rural livelihoods and boost economic development through a thriving wood industry, while also increasing carbon sequestration.
- In the Philippines, a three-year FAO-financed project is promoting assisted natural regeneration for effective low-cost forest restoration, as a means to halt further forest degradation while increasing carbon sequestration and contributing to climate change mitigation. Assisted natural regeneration aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy species, and recurring disturbances (e.g. fire, grazing and wood harvesting).

For more information:

[www.fao.org/forestry/plantedforests](http://www.fao.org/forestry/plantedforests)

[www.fao.org/forestry/anr](http://www.fao.org/forestry/anr)

## Increase of tree cover outside forests

Trees outside forests include agroforestry systems on agricultural lands and farms, trees in the rural landscape and along roads, rivers and human settlements, and trees in and around cities. While contributing to environmental sustainability, they also provide income and a range of goods and ecosystem services for rural households, thus contributing to food security and poverty eradication.

Throughout the world, trees outside forests help mitigate climate change by storing carbon, halting land degradation, providing fuel to substitute fossil fuels and fixing nitrogen to reduce the use of fertilizers. Trees in agricultural landscapes represent a globally important carbon stock: almost half of the world's agricultural land has at least 10 percent tree cover. The contribution of trees outside forests to climate change mitigation can be increased by promoting agroforestry systems and urban forestry.

Trees outside forests can also have an important role in climate change adaptation, through diversified land-use practices, livelihoods and sources of income, and through enhancement of agricultural productivity and buffering against weather-related production losses, enhancing resilience against climate impacts in farming systems.



### FAO'S SUPPORT

Large-scale and reliable information on the extent of agroforestry practice is limited, making it difficult to quantify its importance and justify increased investments in tree-based systems at large. Consequently, FAO is carrying out a thematic study on the assessment of trees outside forests which takes into account the information requirements of the Intergovernmental Panel on Climate Change (IPCC) and other internationally recognized reporting processes.

FAO also supports countries in enabling the most appropriate framework to promote

tree planting outside forests, maximizing full opportunities for increasing carbon sequestration in all land uses.

FAO provides technical assistance to improve the management of agroforestry systems, tree systems and urban and periurban forests so as to enhance the potential of trees outside forests to address global challenges of poverty, land degradation, climate change and biodiversity loss.

For more information:  
[www.fao.org/forestry/tof](http://www.fao.org/forestry/tof)



## Enhancement of forest carbon stocks

Effective implementation of good management practices ensures the multiple functions of forests and can increase forest carbon stocks. Specific management practices – e.g. silvicultural treatments (tending operations, enrichment of gaps, etc.), species selection, modification of rotation cycles, can be adopted to enhance forest carbon stocks and the climate change mitigation potential of stands, keeping in mind the impact on other forest values as well as the multiple interactions within ecosystems.



### FAO'S SUPPORT

FAO works in bridging the gap between science and practical implementation in countries. Research is generating specific data for different forest ecosystems and biomes and is discovering new information on relevant topics such as the different management options that influence carbon sequestration in biomass and soils; the complex interactions between increased

carbon sequestration and other forest functions; and the impact of harvesting on carbon stocks and carbon storage in forest products.

FAO collects and disseminates this information, making it available to countries and facilitating its use in the support of international processes and negotiations.

## Supporting countries to **CONSERVE FOREST CARBON STOCKS**

Deforestation and forest degradation, whether due to human activities or natural causes, result in carbon stock reductions and greenhouse gas emissions, as well as loss or impairment of other forest goods and services, threatening livelihoods, environmental functions and other socio-economic values. Forest conservation endeavours to rectify such deleterious impacts that cause forest degradation, and ultimately deforestation.

Forest threats include fires, pests and diseases, poor management and harvesting, overexploitation, grazing and other disturbances. Management measures must be adapted to the specific threats of the site.

Forest management activities that conserve carbon stocks in forests include:

- sustainable practices of forest management and use;
- integrated fire management;
- management of forest health and vitality;
- management of forest biodiversity;
- management and extension of protected areas.



