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**Guidelines on** **Sustainable Forest Management under the Impact of Climate Change in Central Asia – Implications for Practitioners**

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**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**Ankara, 2021

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OMO organized the Conference on Climate Change Impact on Forests of Central Asia in Antalya, Turkey, between 3 and 5 August 2021. Individual country reports and the synthesis of the discussions held during the Conference established the basis of the Guidelines.

The Guidelines mainly draw on the output obtained from the Conference. The Guidelines aim at compiling and systematizing relevant and up-to-date information on sustainable forest management (SFM) under the impact of climate change in Central Asia.

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# **Abbreviations and acronyms**

AF Adaptation Fund

ANR Assisted Natural Regeneration

CACs Central Asian Countries

CBDR-RC Common but Differentiated Responsibilities and Respective Capabilities

C&I Criteria and Indicators

CO2 Carbon dioxide

FAO The Food and Agriculture Organization of the United Nations

FFS Farmer Field School

FLR Forest Landscape Restoration

FMU Forest Management Unit

GCF Green Climate Fund

GEF Global Environment Facility

GHG Greenhouse Gas

IFAS International Fund for Saving the Aral Sea

INRM Integrated Natural Resource Management

IPCC Intergovernmental Panel on Climate Change

LDCF Least Developed Countries Fund

MP-FM Multi-purpose Forest Management

NBS Nature-based Solution

NDC Nationally Determined Contribution

NGO Non-governmental Organization

NWFP Non-wood Forest Product

OMO Chamber of Forest Engineers of Turkey

REDD+ Reducing Emissions from Deforestation and Forest Degradation and the Role of Forest Conservation, Sustainable Management of Forest and Enhancement of Forest Carbon Stocks in Developing Countries

SCCF Special Climate Change Fund

SDGs Sustainable Development Goals

SEC FAO Sub-regional Office for Central Asia

SFM Sustainable Forest Management

UNFCCC United Nations Framework Convention on Climate Change

UNFF United Nations Forum on Forests

# **Currency, units and symbols**

ha hectare

ºC degree Celsius

# **Executive summary**

Climate change is one of the most critical challenges of human history, and Central Asia is one of the regions most vulnerable to climate change. Although forests cover only 5.7 percent of Central Asia, they play a crucial role in climate change mitigation and adaptation. However, only sustainably managed or natural forests can fully contribute to this role.

Globally, solutions against climate change were initiated by the United Nations Framework Convention on Climate Change (UNFCCC), which entered into force on 21 March 1994. Additionally, the Paris Agreement, the United Nations Forum on Forests (UNFF), and the 2030 Agenda for Sustainable Development were concluded to support the conservation, restoration, expansion, and sustainable management and use of forests under the impact of climate change.

Regionally, sustainable forest management (SFM) and climate change have been on the environmental agenda of Central Asian Countries (CACs) following the signing of the UNFCCC. As a result, governments have developed national strategies and programs to support global climate change mitigation and adaptation actions to reduce greenhouse gas emissions (GHG) and adapt to climate change. For example, Kazakhstan has developed the "Green Kazakhstan Programme"; Kyrgyzstan has elaborated a new Concept of Improving the Forestry Sector until 2040 and a National Action Plan for the Development of the Forestry Sector until 2023; Tajikistan has developed the Draft Strategy for the Development of Forestry for the period 2016–2030 and approved the National Strategy of Adaptation to Climate Change for the period until 2030; Turkmenistan has put in force the "Climate Change Programme" and "Forestry Programme"; and Uzbekistan has developed the Forestry Concept 2030.

The theoretical part of these Guidelines is intended to serve as a reference to integrate climate change into SFM practices, improve understanding of climate change impacts on forests, revise strategies related to forestry and climate change, and adjust forest management practices to enhance climate change mitigation and adaptation.

The practical part of the Guidelines is centred around four topics:

1. Observed impacts of climate change;
2. Anticipated impacts of climate change;
3. current SFM implementation; and
4. Required actions to strengthen SFM and best practice examples of SFM.

Observed impacts of climate change are decline in water resources; poor regeneration; the low survival rate of native tree species; biodiversity loss; tree cover loss; increased number, frequency and intensity of wildfires, landslides, floods, and extreme weather events; increased pests and diseases attacks; decreased production; and melting glaciers. Anticipated impacts of climate change in addition to those already observed are increased temperature; increased period of drought; increased number and impact of storms and avalanches; changes in tree species distribution; and decline in forest functions and provision of ecosystem services. Current SFM implementation in Central Asia focuses on two primary strategies: increasing forest areas and conserving the existing forests and biodiversity.Increasing forest areas is achieved throughnatural regeneration, afforestation and rehabilitation activities. Conserving the existing forests and biodiversity is ensured by *in situ* and *ex situ* conservation methodologies in Central Asia. Required actions to strengthen SFM and best practice examples are synthesized and categorized under the selected nature-based solutions (NBSs) approaches mentioned below.

To support global and regional efforts, these Guidelines offer selected NBSs for SFM under the impact of climate change. The selected NBSs include:

1. Ecosystem restoration approaches;
2. Issue-specific ecosystem-related approaches;
3. Ecosystem-based management approaches;
4. Ecosystem protection approaches; and
5. Infrastructure-related approaches.
* **Ecosystem restoration approaches**

There is potential to extend forest area and tree coverage in Central Asia through ***afforestation and reforestation activities***. Afforestation, reforestation and avoiding tree cover loss increases the carbon pools held in aboveground and belowground biomass, litter, dead organic matter and soil organic carbon. The success of adaptation measures also depends on ***rehabilitation and reforestation techniques.*** In this sense, ***forest landscape restoration*** aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes. Adaptation measures might include selecting and using drought-tolerant, heat-, salinity- and/or pest-resistant, fast-growing, and income-generating ***native tree species***. This could be ensured by planting good-quality seedlings produced in ***forest tree nurseries***.

* **Issue-specific ecosystem-related approaches**

***Adaptive thinning*** practices help reduce water competition and improve water balance. Forest plots where tree density is reduced could resist drought events. ***The pruning*** of dead tree branches helps create discontinuity between the forest floor and tree crowns and reduces the risk of fire spreading. ***Changes in optimal rotation age***, such as a more extended growth period,could compensate for the reduction in the growth rate due to water constraints and the increased amount of carbon sequestered in tree biomass, forest soil and vegetation. ***Changes in thinning periods,*** the planned number of years between the formation or regeneration of a crop of trees and the time when the same crop is felled for final harvest, and ***close-to-nature forest management*** could also support the adaptation of forests to the impacts of climate change.

***Natural regeneration*** is the process whereby forests are restocked by trees that germinate from seeds falling from nearby standing mother trees. It can also include regeneration from stumps and roots. ***Assisted natural regeneration*** (ANR) can be defined as the process of rehabilitating clear-cut forest lands by taking advantage of trees already growing in the surrounding area.

