Building resilience for adaptation to climate change through sustainable forest management

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INTRODUCTION

There are many and varied drivers of deforestation and causes of forest degradation around the world. Among others, these include conversion to other land uses (mainly agriculture), overharvesting of wood and non-wood forest products, poor timber harvesting practices, overgrazing, pest and disease outbreaks, invasive species and wild fires. Underlying drivers vary from place to place, including government policies that drive land-use changes, market forces altering demand for forest products, poverty and food insecurity, unclear or insecure land or resource tenure, among others. Climate change, and in some cases climate change responses, are adding to the existing stresses on forests.

The risks that climate change and variability pose to forests and trees are well recognized. Negative impacts are apparent in many places. Although it is often difficult to separate climate change from other stresses, evidence shows that in various places climate change is contributing to decreased productivity and dieback of trees from drought and temperature stress, increased wind and water erosion, increased storm damage, increased frequency of forest fires, pest and disease outbreaks, landslides and avalanches, changes in ranges of forest plants and animals, innundation and flood damage, saltwater intrusion and sea level rise, and damage from coastal storms.

Climate change and cliamate variability are threatening the delivery of a range of crucial goods (wood and non-wood) and environmental services from forests on which an estimated 1.6 billion people fully or partly depend. Forests' and trees' roles are varied, including, among other things, delivering clean and reliable water supply, protecting against landslides, erosion and land degradation, providing or enhancing the habitat of aquatic and terrestrial animals, providing a range of products for household use or sale, and providing employment. Given that forest resources directly contribute to more than 1 billion of the 1.2 billion people living in extreme poverty (World Bank, 2002), climate change impacts on forests can be expected to hit the poorest the hardest, thus making already vulnerable people even more so. Successfully addressing the negative impacts of climate change on forests and forest dependent people will be crucial to making progress towards sustainable development goals.

WHAT CONSTITUTES ACTIONS TO BUILD RESILIENCE IN THE FOREST SECTOR

The word "resilience" is used here to encompass the following attributes of a system: the ability **to cope** with stress (also called "resistance"), the capacity **to recover** from the effects of disturbance and the capability **to adapt** to stress and change.[1]

Building resilience in the context of the forestry sector includes adjusting forest management to build resilience of forests and trees to the negative impacts of climate change, to increase the resilience of vulnerable people and to help build and maintain resilient landscapes.

Building resilience in the forest sector also requires efforts to ensure that adequate technical knowledge and expertise, an enabling policy and legal framework, responsive and effective institutions and governance mechanisms that can support timely, appropriate and equitable decision-making and action at local level are all in place.

THE ROLE OF SUSTAINABLE FOREST MANAGEMENT IN BUILDING CLIMATE CHANGE RESILIENCE

Sustainable forest management (SFM) is an overarching goal for the forestry sector, applicable at international, national and subnational levels. The concept of SFM recognizes that forests have important economic, environmental, social and cultural values and that the appropriate balance of these should be sought in each country, reflecting the countries' particular goals, needs and circumstances.

The most widely intergovernmentally agreed language on SFM was agreed and included in a resolution of the UN General Assembly[2] in December 2007 and reads as follows:

> *"Sustainable forest management as a dynamic and evolving concept aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations."*

The resolution further specifies that countries should develop or update and implement national forest programmes (NFPs) and other strategies for sustainable forest management. Furthermore, it lists seven thematic elements of SFM: (i) extent of forest resources; (ii) forest biological diversity; (iii) forest health and vitality; (iv) productive functions of forest resources; (v) protective functions of forest resources; (vi) socio-economic functions of forests; and (vii) legal, policy and institutional framework.

These specifications are important because the thematic elements define the scope of SFM, and the endorsement of NFPs identifies a credible approach for defining what constitutes SFM in a country and what is needed to achieve it. The principles of NFP processes are as follows: national sovereignty and country leadership; consistency within and integration beyond the forest sector; and participation and partnership. A country's NFP process helps it define its goals for SFM and policies to achieve it, using a

[1] This is consistent with the definition given by the Second Assessment Report of the Intergovernmental Panel on Climate Change, which speaks of the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

[2] See UN Resolution 62/98 on establishing a non-legally binding instrument on all types of forests: http://daccessdds.un.org/doc/UNDOC/GEN/N07/469/65/PDF/N0746965.pdf?OpenElement

participatory approach involving all stakeholders. As needs and conditions in the country evolve (including those driven by climate change), the NFP can be used to adapt the forest policy framework accordingly. In short, the NFP process is conducive to responsive and adaptive policy development and implementation, taking into consideration risks and impacts of climate change on forests and forest dependent people.