## Sustainable practices of forest management and use

Sustainable management practices can ensure that productive or multipurpose forests continue to store carbon and maintain their capacity to provide other goods and services for the benefit of current and future generations. Management practices need to be actively planned, tailored to each specific ecosystem and evolving situations, so as to avoid overexploitation and forest degradation.

Forest management plans and practices will also need to be adapted to modifications caused by climate change, both gradual and abrupt. Adaptive forest management will be essential to address arising challenges and reduce forest vulnerability. Adaptation measures might include, for example, selection of pest-resistant or drought-tolerant varieties, use of stocks from a range of provenances, underplanting of genotypes of species adapted to expected new climate conditions, or assisted natural regeneration of functional species. The measures need to be adapted to forest condition (primary, secondary, degraded) and the specific site.

### FAO'S SUPPORT

FAO supports countries in improving forest management planning and practices for securing the continuity of forests and their functions, and for increasing the resilience of ecosystems, through the following activities.

- identifying, testing, adapting and promoting innovative forest management approaches and techniques adapted to each specific context, e.g. through support for model and demonstration forests;
- planning and supporting field projects on sustainable management of forests and woodlands in a changing climate;
- promoting environmentally sound, economically feasible and socially acceptable forest operations, including silvicultural treatments and reduced-impact logging (see FAO Model Code of Harvesting Practice);
- supporting exchange of experiences to facilitate legal, transparent and accountable forest management practices (e.g. strengthening legal frameworks and law enforcement, involving communities in management, supporting forestry interventions that address poverty as a driver of deforestation, etc.);
- collecting, analysing and disseminating information to countries and key stakeholders through databases, case studies, Web-based information systems, publications and exemplary cases of sustainable management of forests and woodlands;
- developing manuals and guidelines and organizing workshops and seminars to facilitate the dissemination of best practices and exchange of experiences;
- facilitating the translation of concepts of sustainable forest management into practice through capacity building;
- supporting networks, partnerships and twinning arrangements among countries and institutions.

For more information:

[www.fao.org/forestry/sfm](http://www.fao.org/forestry/sfm)

[www.fao.org/forestry/modelforests](http://www.fao.org/forestry/modelforests)

[www.fao.org/forestry/harvesting](http://www.fao.org/forestry/harvesting)

## Integrated fire management

Wildfires are a significant source of greenhouse gas emissions, and their incidence is likely to increase because of climate change. Integrated fire management is essential for forest conservation and as a part of climate change adaptation strategies.

Strengthening capacities to prevent wildfires or to reduce risk of large disastrous wildfires can contribute to protecting storage and sequestration of carbon in natural or planted forests, and also in other vegetation types such as range and flood lands.

With the increased risk of wildfires, integrated fire management is a key component of both climate change mitigation and adaptation strategies. Fire management practices will need to be intensified and adapted as the context evolves with climate change.



### FAO'S SUPPORT

FAO promotes integrated fire management through capacity building and the use of the *Fire Management Voluntary Guidelines* at the global level, as well as through field projects.

The guidelines address strategic actions such as prevention, monitoring, awareness raising, preparedness and suppression of fires, as well as restoration of affected areas, which should be part of national vegetation fire policies, and planning and management, integrated in broader landscape policies. They also address the involvement of all stakeholders and sectors.

They deal with both uncontrolled wildfires and the use of fire as a management tool.

FAO supports community-based approaches, since the communities that suffer most from wildfires are likely to be most motivated to prevent or suppress them. Strengthening communities' capacities to prevent and suppress devastating wildfires and to use fire wisely as a management tool not only contributes to enhancing their livelihoods, but also addresses global issues such as reducing deforestation and carbon emissions.

For more information:  
[www.fao.org/forestry/firemanagement](http://www.fao.org/forestry/firemanagement)

## Management of forest health and vitality

Increased temperatures and levels of atmospheric carbon dioxide as well as changes in precipitation and in the frequency and severity of extreme weather events are having notable impacts on the condition of the world's forests, for example by making winters warmer or affecting the length of growing seasons.

Climate change, particularly extreme weather events, can affect forest pests and the damage they cause by directly impacting their development, survival, reproduction and spread; altering host defences and susceptibility; and indirectly impacting ecological relationships such as changing the abundance of competitors, parasites and predators.