***Assisted migration of native tree species*** ***and populations*** within species is recognized as a potentially critical response to climate change. Assisted migration includes the managed movement of species to areas where they are not yet present and the introduction of better-suited populations within species.

* **Ecosystem-based management approaches**

***Adaptive forest management*** is a fundamental approach to reducing forest vulnerability and maintaining forest productivity. Adaptation measures might include the selection of heat-tolerant and drought-tolerant species, the use of planting stock from a range of provenances, underplanting using tree varieties adapted to expected climatic conditions, and the assisted natural regeneration of adapted species and varieties. **Integrated natural resource management** involves coordination and cooperation among stakeholders to implement sustainable forest, land, water and biological resource management. The use of forest resources is integrated with the use of other resources that form a specific productive landscape. ***Multi-purpose forest management planning*** (MP-FM) is a common global trend. In addition to producing commercial wood and non-wood forest products (NWFP), MP-FM planning also considers appropriate protections for soil, water, climate, environment, biodiversity and recreational values of forests. It is based on a variety of forest functions, which deliver a broader spectrum of forest-based products for the benefit of rural people through ecosystem services. Forests are a foundation of the ***green economy concept***, sustaining a wide range of sectors and livelihoods. The wood and forestry sectors can significantly contribute to meeting green economy objectives linked to climate change policies, mainly through mitigating GHG emissions and expanding renewable energy objectives. There are three main routes by which the wood and forestry sectors can contribute: the supply of biomass for energy production, the use of wood products in green infrastructure and construction, and the role of forests as carbon sinks.

* **Ecosystem protection approaches**

***Biodiversity conservation*** is essential for climate change adaptation. Forest management practices that conserve and restore biodiversity lead to more resilient forests. Therefore, all forests should be sufficiently biodiverse, considering the differences in natural conditions, biogeographic regions and forest typology. ***Old-growth forests*** must be strictly protected. Old-growth forests store significant carbon stocks and remove carbon from the atmosphere while being of paramount importance for biodiversity and the provision of critical ecosystem services. ***Fire management*** is an essential part of climate change adaptation and mitigation strategies. It includes fuel management, fire occurrence prediction, fire prevention, fire detection, initial attack and suppression, and forest restoration. ***Management of pests and diseases*** and the prevention of their spread will help ensure that forests remain healthy in the face of climate change. Robust ***forest monitoring and reporting systems*** are vital aspects of forest-based responses to climate change to inform the international community on the actual status of forests.

* **Infrastructure-related approaches**

The underdeveloped infrastructure within the forest sector currently hinders the sustainable management, use and protection of forests. It is vital to invest in ***forest road networks*** to support forest management, improve forest protection, temporarily store forest products, ensure the transport of forest products, reduce the risk of forest fires and outbreaks of pests and diseases, and support the transportation of goods and services to remote rural areas adjacent to forests.

# **Introduction**

Climate change is one of the most critical challenges of human history. Changes in climate patterns, the rise of sea level, global temperature and greenhouse gas (GHG) levels in the atmosphere, and loss of continental and sea ice all adversely affect natural ecosystems. They also affect the extent and distribution of forest ecosystems, especially in developing countries such as Central Asian Countries (CACs).

To propose solutions to climate change, countries signed the **United Nations Framework Convention on Climate Change (UNFCCC)** at the Rio Earth Summit in 1992. The UNFCCC entered into force on 21 March 1994, and 197 countries that have ratified the Convention are called Parties to the Convention. These Parties adhere to the ultimate objective of the Convention to stabilize the GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The UNFCCC secretariat supports Parties to promote sustainable management and cooperate in the conservation and enhancement of sinks and reservoirs of all GHG, including biomass, forests and other terrestrial ecosystems.

More recently, Parties to the UNFCCC reached a global agreement to combat climate change and to accelerate and intensify actions and investments needed for a sustainable low carbon future – including formulating long-term low GHG emissions development strategies – and adopted the **Paris Agreement** in 2015 (UNFCCC, 2015). The Paris Agreement entered into force on 4 November 2016, with 191 Parties to the Convention have ratified the Paris Agreement (UNFCCC, 2021a). The Paris Agreement focuses on forests and highlights that Parties should conserve and enhance sinks and reservoirs of GHG, including forests. Furthermore, Parties are encouraged to implement and support – including through results-based payments – the existing framework for policy approaches and positive incentives for reducing emissions from deforestation and forest degradation. They are also encouraged to support the role of forest conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+), and alternative policy approaches, such as joint mitigation and adaptation approaches for the integrated sustainable management of forests. The Paris Agreement introduced Nationally Determined Contributions (NDC) as the implementation tool for the post-2020 period to achieve the Agreement's long-term goals.

The **United Nations Forum on Forests (UNFF)** has developed "The United Nations Strategic Plan for Forests 2030", which provides a global framework for action at all levels to manage all types of forests and trees outside forests sustainably and halt deforestation and forest degradation. At the heart of the Strategic Plan are six Global Forest Goals and 26 associated targets to be achieved by 2030 (UN, 2017).

**The 2030 Agenda for Sustainable Development,** adopted by all United Nations Member States in 2015, introduced seventeen **Sustainable Development Goals (SDGs)**. The SDGs have great relevance for climate change and forests, including:

* Climate action (SDG13) aims to take urgent action to combat climate change and its impacts.
* Life on land (SDG15) aims to ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands; this includes promoting the implementation of sustainable forest management, halting deforestation, restoring degraded forests, and substantially increasing afforestation and reforestation globally.

Forests play a crucial role in meeting national mitigation and adaptation targets to tackle climate change and reduce its adverse effects on developing economies and societies. In the forest sector, adaptation refers to changes in management practices and interventions to decrease the vulnerability of forests and people to climate change. Mitigation strategies in the forest sector can be grouped into four main categories: reducing emissions from deforestation, reducing emissions from forest degradation, enhancing forest carbon sinks, and product substitution (FAO, 2010c). Forests make a unique contribution to the fight against climate change. They can enhance removals of GHG emissions, and GHG emissions can be reduced through improved management of land (IPCC, 2014a). Forests store carbon mainly in vegetation, litter, deadwood and soil in this context. However, only sustainably managed or natural forests can fully contribute to this role, as they can maintain and enhance the provision of goods and ecosystem services, contribute to climate change mitigation and adaptation, and sustain economic, social and environmental values for the benefit of present and future generations.

Central Asia is one of the regions most vulnerable to climate change. Forests are therefore essential for climate change mitigation and adaptation. Forests are located in mountains, valleys and floodplains, and may even grow in some parts of deserts, such as bush-like stands composed of saxaul species. Central Asian forests are unevenly distributed. They cover 5.7 percent of the total land, specifically 1.3 percent of Kazakhstan (FAO, 2021a), 6.9 percent of Kyrgyzstan (FAO, 2021b), 3.1 percent of Tajikistan (FAO, 2021c), 8.8 percent of Turkmenistan (FAO, 2021d), and 8.7 percent of Uzbekistan (FAO, 2021e). Forests and climate change have been on the environmental agenda of CACs following the signing of the UNFCCC.