Since the concept of SFM was reflected in the Forest Principles adopted at the Earth Summit in Rio in 1992, it has been made operational through regional and international criteria and indicator processes for SFM, actions agreed by the United Nations Forum on Forests (UNFF) and its predecessors,[3] and various regional policy processes on forests (e.g. the Central Africa Forests Commission – COMIFAC, and an effort currently under way to develop a legally binding agreement on forests in Europe), among others. A wide range of technical materials and best practice guidance have been developed to support the implementation of sustainable forest management on the ground. Forest certification systems for production forests have been developed and the area of forests certified to be under sustainable management continues to grow. Many countries are engaged in forest law enforcement and governance processes that support and provide incentives for SFM through trade measures. Overall, various indicators of sustainable forest management show that progress is being made in tropical countries and at global scale (FAO, 2010; ITTO, 2011). In short, SFM represents a broad goal for the forest sector, the achievement of which is facilitated on the ground by the application of best practices for the sustainable management of forests.

It was with this definition of SFM and with the supporting approaches, partnerships and tools in mind that the 14 members of the Collaborative Partnership on Forests (CPF) recognized that "sustainable forest management provides an effective framework for forest-based climate change mitigation and adaptation" (CPF, 2008). This includes building resilience to climate change and climate variability.

BUILDING RESILIENCE OF FORESTS AND TREES TO CHANGING CLIMATE THROUGH FOREST MANAGEMENT

Management measures

Some key strategies for increasing resilience of forests and trees to climate change through management of forests include the following:

- maintaining healthy forest ecosystems for resilience;
- restoring degraded forests;
- conserving, enhancing and using biodiversity.

These strategies can help both to enable autonomous adaptation, whereby ecosystem adjustments are made spontaneously, and facilitate planned adaptation, which requires human intervention.

Maintaining healthy forest ecosystems for resilience

Maintaining forest ecosytems in a healthy state is the most straight-forward action to retain their resilience. Healthy forests are better able to cope with stress, recover from damage

[3] Intergovernmental Panel on Forests and Intergovernmental Forum on Forests.

and adapt autonomously to change. Healthy ecosystems are more resilient to negative biotic and abiotic influences than are ecosystems under stress whose ecological processes are impaired. Enacting policies that create positive incentives, removing perverse incentives that act as barriers to sound forest and tree management and employing best practices in forest management will help maintain forests in a healthy state. Best practices include integrated pest management, disease control, forest fire management, employment of reduced impact logging (RIL) in production forests, limitation of gathering of non-wood forest products or livestock grazing in forests at sustainable levels, and forest law enforcement.

Removing constraints to implementing sound forest management may include dealing with financial constraints: too high absolute or up-front costs. It could mean improving monitoring systems to know where good practice is not being employed and why. There may be perverse incentives working against good forest management, or a lack of technical knowledge. The current spotlight cast on forests and on drivers of deforestation and forest degradation in conjunction with REDD+ (reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks) discussions under way in the United Nations Framework Convention on Climate Change (UNFCCC) can be expected to lead to a better understanding of the drivers of deforestation and forest degradation. Climate financing for adaptation and mitigation, through early action for REDD+ and also through the Green Climate Fund, could be expected to be helpful to countries'efforts to address the drivers of deforestation and forest degradation.

Concerning the constraints related to technical expertise, technical guidelines developed to support SFM, including some directly focused on climate change, could be helpful. Two organizations that have been particularly active in producing guidance documents are the Food and Agriculture Organization of the United Nations (FAO) and the International Tropical Timber Organization (ITTO). Among others, guidelines have been developed on codes of practice for forest harvesting, fire management, management of planted forests and sustainable management of dryland forests by FAO,[4] and on sustainable management of natural tropical forest, restoration, management and rehabilitation of degraded and secondary tropical forests, conservation and sustainable use of biodiversity in tropical timber production forests (with the International Union for Conservation of Nature – IUCN), fire management in tropical forests, management of planted tropical forests by ITTO.[5] FAO is working on guidance documents for forests and climate change, including integrating climate change into NFPs (FAO, 2011a), climate change for forest managers (FAO, in preparation [a]), and guidelines for building landscapes resilient to global changes in drylands (FAO, in preparation [b]). The recently released *Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security* are also directly relevant (FAO, 2012b).