Insects and diseases may be the first indicators of climate change, and there are already numerous examples where insect and pathogen lifecycles or habits have been altered by local, national or regional climatic changes. For example, the mountain pine beetle (*Dendroctonus ponderosae*) in western North America has shown decreases in generation time and winter mortality resulting in exponential population growth and major range extension. Warmer temperatures have resulted in range expansions of pests such as pine and oak processionary caterpillars (*Thaumetopoea pityocampa* and *Thaumetopoea processionea*) in Europe and red band needle blight (*Mycosphaerella pini*) in the United States.



Research has suggested that insect outbreaks can significantly affect the carbon sink or source status of a large landscape. Thus preventing and reducing pest impacts on forests may also provide an opportunity to mitigate climate change. Management of pests and prevention of their spread helps ensure that forests remain healthy, reducing the risk of forest degradation and increasing resilience to climate change.

### FAO'S SUPPORT

FAO assists, advises and supports countries to safeguard the health and vitality of forests, forest ecosystems and trees outside forests, with special reference to insects, diseases and other harmful biotic and abiotic agents.

In 2010, FAO has developed a tool to help foresters deal with the increasing threats to forests posed by pest movement through expanded global trade, coupled with local climatic change which may increase the potential for establishment of pests in new

areas.

A *Guide to implementation of phytosanitary standards in forestry*, prepared through a multistakeholder process, provides clear and concise guidance on forest health practices. Strengthening country capacity to implement the guide will be a strong focus from 2011.

For more information:  
[www.fao.org/forestry/pests](http://www.fao.org/forestry/pests)

## Management of forest biodiversity

Biodiversity is key to resilience of forest ecosystems to climate change, and therefore for conservation of forest carbon stocks.

Forests are among the most important repositories of terrestrial biological diversity. Together, tropical, temperate and boreal forests offer very diverse habitats for plants, animals and micro-organisms. Biological diversity is the basis for a wide array of goods and services provided by forests. In their great variety, forest trees and shrubs have a vital role in the daily life of rural communities in many areas, as sources of wood and non-wood products, as contributors to soil and water conservation, and as repositories of aesthetic, ethical, cultural and religious values.

In forests, biological diversity, in particular genetic diversity, allows species to adapt continuously to evolving environmental conditions (including climate change), to maintain the potential for selection and improvement to meet future needs and changing end-use requirements, and to support ecosystem functions. However, inadequate information and knowledge is generally an obstacle in identifying issues, needs and priorities for action in conservation of biodiversity in the context of climate change, at national and global levels.

“Biodiversity underpins forest resilience, which in turn underpins the permanence of forest carbon stocks. For these and numerous other reasons the achievement of biodiversity benefits are essential for the success of REDD+.”

*Summary of Forest Day 3. CIFOR, 2009*



### FAO'S SUPPORT

FAO is actively working with countries to assess the state of genetic diversity in the world's forests and to find solutions to the threats facing them, including climate change. The Organization also promotes best practices in forest genetic resources management, specifically in the areas of conservation, exploration, testing, breeding and informed use of new biotechnology.

To meet the information needs at the national level, FAO supports the collection of information related to biodiversity through the National Forest Monitoring and Assessment (NFMA) programme. At the international level, FAO works closely with other forest-related international

and regional organizations to harmonize information and requirements for reporting on forests. FAO provided forest-related information for the Third Global Biodiversity Outlook and incorporated the indicators for the 2010 Biodiversity Target and other forest-related biodiversity indicators into the Global Forest Resources Assessment (FRA) 2010. The preparation of the first report on the state of the world's forest genetic resources and the expansion of the NFMA approach should contribute to the development of additional indicators for monitoring forest biological diversity and the effectiveness of conservation measures.

For more information:  
[www.fao.org/forestry/fgr](http://www.fao.org/forestry/fgr)

## Management of protected areas and wildlife

Protected areas are among the most important tools for forest and wildlife conservation. Accordingly, improved management, and possibly expansion, of protected areas is considered one of the REDD+ mitigation options.