In this context, **Kazakhstan** has increased efforts towards integrated forest management. The "Green Kazakhstan Programme" under the "Green Economy" aims to extend the green areas around cities and other areas in Kazakhstan, increase forest cover, ensure efficient use of resources and adequate waste management, improve air quality, reduce wind/dust storms, halt land degradation, and avoid salinity and soil erosion to create resilient settlements. Kazakhstan has also amended its legislation and increased penalties for crimes against forests, especially for illegal logging. **Kyrgyzstan** has produced the National Development Strategy of the Kyrgyz Republic for 2018-2040 (the Concept 2040) for all sectors – including forestry sector reforms in line with the SDGs – aiming to increase forest area by 6 percent along with other objectives. The "Concept for the Development of the Forestry Sector" of Kyrgyzstan defines four main priorities for forestry development to achieve this goal. **Tajikistan** has implemented a state program to conserve forests and rehabilitate degraded forests between 2006 and 2015. Additionally, Tajikistan has adopted the National Strategy of Adaptation to Climate Change for 2030 to tackle climate change and produced the Draft Strategy for the Development of Forestry for 2016–2030. **Turkmenistan** has developed the "Climate Change Programme" and "Forestry Programme" and a legislative framework to conserve the environment. **Uzbekistan** has an ongoing process to update forestry legislation and develop the Forestry Concept 2030 to improve water resources, ensure efficient use of water resources, improve sanitary conditions of forests, increase income, and conserve forest ecosystems.

Forestry is a critical sector for mitigation of and adaptation to climate change. The actual number of progressive laws, policies and strategic documents in Central Asia to improve the productivity and sustainability of the forestry sector are high. However, adequate mechanisms to turn legislation and guiding documents into a systematic mainstreaming of climate change mitigation and adaptation actions are still lacking. In this sense, SFM could be a tool to fight against climate change, improve technical capacity, observe the trends in forests under climate change conditions, offer NBSs, introduce best practice examples, and support decision-making and global commitments.

## **Objectives of the guidelines**

The "Guidelines on Sustainable Forest Management under the Impact of Climate Change in Central Asia – Implications for Practitioners" primarily consider the impacts of climate change on forests and support the strengthening of capacities of regional technical networks in the adoption and promotion of NBSs and sustainable natural resource management under climate change.

The Guidelines will support the FAO Member States in Central Asia, providing examples of best practices to support common development objectives for promoting local, cost-effective and proven solutions. Such solutions can be helpful for capacity development in the other FAO Member States. Moreover, the Guidelines will contribute to the improvement of policies towards achieving the SDGs, enhance progress in reaching common development objectives, and strengthen the capacities of government officials in given technical areas and on policy and strategy development.

The Guidelines will be used as a guidance document to support informed and evidence-based policy and strategy development. In this sense, the Guidelines were developed to assist CACs as a baseline document to integrate climate change into SFM practices through SFM principles. The Guidelines will also be helpful to countries willing to improve their understanding of climate change impacts on forests, revise strategies related to forestry and climate change, and adjust forest management practices to enhance climate change mitigation and adaptation. The Guidelines provide general recommendations on SFM by considering the impacts of climate change.

Countries should consider their common but differentiated responsibilities and respective capabilities (CBDR-RC) while planning and implementing SFM practices under the impact of climate change. When using the Guidelines, Central Asian countries are invited to consider gender equality and women's empowerment and the role of local farmers and forest villagers in SFM to tackle climate change. The Guidelines should not be considered a final product; instead, they are dynamic and could be expanded by including SFM practices based on future scientific developments on climate change and increased related capacity and knowledge in Central Asia.

## **Target groups**

The Guidelines aim to facilitate progress in SFM under the impact of climate change in Central Asia to ensure enhanced technical capacity on climate actions in the forestry sector by proposing methods and recommendations for SFM practices under climate change conditions. In this sense, the Guidelines mainly target forest managers and practitioners, natural resource managers, technical staff related to the forestry sector, climate change from different ministries, and other stakeholders from academia, civil society, local government, and the private sector. They aim to provide good quality analytical inputs for SFM under the impact of climate change in Central Asia.

# **Definition of sustainable forest management**

In recent decades, there have been significant changes in societal demands for forest goods and services and the approaches used to manage forests. Management objectives now generally encompass a broad scope of forest goods and ecosystem services. Pressures on forests from other land uses have also increased. Governance has emerged as a critical element for using forest resources efficiently, sustainably and equitably, and for achieving forest-related development goals. The formulation of forest policy has evolved toward a process that necessarily involves a range of stakeholders (FAO, 2018).

The United Nations, in Resolution A/RES/62/98, has described SFM as "a dynamic and evolving concept that aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations" (UN, 2016). This indicates that the significant purpose of SFM is to maintain and ensure forest products and services in perpetuity. The resolution further endorses the seven "thematic elements" of SFM (FAO, 2018):

1. The extent of forest resources;
2. Forest biological diversity;
3. Forest health and vitality;
4. Productive functions of forest resources;
5. Protective functions of forest resources;
6. Socio-economic functions of forests; and
7. Legal, policy and institutional framework.

FAO has further unpacked the concept of SFM in the following:

…the process of planning and implementing practices for the stewardship and use of forests and other wooded lands to meet specific environmental, economic, social and cultural objectives. It deals with the overall administrative, economic, legal, social, technical, and scientific aspects of natural and planted forests. It may involve varying degrees of deliberate human intervention, ranging from actions aimed at safeguarding and maintaining forest ecosystems and their functions to those favouring specific socially or economically valuable species or groups of species for the improved production of forest goods and services… (UN, 2016).

SFM constitutes an overarching approach to forest management, and its implementation requires sound management practices based on good science and traditional knowledge at the national or subnational levels. SFM can be applied in all types of forest, regardless of the objective(s) of management (including production, conservation, protection and multiple uses) (FAO, 2013). SFM is a sound foundation for forest managers' responses to climate change as a standard solution. SFM can help forest managers reduce the risk of damage and possible losses from changing climatic conditions and undertake practical mitigation actions (FAO, 2012). Sustainable management practices can ensure that productive or multi-purpose forests continue to store carbon and maintain their capacity to provide other goods and services for the benefit of current and future generations. However, unsustainably managed forests could only partially contribute to these roles.

# **Sustainable forest management in Central Asia**

Climate change and its impacts on forest resources are already evident throughout Central Asia. There is a growing interest among governments and many of their development partners to better understand the exposure, sensitivities, and impacts of climate change at the landscape level. This understanding can lead to the development and prioritization of mitigation/adaptation measures to build resilience to the potentially adverse consequences and mitigate these consequences.