[4] See: http://www.fao.org/forestry/en/
[5] See: http://www.itto.int/policypapers_guidelines/

Restoring degraded forests

Restoring degraded forests to healthy states, thereby re-establishing ecosystem functions, is a major strategy for increasing resilience. An estimated two billion hectares of land have the potential to be restored or reforested.6 Restoring the vast areas of degraded lands around the world would go a long way towards increasing the resilience of the world's forests. The Bonn Challenge, agreed at a ministerial conference held in Bonn in September 2011, calls for the restoration of 150 million hectares of lost forests or degraded lands by 2020.7 Undertaking restoration at an appropriate scale is essential. A case is made later in the paper for working at the landscape level. Landscape restoration covers a wide range of conservation, management and active restoration practices that strengthen the resilience, increase the quality and diversity of land resources, and provide additional socio-economic and environmental benefits in large territorial units, such as in watersheds.

Conserving, enhancing and using biodiversity

Biodiversity is a key factor underlying the resilience of forest ecosystems and trees to existing stresses and is a basic ingredient for building their adaptive capacity in the face of future stresses. Conserving, enhancing and using biodiversity in the landscape are important for resilience. Resilience to changing environmental conditions is influenced by the diversity of species, of genetic variability and, at the larger geographic scale, of forest communities and ecosystems . Thompson *et al.* (2009) highlight some actions that may be taken to maintain or increase resilience in forests through management and use of biodiversity, including the following:

- maintain genetic diversity in forest by avoiding [intensive] selection for harvesting of only certain trees based on site, growth, rate or form;
- maintain stand and landscape structural complexity;
- maintain conductivity across the landscape by reducing fragmentation, recovering lost habitats (forest types), expanding protected area network and establishing ecological corridors;
- maintain functional diversity and eliminate the conservation of diverse natural forests to monotypic or reduced-species plantations;
- control invasive species and reduce reliance on non-native species for afforestation and reforestation;
- manage plantation and semi-natural forests – in a way that recognizes and plans for predicted future climate (e.g. assisted natural regeneration using provences from areas with climates approximating anticipated future climate);
- maintain biodiversity at all scales (stand, landscape, bioregional) and all elements (genes, species and communities) – and particularly populations that represent pre-adapted gene pools for responding to climate change.

Table 1 provides examples of forest management measures consistent with those mentioned above to increase forest resilience. A more complete set of management options

[6] See: *A world of opportunity for forest restoration* http://pdf.wri.org/world_of_opportunity_brochure_2011-09.pdf
[7] See: http://www.ideastransformlandscapes.org/

Table 1: Examples of measures to increase forest resilience to various impacts of climate change

Risks/impacts	Implications (social, economic, environmental)	Response measures for risk reduction and increased resilience
Decreased forest vitality and productivity	Reduced revenue from wood and non-wood forest products; reduced forest ecosystem services	Adjust silvicultural practices, change composition of species and varieties; increase forest biodiversity; implement forest restoration measures
Increased forest pests and diseases	Reduced forest revenue; reduced forest ecosystem services	Implement and Intensify pest and disease management measures; adjust silvicultural practices
Increased wildfires	Loss of life; damage to infrastructure; reduced forest revenue and ecosystem services; wildlife losses	Implement and Intensify wildfire management; adjust silvicultural practices
Increased water erosion and landslides	Damage to forest and to infrastructure (towns, roads, dams); reduced water quality	Undertake watershed management measures (including protecting and increasing vegetation cover; reducing intensities of harvesting and other uses)
Drought-induced forest/ tree dieback and land degradation	Reduced availability of forest products; increased wind damage; reduced grazing values	Plant windbreaks; maintain tree cover; change composition of species and varieties
Increased storm damage	Reduced forest revenue and ecosystem services; increased risk of pests and disease	Change species and adjust tree spacing to reduce risk; salvage harvesting; pest/disease control
Reduced extent and vitality of mangroves and coastal forests	Increased exposure of land to storm damage; reduced productivity of coastal fisheries	Increase protection, restoration and enhancement of mangroves and other coastal forests
Changes in species ranges and species extinctions	Reduced forest ecosystem functions; loss of forest biodiversity	Restore/increase forest connectivity and wildlife corridors; assist migration; take ex-situ conservation actions

will be available in the upcoming publication, expected to be published in 2013, entitled *Climate change guidelines for forest managers* (FAO, in preparation [a]).

Dealing with uncertainty

While broad regional and national patterns of climate change can be predicted with some certainty using climate models, making accurate predictions of the dimensions and character of changes at local level is problematic. The uncertainties associated with projections of climate change at local level, coupled with uncertainties about how impacts will reverberate in complex natural systems, make it difficult for resource managers to decide which adaptation actions would be most appropriate and cost effective to take. The fact that managers generally manage forest resources on medium- to long-term time cycles, in which their ability to make rapid changes is constrained, adds to the challenge. Measures that respond to expected trends in climate and that are consistent with sustainable forest management practices, represent "no regrets" options (Seppälä, Buck and Katila, 2009). These are the logical starting point. Actions, for example, to reduce the risk and control against wildfires and pest outbreaks, where they exist, would convey benefits in any event, even if increased risks of climate change do not materialize.