Climate change is greatly adding to human-induced pressures on wildlife and protected areas (e.g. the unsustainable and often illegal hunting and trade in wildlife and its products) by modifying habitats and increasing the prevalence of threats such as fire, pests and pathogens. Wise management of wildlife and protected areas is critical for successful conservation and sustainable use of wild animals in the prospects of a changing climate. Priority activities include:

- developing adapted strategies, policies and legislation;
- setting up long-term monitoring and reporting schemes for indicator plant and animal species;
- transboundary cooperation;
- better involvement of local people;
- implementing measures that help reduce non-climate related, human-induced pressures, e.g. from habitat loss or degradation and illegal hunting and trade, and thus overall vulnerability to climate change;
- expanding or shifting protected area boundaries for conservation of forest ecosystems and species at risk from climate change;
- improving habitat connectivity and providing migration corridors and seasonal feeding areas for migratory species;
- integrating carbon sequestration and storage, along with other ecosystem services, into management and finance plans.



### FAO'S SUPPORT

FAO's Wildlife and Protected Area Management Programme has identified the impacts of climate change as a priority area of work. It seeks to strengthen countries' capacities to adapt to climate change through actions that sustain conservation and sustainable management of protected forest ecosystems and wildlife.

To this end, the programme develops materials and publications that show the facts and problems and identify priority measures for action. The findings of such analyses will feed directly into the design of technical assistance projects on the ground.

For more information:  
[www.fao.org/forestry/wildlife](http://www.fao.org/forestry/wildlife)

## Supporting countries to **MANAGE FRAGILE FOREST ECOSYSTEMS**

Some forest ecosystems are particularly vulnerable to climate change:

- mountain forests and watersheds;
- dryland forests;
- coastal forests.

These ecosystems, with their unique features and resources, also have an important role for climate change mitigation on a global scale, as well as providing many other environmental, economical, social and cultural functions. Management measures are often critical to reduce their vulnerability and facilitate their adaptation to climate change.





## Management of mountain forests and watersheds

Mountains are among the regions most affected by climate change. The expected increase in temperature and extreme weather events will amplify hazards in mountains worldwide and change the hydrological cycle, in which mountains play a key role. Melting of glaciers and movement of permafrost to higher altitudes will exacerbate the danger of rockfall, debris and mud flows and the risk of glacial lake outburst floods. Climate change will alter precipitation and runoff patterns. For large parts of the world, this will mean reduced availability of water when it is most needed.

Sound forest management and afforestation of degraded areas reduce erosion, increase slope stability and hence contribute to the provision of essential environmental services such as a regulated water flow and protection against natural hazards. Sustainable mountain development and collaborative and integrated approaches to watershed management are therefore vital for climate change mitigation and adaptation.



### FAO'S SUPPORT

In forest hydrology, watershed management and sustainable mountain development, FAO addresses the needs of governments, technicians and local stakeholders mainly through the following activities.

- Advancing concepts: FAO provides state-of-the-art reports on current issues and contributes to the advancement of concepts and approaches. Findings and recommendations are field tested, which allows continuous improvement.
- Supporting international processes on intersectoral topics: In particular, the topic of forest and water interactions, which is strongly linked to watershed management, sustainable mountain development and adaptation and mitigation of climate change, has gained visibility in international fora.
- Capacity-building, institutional strengthening and demonstration of technical innovations: Field projects, for example in West Africa, Pakistan, Ecuador, Mauritania, Morocco and Tajikistan, target issues such as protection and sound management of highland forests and water resources; adaptation to climate change and enhanced resilience of integrated livelihood systems; and post-emergency rehabilitation of watersheds.

For more information:  
[www.fao.org/forestry/forestsandwater](http://www.fao.org/forestry/forestsandwater)

## Management of dryland forests

Forests in drylands are important in terms of biodiversity conservation, harbouring unique and endemic species that are particularly adapted to extreme ecological conditions. They provide essential ecosystem goods and services for people, livelihoods and well-being. They have the potential, if well valued and sustainably managed, to contribute to climate change adaptation and mitigation, buffer against erosion and desertification, and contribute to economic development, food security and poverty reduction.