At the field level, adjustments to forest management plans and practices are required to avoid the impacts of climate change. When adjusting plans and implementing SFM practices, forest managers and practitioners should assess and consider the challenges and the opportunities (FAO, 2013), including forest functions, provision of goods and ecosystem services, and stakeholders. This would balance the forestry objectives with the climate change objectives (FAO, 2018). Forests, when sustainably managed, can have a central role in climate change mitigation and adaptation (FAO, 2010a). Under the uncertain climate change conditions and impacts on the forests of Central Asia, the SFM concept should be implemented to ensure sustainable provision of forest ecosystem goods and services, reduce the vulnerability of forests to climate change, and ensure adaptation of forests to climate change, as well as contribute to climate change mitigation. Moreover, SFM facilitates forests' expansion, regeneration, growth, and functional utility essential to their conservation and sustainable development (FAO, 2010b). It also contributes to food security, poverty alleviation, economic development and sustainable land use in the broader context of sustainable development (FAO, 2010a). In this sense, the practical part of the Guidelines is centred around the following four topics.

## **Observed impacts of climate change on forests**

Signs of climate change are already evident in Central Asia. A decline in **water resources** and increasing **water scarcity** is a common problem affecting forest growth, drought and soil salinity in the future. Native tree species have shown significant **adaptation problems** when faced with changing site conditions. For example, saxaul's natural regeneration and survival rate suffer due to water scarcity and temperature increase, and assisted natural regeneration is necessary for successful regeneration. Dramatic reductions have also been observed in the natural regeneration rate of other species. In addition, protected areas have suffered significant **biodiversity loss** (in terms of endemic species and forest genetic resources), and changes in the visual landscape have been apparent. Moreover, increases in the number, frequency and intensity of **wildfires, soil erosion, landslides, wind** and **floods** have been reported, as well as the spread of **pests and diseases**. In recent decades, **tree cover loss** has accelerated because of the increased number of **extreme weather events**, **illegal harvesting, fuelwood collection** and **unsustainable use of forest resources** for various purposes. Furthermore, reduced quality and quantity of available pastures and overgrazing have added more pressure on forestlands.

Additionally, the following changes have been reported in Central Asia:

* Changes in the **precipitation regime** (lower and more erratic annual rainfall volume and distribution, less snowfall, changes in patterns);
* Increases in **salinization** (for example, following shrinkage of the Aral Sea, 5.5 million ha of new saline land or Aralkum was formed in Uzbekistan);
* Increased food prices due to natural disasters;
* The spread of **invasive species** and associated costs for disaster management;
* Migration to urban areas from rural areas due to low living standards of forest-dependent people and adverse effects of climate change; and
* **Decreases in pistachio, walnut, apricot, fig and pomegranate production** due to frequent dust storms and frost, extended dry spells, forest degradation, **melting glaciers** (including in the Tien Shan and the Mt. Pamir-Alai), and varying growing period.

## **Anticipated impacts of climate change on forests**

According to climate change projections and scenarios of the Intergovernmental Panel on Climate Change (IPCC), the increase of global mean surface temperature by the end of the twenty-first century (2081–2100) relative to 1986–2005 is likely to be 0.3 °C to 4.8 °C (IPCC, 2014b). Warmer temperatures cause trees to use more water and photosynthesize less. Moreover, mountainous forests are expected to shrink and occur at higher elevations. On the other hand, whether the soil at higher elevations will support these ecosystems is unknown. Slow-growing juniper forests are expected to replace some mountainous forests with lower levels of species diversity. Migration and changes in the distribution of native tree species are also expected. However, to some extent, longer growing seasons or greater carbon dioxide concentrations in the atmosphere are expected to increase tree productivity. Higher atmospheric CO2 allows trees to use less water and photosynthesize more. Furthermore, the number and impact of disturbances (such as storms, low humidity), disasters (such as avalanches), and periods of drought are expected to increase in Central Asia. Finally, a decline in forest functions (including nature, soil and water conservation functions) and land-use changes due to increased demand for croplands and grasslands are the other anticipated results of the impact of climate change on forests in Central Asia.

## **Current SFM implementation**

All Central Asia countries are aware of the impacts of climate change on forests, and they are committed to **increasing forest areas** and **conserving the existing forests and biodiversity**. Substantial efforts have been made to restore and increase forest cover as a significant contribution to carbon sequestration. **Plantation** activities have been launched, and **afforestation,** **natural regeneration** and **rehabilitation** are critical in extending forest areas, restoring degraded forests and tackling climate change. In addition, ***in situ*** and ***ex situ*** conservation methodologies play a critical role in conserving the existing forests and biodiversity.

For example, **Kazakhstan** aims to increase forest areas by 5 percent by 2025 by planting two billion seedlings of drought-resistant and economically valuable pine, oak, walnut and linden tree species. In addition, Kazakhstan has established eight particular plantations with fast-growing tree species in the last decade. Additional work is being conducted to save the Aral Sea basin from salinity and improve soil fertility through afforestation activities of saxaul species on 0.25 million ha. The afforestation area in the Aral Sea will be extended to 1 million ha. Moreover, Kazakhstan has established 155 new forest nurseries and modernized existing nurseries to provide high-quality seedlings to achieve the objectives mentioned above. Furthermore, there is an aim to reduce fire, pest and diseases risks by 20 percent in 2025. **Turkmenistan** is conducting afforestation activities with drought-resistant plant species, and established the "Golden Century Lake" in the Karakum Desert to improve the climate conditions and conserve biodiversity. The environmental disaster in the Aral Sea region of **Uzbekistan**, formerly abundant in flora and fauna species, has resulted in a sharp decrease in biological diversity in this area. In this sense, Uzbekistan declared the Aral Sea region an environmental protection area and plans to implement afforestation activities on 0.5 million ha until 2030 to create the green cover zone. In total, afforestation activities have been conducted on 1.5 million ha to support climate change mitigation actions with saxaul (*Haloxylon aphyllum*) and *Tamarix ramissossima*. The most valuable nut species in Uzbekistan is the pistachio. Currently, pistachio plantations cover more than 30 000 ha. In recent years, the area under nuts (pistachios, almonds, walnuts) has increased significantly. In particular, pistachio plantations have been expanded in the country's low- and non-irrigated areas. The pistachio plantations are very resistant to droughts and dry conditions, and pistachio plantations seem to be a possible and probably the only solution for reforestation of the arid foothill zones of the country. **Kyrgyzstan** has planned a 1 000 ha annual plantation programme and expanded existing protected natural areas to 10 percent. **Tajikistan** is implementing 2 000 ha of annual plantation activities to increase the greenhouse gas mitigation potential through participatory forestry sector development. Leasing forest areas to local people ensure the conservation of these areas, improves local livelihoods, and ensures food security. Tajikistan has also developed a new concept for walnut and almond plantations. In addition, Tajikistan has initiated strategic governance to integrate climate change and has developed a database for fast-growing species. Tajikistan has also established protected areas and conducted afforestation activities on 66 000 ha with mostly saxaul and pistachio.

Although some of the above mentioned SFM activities have been initiated, there are still problems related to SFM implementation. The most critical challenges and gaps for SFM are listed below for Central Asia:

* Lack of updated forest inventory;
* Limited participatory forest management approaches (such as adaptive management, integrated management);
* Limited relationship between the forestry agencies and the community and inefficient stakeholder consultation to analyze community needs and implement measures;
* Limited coordination between government, academia, non-governmental organizations (NGOs) and the private sector;
* Increased number and frequency of forest fires, pest and diseases, and biodiversity loss; and
* Increased demand for wood, non-wood forest products (NWFPs) and ecosystem services.

## **Required actions for improved SFM implementation**

Conference discussions focused on local and cost-effective NBSs under climate change to promote sustainable forest management, guide forest practitioners and contribute to rural development. The importance of implementing **SFM practices** and adapting the **green economy concept** to contribute to climate change mitigation and adaptation was stressed. The following practices were proposed for the Central Asia region:

* **Participatory forest management** and **stakeholder consultation**;
* **Adaptive forest management**;
* Developing **SFM criteria and indicators (C&I)**;
* **Biodiversity conservation** (including safeguarding native flora and fauna, protection and enhancing of rare and endangered species, increasing the protected area network, gene conservation);
* Conservation of **old forests**;
* **Use of native species** (ideally fast-growing and income-generating) adapted to local conditions and climate (drought, temperature), and pest- and disease-resistant;
* **Multi-functional forest inventory and forest management planning**;
* **Forest monitoring**;
* **Afforestation, reforestation, rehabilitation and restoration** activities with native species to extend forests and rehabilitate degraded forests;
* Increasing carbon storage capacity by adjusting **silvicultural practices**;
* **Fire management and pest and diseases management**; and
* Implementing **capacity building and awareness-raising events** for different target groups.

# **Best practice examples of nature-based solutions for SFM under climate change**

These Guidelines aim to support forest practitioners in their efforts to scale-up best practices and ensure an increase in the quantity and quality of forest cover in Central Asia under climate change. IUCN defines NBSs as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (International Union for Conservation of Nature, 2021a). In framing NBSs and considering their applications, an umbrella concept covering a whole range of ecosystem-related approaches that address societal challenges is beneficial (International Union for Conservation of Nature, 2021b). These approaches can be placed into five main categories, as presented below.

## **Ecosystem restoration approaches**

### **Afforestation, reforestation, rehabilitation, and restoration**

There is potential to extend forest area and tree coverage in Central Asia through afforestation and reforestation activities (planting, seeding, assisted natural regeneration and natural succession). This concerns urban, peri-urban and rural areas (including urban forests, greenbelts, urban parks, trees on other land-use types, urban gardens and rural plantations), grasslands and agricultural areas (such as abandoned croplands, agroforestry and ecological corridors). Afforestation, reforestation and avoiding tree cover loss increases the carbon pools held in aboveground and belowground biomass, litter and dead organic matter.

The success of adaptation measures also depends on rehabilitation and reforestation techniques. Rehabilitation and reforestation should aim to create more climate-resistant plantations by reducing the risk of forest fires. After deforestation, fires, pests and diseases, lands that are temporarily not covered by forest should be rehabilitated and restored naturally. Rehabilitation and restoration of degraded areas reduce erosion and increase slope stability and resilience to natural hazards and, therefore, contribute to the provision of a regulated water flow (FAO, 2013). A more precautionary approach will facilitate long-distance dispersal needs by restoring scattered forest stands and riparian corridors with native species in extensively converted landscapes. This technique will reduce the dispersal distance required by seeds to reach suitable habitat conditions to grow. The restoration of riparian forests will play multiple outstanding functions, as they will act as corridors in the migration of species and help improve water infiltration, groundwater recharge and the filtration of pollutants. Riparian forests can also reduce the temperature of watercourses, and they can act as barriers that prevent the spread of fire over the landscape.

Forest landscape restoration (FLR) is defined as a process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes. Principles of forest and landscape restoration are listed below:

* + **Focus on landscapes** – FLR takes place within and across entire landscapes, not individual sites.
	+ **Engage stakeholders and support participatory governance.**
	+ **Restore multiple functions for multiple benefits** – FLR interventions aim to restore ecological, social, and economic functions across a landscape.
	+ **Maintain and enhance natural ecosystems within landscapes** – FLR does not lead to the conversion or destruction of natural forests or other ecosystems.
	+ **Tailor restoration to the local context using various approaches** – FLR draws on the latest science, best practices, and traditional and indigenous knowledge.
	+ **Manage adaptively for long-term resilience.**

Planting native trees and increasing other native vegetation cover form the core of silvicultural activities. Considering the scarce water resources, it is best to use drought-resistant and fast-growing species and select deciduous over coniferous species (Sohlo, 2017). Diversifying native tree species with different life strategies (for example, resprouting species, fruit and nut trees that attract seed-dispersal fauna, or nitrogen-fixing trees) at landscape and forest stand levels helps diversify the forest responses to climate stressors and disturbances (Regato *et al.,* 2010). Activities to maintain or increase stand-level forest carbon stocks include reduced impact logging and minimizing the loss of the dead organic matter and soil carbon pools by reducing high-emission activities such as soil erosion and slash burning.

### **Use of native tree species**

Adaptation measures might include selecting and using drought-tolerant, heat-, salinity- and/or pest-resistant, fast-growing, and income-generating native tree species. Other measures to consider include:

* Using stocks from a range of provenances;
* Underplanting with genotypes of species adapted to new climate conditions;
* Incorporating local native tree species with a potential to produce wood and non-wood forest products or sequester carbon under climate change; and
* Increasing the share of broadleaved species in mixed forests, as they might perform better under climate change.

### **Forest nursery**

Sustainable forest management practices, rehabilitation/restoration techniques for degraded forests, and the production of ornamental and fruit tree seedlings all require high-quality planting materials. A forest nursery is a managed site established to produce suitable quality planting materials grown under special conditions and care. Nurseries play a critical role in global efforts to combat climate change, forest degradation, land degradation and desertification, and support forest and landscape restoration programs. Nurseries can also serve as a seed bank and propagation site, provide storage for species, and establish and maintain demonstration plots, seed orchards, stooling beds, and other sources of propagative material. Moreover, nurseries serve as training centers, and educational programmes can be implemented in nurseries, including extension services. Furthermore, nurseries play a crucial role in improving people's livelihoods through employment (Yalvac and Bassullu, 2019).