Climate change is a huge concern in the drylands, as it is expected to exacerbate degradation caused by human activities. Global warming is expected to cause a decrease in rainfall and an increase in extreme weather conditions such as long periods of drought (with few exceptions), an increase in the frequency and intensity of wildfires and loss of biodiversity. Severe water scarcity and increased desertification are likely, thus causing a vicious circle of forest and land degradation. Climate-related changes are likely to result in species range shifts and altered tree productivity, adding further stress to forest ecosystems and putting at risk the livelihoods of local communities that rely on the forest for their survival.

If the forests in drylands are to continue to play their multifunctional role, forest management needs to take climate scenarios into account. Managers need to plan to build resilience of dryland forest ecosystems. Greater awareness and appropriate policies and investments are needed at the country, regional and global levels to counteract the increasing vulnerability of people, forest ecosystems and species living in drylands.



### FAO'S SUPPORT

FAO develops partnerships and implements field projects for the rehabilitation of degraded lands and for the conservation and sustainable management of arid-zone forests within the framework of climate change. FAO has developed guidelines for improving forest planning and management to enhance the social, cultural, economic and environmental benefits of dryland forests, including climate change mitigation and adaptation. These include *Guidelines for good forestry and range practices in arid and semi-arid zones of the Near East* and *Guidelines on sustainable forest management in drylands of sub-Saharan Africa*.

FAO helps countries achieve the objectives of the United Nations Convention

to Combat Desertification (UNCCD) and promotes consideration of dryland forestry issues in other UN conventions (CBD, UNFCCC).

As Secretariat of the committee on Mediterranean forestry *Silva Mediterranea*, FAO launched a collaborative partnership on Mediterranean forests in 2010, designed to improve the political framework conditions for sustainable management of forests and related ecosystem services in the context of climate change in Mediterranean countries. The first phase will be implemented in six member countries (Algeria, Lebanon, Morocco, Syrian Arab Republic, Tunisia and Turkey).

For more information:

[www.fao.org/forestry/arid](http://www.fao.org/forestry/arid)

[www.fao.org/forestry/silvamed](http://www.fao.org/forestry/silvamed)

## Management of coastal forests

Coastal forests – including mangroves, beach forests, peat swamp forests and lowland moist tropical forests – have a number of important roles:

- environmental: protecting against shoreline erosion and surge-tide damage, providing wildlife refuges, safeguarding water quality, stabilizing land, trapping sediments, providing nutrients to inshore waters;
- social: protecting human settlements, offering aesthetic and recreational values;
- economic: as productive ecosystems, providing income-generating opportunities for the local population; providing nursery grounds for many commercially valuable fish and shellfish species.

The risk of sea-level rise due to climate change, combined with existing threats caused by population pressure such as overexploitation, conversion to other uses (ports, resort development and other infrastructure as well as aquaculture and rice cultivation) and marine pollution, poses a threat for many natural coastal forests.

The management of these forests requires an integrated multidisciplinary approach, defined as integrated coastal area management (ICAM). Their protection and restoration are important to mitigate the impact of climate change, while adaptive management will need to be adopted to secure their existence.

Peatlands are particularly carbon-rich ecosystems, whose forests have much more carbon below the ground than above it. When forests in peatlands are burned, drained or cut, they are a huge source of carbon emissions and a major contributor to climate change.



### FAO'S SUPPORT


FAO supports countries in the rehabilitation, conservation, sustainable use and extension of coastal forests through the following activities:

- field projects in more than 35 countries to strengthen the management of coastal forests in a changing climate, while supporting local livelihoods through inclusive participation and co-management by local communities;
- technical support for the rehabilitation and management of coastal forests in the aftermath of natural disasters, such as tsunamis;
- compiling information on damage caused by natural disasters to coastal forests and their potential role in lessening the impacts of tsunamis and similar events in the future;
- institutional strengthening and capacity building;
- collecting, analysing and disseminating worldwide information on mangroves (e.g. *World atlas of mangroves* [2010], a joint initiative by six organizations; assessment study on the world's mangroves 1980–2005 [2007]; and Web site);
- FAO is one of the founding partners of the Mangroves for the Future initiative, which promotes investment in coastal ecosystem management.

For more information:

[www.fao.org/forestry/icam](http://www.fao.org/forestry/icam)

[www.fao.org/forestry/mangroves](http://www.fao.org/forestry/mangroves)



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