## **Issue-specific ecosystem-related approaches**

### **Maintenance activities**

Adaptive thinning practices help reduce water competition and improve water balance (Gracia *et al.,* 1996; Kellomäki and Leinonen, 2005). Forest plots where tree density is reduced could resist drought events. Moreover, reducing tree density and dry biomass reduces fire risk, eliminates growth stagnation in coppice forests, and favours better-structured and more mature forest stands that store higher quantities of carbon. The pruning of dead tree branches helps create discontinuity between the forest floor and tree crowns and reduces the risk of fire spreading (Regato, 2007). Changes in optimal rotation age, such as a more extended growth period, could compensate for the reduction in the growth rate due to water constraints and the increase in the amount of carbon sequestered in tree biomass, forest soil and vegetation. Changes in thinning periods, the planned number of years between the formation or regeneration of a crop of trees and the time when the same crop is felled for final harvest (FAO, 2021f), and close-to-nature forest management could also support the adaptation of forests to the impacts of climate change (Kellomäki and Leinonen, 2005).

### **Natural regeneration and assisted natural regeneration**

Natural regeneration is the process by which forests are restocked by trees that develop from seeds falling from the mother trees and germinating *in situ* or sprouting from stumps and roots (Forest Research, 2021). Natural regeneration could create biodiversity corridors to connect natural forest patches and thus facilitate the movement of pollinators, small mammals, migratory birds and other wildlife to feed on and subsequently deposit seeds, further assisting in natural regeneration (Sohlo, 2017). Assisted natural regeneration (ANR) could be defined as the process of rehabilitating clear-cut forest lands by taking advantage of trees already growing in the surrounding area (Department of Environment and Natural Resources, 2021). ANR is a simple, low-cost restoration method that effectively enhances deforested or degraded lands' productivity and ecosystem functions. The method aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural regeneration such as soil degradation, competition with weedy species and recurring disturbances (such as fire, grazing and wood harvesting) (FAO, 2021g). Natural regeneration and assisted natural regeneration can also be supplemented with enrichment planting in cases where there are insufficient natural seedlings. This is more cost-efficient than relying solely on planting and has a higher success rate because the root system is already in place. This supports climate resilience and carbon sequestration, reduces land degradation, and improves above and belowground biodiversity (Sohlo, 2017).

### **Assisted migration of native tree species based on the distribution maps**

Natural forests are unlikely to migrate sufficiently quickly to "follow" climates to which they are well adapted and will have to rely on genetic adaptation or plasticity, at least in the short term. Natural forests could be supported by broadcasting seeds or pollen in areas where current populations are expected to become maladapted under future climatic conditions. On the other hand, trees grown in plantations can be moved by humans, either as seeds or seedlings, to sites where the future climate is expected to match their requirements. Assisted migration of native tree species and populations within species is recognized as a potentially critical response to climate change. Assisted migration includes the managed movement of species to areas where they are not yet present and the introduction of better-suited populations within species. In many species with sizeable genetic variability, moving well-adapted populations is likely a better strategy than moving species. Assisted migration requires moving increased quantities of germplasm (forest reproductive material) across national boundaries for planting with an appropriate monitoring system (FAO, 2015).

## **Ecosystem-based management approaches**

### **Adaptive forest management**

The spatial variation of the impacts of climate change requires the development of regional adaptation measures for mountain, valley and plains forests. Adaptive forest management, supported by national/local monitoring systems, is a fundamental, flexible, reactive and anticipatory approach to reduce forest vulnerability and maintain forest productivity. Adaptation measures might include the selection of heat-tolerant and drought-tolerant species in planted forests, the use of planting stock from a range of provenances, the underplanting of tree varieties adapted to expected climatic conditions, and the assisted natural regeneration of adapted species and varieties (FAO, 2010a, 2013). Management decisions could include:

* Changes in rotation lengths considering the changing precipitation and temperature risk;
* Changes in planting seasons to improve survival rates of seedlings;
* Enhancing natural regeneration through enrichment planting;
* Planting native tree species and varieties to minimize vulnerability to the impacts of climate change; and
* Assessing forests' vulnerability to forest fire, pests and pathogens, and devising strategies for protection (FAO, 2010b).

### **Integrated natural resource management**

Integrated natural resource management (INRM) is the coordination and cooperation among stakeholders to implement sustainable forest, land, water and biological resource management. The use of forest resources is integrated with the use of other resources that form a specific productive landscape. At the same time, resources, interests and goals are integrated based on sustainability principles. INRM improves the condition of watersheds and poor rural people's livelihoods, reduces land degradation and deforestation, improves sustainable climate-smart agriculture, and generates tangible economic benefits. Mechanisms to achieve these objectives include:

* Payments for water regulation, soil conservation, carbon offsets and biodiversity;
* Income generation from sustainable use, management and value-added processing of forest products; and
* Improved natural resource productivity and climate resilience.

### **Multi-purpose forest inventory and forest management plans**

Multi-purpose forest management (MP-FM) planning is a common global trend in SFM and produces broader societal benefits for stakeholders. MP-FM planning includes commercial wood production and NWFP production, climate and environmental protection, and safeguarding of biodiversity and recreational values. It offers a broader spectrum of forest-based products and services for the benefit of rural people, provided these receive due attention in the subsequent implementation process.

Forests provide various goods and ecosystem services to communities. These goods and services which benefit human society are derived from forest functions. Therefore, accurate determination of forest functions is the initial step in comprehensive MP-FM planning. Forest functions play a critical role in setting sustainable forest management objectives and conservation targets and implementing silvicultural activities.

Forest inventory – another critical step of MP-FM planning – covers, through a combination of geographic information systems and fieldwork:

* Land inventory;
* Habitat inventory;
* Biodiversity inventory;
* Growing stock and volume increment inventory by tree species;
* Age class;
* Canopy cover;
* Diameter class;
* Carbon stocks inventory;
* Non-wood forest products inventory (fauna, flora and mineral resources);
* Inventory of ecosystem services;
* Socio-economic status inventory; and
* Health status inventory.

MP-FM plans are long-term management plans covering ten or more years to better meet public needs locally and nationally. MP-FM plans typically include necessary silvicultural activities (such as thinning, natural regeneration, production of NWFPs, etc.) and appropriate forestry practices (such as afforestation, reforestation, restoration, etc.) to be implemented throughout the plans. This information is typically based on a forest inventory in the forest management units (FMU) concerned. Overall, the MP-FM plans aim to ensure the application of SFM. This means that they aim to guarantee the sustainable provision of forest goods and ecosystem services, which supports rural development to improve the livelihoods of the local poor. Therefore, rural populations should be adequately included in the management planning process to ensure their expectations and demands on forest resources are met. Multi-purpose or multi-functional forest management plans include climate change mitigation and adaptation measures, which is a progressive step to sequester carbon from the atmosphere, protect the ecological potential of forests, adapt to climate change, and increase the sustainability of forests. Adaptation measures should consider the impact and consequences of climate change. For example, measures to protect forests from fires or pests have to consider climate change projections. Silvicultural practices could be adjusted to store more carbon in biomass, soil, litter and deadwood. By updating forest inventory, forest management plans and silvicultural practices, forest managers and practitioners could halt the impact of climate change, help society adapt to climate change, retain other values of forests, and ensure that forests continue to deliver goods and ecosystem services.

### **Green economy concept**

Green economy could be defined as the "process of reconfiguring businesses and infrastructure to deliver better returns on natural,

human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste and reducing social disparities" (UNECE and FAO, 2009). Forests are a foundation of the green economy, sustaining a wide range of sectors and livelihoods (UNEP, 2011.) The wood and forestry sectors can significantly contribute to meeting green economy objectives linked to climate change policies, mainly through mitigating greenhouse gas emissions and expanding renewable energy objectives. There are three main routes by which the wood and forestry sectors can contribute: the supply of biomass for energy production, the use of wood products in green infrastructure and construction, and the role of forests as carbon sinks. Wood energy represents the most important source of bioenergy, and increasing the share of wood utilization as a renewable energy source – using wood energy instead of fossil fuels – could reduce greenhouse gas emissions. Increased use of renewable biomaterials in infrastructure and buildings can be seen as a positive contribution to climate change mitigation since their utilization can minimize the use of non-renewable energy. Climate change mitigation objectives have recognized the potential that forests offer as a carbon sink and, therefore, the necessity of preserving and expanding the forests (UNECE and FAO, 2009).

## **Ecosystem protection approaches**

### **Biodiversity conservation**

Biodiversity conservation is essential for climate change adaptation. Forest management practices that conserve and restore biodiversity lead to more resilient forests. Therefore, all forests should be managed to be sufficiently biodiverse, considering the differences in natural conditions, biogeographic regions and forest typology. Forest management practices include choosing more suitable provenances, favouring forest varieties and species adapted to new climatic conditions, undertaking *in situ* and *ex situ* conservation measures (such as protecting functional groups and keystone species or protecting threatened species outside of their habitat), and enhancing biodiversity corridors to help species migrate (FAO, 2010b). Mixed species plantations (for example, using nitrogen-fixing tree species as part of the mix), using a more significant number of clones, avoiding landscape fragmentation, and reduced harvesting operations are all measures that maintain or increase biological diversity and increase the possibility of ecological connectivity between forest patches (Biringer *et al*., 2005; Piotto, 2008; Louman *et al*., 2010). Moreover, management practices that support biodiversity and resilience are essential in this context. In place of monocultural plantations, these include the creation or maintenance at stand and landscape level of genetically and functionally diverse, mixed‐species forests, especially with more broadleaved trees and with species with different biotic and abiotic sensitivities and recovery mechanisms following disturbances. Furthermore, management practices like uneven-aged and continuous-cover forestry, retention of sufficient quantities of deadwood, regulation of wildlife densities, and the establishment of protected habitat patches or set aside areas in production forests help to ensure long-term environmental and socio-economic viability of forests and increase the resilience of forests to adapt to climate change.

### **Conservation of old forests**

Old-growth forests must be strictly protected. Old-growth forests store significant carbon stocks and remove carbon from the atmosphere while being of paramount importance for biodiversity and the provision of critical ecosystem services. There is still a need to map old-growth forests and establish their protection regime, given their exceptionally high and unique biodiversity value.

### **Fire management**

Fire management is an essential part of climate change adaptation and mitigation strategies. It includes fuel management, fire occurrence prediction, fire prevention, fire detection, initial attack and suppression, and forest restoration. Promoting fire-smart forests resistant to fire spread and resilient to its occurrence is integral to fire management. This may be done, for example, by treating fuels in fire-prone vegetation types or by decreasing the importance of those vegetation types in forests (FAO, 2013). Moreover, forest fire protection systems should include analysis of current and future fire regimes, development and implementation of more effective forest fire protection concepts such as adapted species composition, vegetation and forest structure, and development of effective and mobile firefighting systems.

### **Pest and diseases management**

Changes in the distribution of forest pests and diseases pose a threat. The management of pests and diseases and the prevention of their spread will help ensure that forests remain healthy in the face of climate change. The most effective approach is integrated pest management, a combination of ecologically and economically efficient and socially acceptable prevention, observation and suppression measures designed to maintain pest populations at acceptable levels. Prevention measures may include:

* The selection of species and varieties to suit site conditions;
* Using natural regeneration;
* Planting and thinning practices that reduce pest populations;
* Favouring natural enemies;
* Developing biological methods against pests; and
* Monitoring pest populations through visual inspection and trapping systems to determine when control activities are needed (FAO, 2013).

### **Forest health and vitality**

The main threats to health and vitality are pests, diseases, fires and extreme weather events. Removing poorly formed and damaged trees reduces the risk of spreading diseases and pests, although, at the same time, it may reduce diversity and thus increase the susceptibility of forests to diseases and pests. Reducing the risk of damage to forests can be done through silvicultural practices such as shorter rotation cycles; young trees are often more resistant to windthrow, but if thrown, will result in less biomass lost than larger trees. Increasing resilience by maintaining good seed sources and mixed-species forests, including species that readily sprout after windthrow, is another means of reducing damage (FAO, 2012).

### **Forest monitoring**

Improved monitoring of the condition of forests and ecosystem services provides a database to reduce the impacts of climate change and make decisions on forest management under climate change. Robust forest monitoring and reporting systems are vital aspects of forest-based responses to climate change (FAO, 2010d) to inform the international community of the actual status of forests. These systems will provide timely warnings of extreme events and climate change impacts and helpful information on the effectiveness of management responses.

## **Infrastructure-related approaches**

### **Forest road network**

The underdeveloped infrastructure within the forest sector currently hinders the sustainable management, use and protection of forests. It is vital to invest in forest road networks to support forest management, improve forest protection, temporarily store forest products, ensure the transport of forest products, reduce the risk of danger such as forest fires and outbreaks of pests and diseases, and support the transportation of goods and services to remote rural areas adjacent to forests.

# **Other businesses related to SFM**

## **Stakeholder engagement and consultation**

The term "participation" describes a spectrum of levels or forms of people's engagement in decision-making processes. In forestry, participatory processes are designed to enable local people to make decisions in all aspects of forest management. The participatory forest planning process empowers stakeholders through exposure, direct interaction with decision-makers at different levels of government, and timely access to relevant and appropriate information, knowledge and technology. Such participatory processes lead to increased local responsibility for forest resources, improved local rights, increased bargaining power for local actors at the national level, and policy reform processes that are genuinely inclusive and multi-stakeholder in nature. The use of participatory approaches involving stakeholder analysis and gender analysis makes it more likely that all relevant aspects get due consideration and that management options and decisions are better tailored to the needs of local people (FAO, 2021h).

Moreover, the main threat to forests in Central Asia comes from negative anthropogenic pressure on natural resources caused by adverse economic conditions and demographic growth. In these conditions, the involvement of local people and communities in SFM is a critical task. It is necessary to involve all stakeholders; improve intersectoral and interdepartmental interaction; develop mutually beneficial partnerships between the public and private sectors (rent, transfer of economic functions); ensure a balance between environmental, economic, and social aspects of development; and increase forest cover and conservation of biodiversity to solve negative anthropogenic pressure on natural resources. Taking an MP-FM approach creates opportunities for rural people's engagement in conservation and land-use-related activities, the means for them to benefit, and the institutional responsibilities for local-level management. Such engagement may express itself in diverse ways, from, for example, managing and restoring their forest area, being actively involved in the management of forest assets under the legal responsibility of others, and restoring the goods and services of forests in rural areas.

## **Capacity building and awareness-raising**

Capacity development and awareness-raising are crucial activities for SFM implementation. The Farmer Field School (FFS) approach could facilitate capacity development and awareness-raising through training and events which bring all stakeholders together to identify cost-effective practices. The training topics could include management approaches, multi-functional forest inventory, forest management plans, silviculture plans and annual operational plans, silvicultural practices, forest monitoring, conservation practices, technology and financial resources transfer, participation and rural development, and climate change. By building capacity and raising awareness, training will eventually support SFM, health and vitality, and provision of goods and services under the impact of climate change. Europe and Central Asia Forest Communicators Network could be a valuable platform for improving forest management, monitoring and related products, establishing cooperation in forest-related communications, and sharing best practices and tools to implement effective communication campaigns on a regional level (FAO, 2021i). The dialogue builds trust amongst the stakeholders, raises awareness of the critical issues facing Central Asia, and assists in achieving NBSs.

### **Rural development and improved livelihoods**

Rural people in Central Asia depend directly on forest ecosystems and their constituent trees, shrubs, plants and animals for subsistence and income. The forests of Central Asia are a resource base (with resources including wood, firewood, NWFPs and biodiversity) for some of the poorest people, especially in rural areas. Ecosystem services, such as the provision of water and soil fertility, are essential components of livelihoods, while forests can also have important sacred and cultural values. The amount or extent of diversity within forests can be an asset for forest-dependent people since forests provide various resources and livelihood options at different spatial and temporal scales.

The foremost solutions are carrying out forestry activities with forest villagers and establishing a system to improve livelihoods, reduce poverty, reduce vulnerability, improve resilience and stop migration. Systems that combine agriculture, forestry and livestock (such as agroforestry) could support rural development, improve livelihoods and increase resilience – in this sense, meeting the needs of rural communities by providing income, increasing their welfare level, and improving forest-public relations to support sustainable forest management. In this concept, as the implementation tool of SFM, MP-FM plans should focus on rural development and improved livelihoods through developing income-generating activities. The income-generating activities could include:

* Wood production by local communities (both round wood and firewood)
* NWFPs (such as honey, mushrooms, fruits, nuts, medicinal and aromatic plants, hunting)
* Employment in forest nurseries
* Payments for nature conservation forests (such as national parks, archaeological sites, heritage sites)
* Eco-tourism and recreation, including accommodation facilities
* Income-generating local products and certification of local products
* Camping, picnic, cultural tourism, sports fields
* Festivals, fairs, and other events
* Nature walking areas, hiking, tracking, rock climbing areas, mountain biking, horse riding
* Bird watching sites and towers
* Provision of solar power equipment and water heating
* Insulation
* Alternative renewable resources
* Capacity building and awareness-raising events, training camps
* Establishment of cooperatives
* Sustainable and rotational grazing and pasture management
* Introduction of climate-smart agriculture
* Payments for ecosystem services, credits and grants.

## **Empowering the role of women and gender equality**

Men and women often have different roles in managing forests, different knowledge about them, different access to forests, and different ways of using forest resources. Forestry tends to be perceived as male-dominated, although women are heavily involved in forest work such as gathering fuelwood, medicinal plants and other NWFPs, collecting food for family consumption and income, and processing secondary wood products. Women in forest communities can generate more than 50 percent of their income from forests compared to about a third for men. Mainstreaming gender equality at all levels of the forestry sector positively affects many forest management issues, including resource sustainability, forest regeneration and conflict management. Properly integrating gender equality issues in forestry development contributes to meeting environmental targets, avoiding adverse impacts on women, and transforming unequal gender relations within the forestry sector (FAO, 2021j).

## **Technology and financial resources transfer**

Technology transfer in the forest sector provides a significant opportunity to help mitigate climate change and adapt to potential changes in the climate. Apart from reducing GHG emissions or enhancing carbon sinks, technology transfer strategies in the forest sector can provide tangible socio-economic and local and global environmental benefits, contributing to sustainable development. The forest sector includes a wide variety of environmentally sound technologies and practices such as:

* Genetically superior planting material;
* Improved silvicultural practices;
* Sustainable harvest and management practices;
* Protected area management systems;
* The substitution of fossil fuels with bioenergy;
* Incorporation of indigenous knowledge in forest management;
* Efficient processing and use of forest products; and
* Monitoring of the area and vegetation status of forests, particularly under afforestation and reforestation activities (IPCC, 2000).

Climate finance refers to local, national or international financing provided by public, private and alternative sources to support climate change mitigation and adaptation actions. Climate finance is needed for mitigation because large-scale investments are required to reduce emissions significantly. Climate finance is equally essential for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate. To facilitate the provision of climate finance, the UNFCCC established a mechanism to provide financial resources to developing country parties (UNFCCC, 2021b). The Convention states that the operation of the financial mechanism can be entrusted to one or more existing international entities. The Global Environment Facility (GEF) has served as an operating entity of the financial mechanism since the Convention in 1994. At COP 16, in 2010, Parties established the Green Climate Fund (GCF), and in 2011 also designated it as an operating entity of the financial mechanism. In addition to guiding the GEF and the GCF, Parties have established two special funds – the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF), both managed by the GEF – and the Adaptation Fund (AF), established under the Kyoto Protocol in 2001 (UNFCCC, 2021b). Finally, the International Fund for Saving the Aral Sea (IFAS), the oldest regional environmental fund of Central Asia, is a formal high-level entity responsible for the regional Climate Adaptation and Mitigation Program for the Aral Sea Basin (Regional Environmental Centre for Central Asia, 2020; Zoï Environment Network, 2021).

# **Conclusion**

The "Guidelines on Sustainable Forest Management under the Impact of Climate Change in Central Asia – Implications for Practitioners" provide the selected NBSs for SFM under the impact of climate change in Central Asia. The Guidelines are based on the synthesis of the Conference on Climate Change Impact on Forests of Central Asia, in which stakeholders from the invited Central Asian countries described their problems and envisioned solutions. **Local and cost-effective NBSs** listed in the Guidelines are provided to support improved SFM under the impact of climate change. They can only be applied if based on thorough planning and responsible preparation of implementation actions. Forest managers are invited to choose listed NBS approaches by carefully considering local conditions, such as forest types and natural tree species distribution in diverse landscapes in the context of the ecological conditions of Central Asia. Climate change provides forest managers with a significant and potentially formidable challenge. By implementing selected NBSs, forest managers can help slow down the rate of climate change, mitigate GHG emissions, assist society in adapting to climate change, retain the values of forests, and ensure that forests continue to deliver goods and ecosystem services.

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