Implementing best practices for forest management and implementing "no regrets" options that will help forests cope with change and recover from disturbance will not be sufficient, however. Forest managers will need to take additional measures to increase the

adaptive capacity of forests. Adaptive management is particularly relevant In environments where the future is uncertain (Robledo and Forner, 2005). Adaptive management involves a systematic process for continually adjusting and improving management practices by monitoring, analysing and learning from the outcomes (Seppälä, Buck and Katila, 2009). This process of observation, analysis, planning, implementing, monitoring and taking corrective action for further improvement is in itself a valuable adaptation tactic, particularly where the speed, direction and impacts of climate change are difficult to predict. Setting up systems for forest management conducive to adaptive management can help keep improvements in resilience in step with climate changes.

CONFERING LIVELIHOOD RESILIENCE THROUGH SUSTAINABLE FOREST MANAGEMENT

Change, whether as a result of extreme events or more gradual change, is inherent in the human condition. People survive by adapting. Understanding traditional coping strategies and adaptation measures, and the role that social capital and local institutions play in facilitating adaptation, will help to formulate effective strategies for adaptation to climate change, climate variability and climate-induced extreme events.

Forests and trees play important roles in livelihood resilience in the face of climate change, including:

- as safety nets in times of emergency;
- as sources of products important for production and income diversification for farm household and rural families;
- as sources of employment (particularly important where farming and other rural livelihoods are no longer viable).

The importance of forests as safety nets in time of natural disasters (e.g. floods and droughts) or civil unrest is well documented (e.g. Angelsen and Wunder, 2003). During these times, forests are often relied upon to provide food for the household or products to sell for survival. They also fill gaps in other times of difficulty. While heightened dependence on forest foods and products generally drops off when times return to normal, it is important to keep the safety net option open (i.e. not restricting access of vulnerable people to forests when needed for survival), particularly where relief services and social services are not adequately developed to meet emergency needs.

Production and income diversification is a key strategy to spread risk and to help vulnerable rural people cope with environmental disruptions and economic downturns or shocks. This is a strategy widely seen in small farmer production systems with diverse crops, livestock and trees. In many places, the farmers' motivation for integrating trees into the farming system through agroforestry practices is income generation and diversification.

Small- and medium-sized forest enterprises have critical roles in local economies and helping alleviate poverty. Small- and medium-sized forest enterprises are estimated to make up more than 90 percent of forest enterprises and provide more than half of the forest sector employment in most countries (IIED, 2012). Together, they employ an estimated 20 million, a number that might be as high as 100 million if the informal sector, mainly in developing countries, were accounted for. A study on adaptive capacity and livelihood

resilience in South Asia highlighted income diversification as a major coping strategy in response to flooding and drought; in several places farm households became increasingly involved in non-farm work, including woodworking and furniture making (Moench and Dixit, 2004).

The development of varied and effective coping mechanisms is prominent among people living in environments that are commonly subject to environmental stress. Arid zones provide a good illustration of this point. People living in arid zones have developed successful strategies to withstand drought and other climate and economic impacts. This adaptative knowledge and the skills of dryland peoples are key tools to cope with climate change. A wealth of examples are provided in the publications *Guidelines for building landscapes resilieint to global changes in drylands* (FAO, in preparation [b]) and *Highlands and drylands. Mountains, a source of resilience in arid regions* (FAO, 2011b).

Recognizing these coping strategies, providing policy support and incentives, and encouraging social networks and local governance structures that facilitate their perpetuation and further development are crucial for enhancing vulnerable people's resilience to climate change.

BUILDING RESILIENCE AT LANDSCAPE LEVEL

Landscapes include the physical and biological features of an area as well as the institutions and people who influence it. The interconnectiveness of these factors underlines the value of working across sectors and addresses environmental, social and economic issues in an integrated way. The landscape is a useful unit on which to work in an integrated manner.

In most areas, forests and trees are embedded within a broader landscape influenced by a range of biophysical, social and institutional forces. Working at the landscape level is conducive to building resilience of land-use systems, natural resources and people's livelihoods in a cohesive way and supported by effective institutional and governance mechanisms. Managing forests within the context of a landscape approach is more likely to optimize their contributions to the stability and vitality of ecosystems and their ability to support societal needs in a sustainable manner. Understanding the dynamics between the different elements (biophysical, social, economic and institutional) and engaging local stakeholders in decisions will help in the development of strategies and actions to increase resilience.

Two examples of integrated approaches for managing forests and trees within a wider landscape context are provided below (taken from FAO, 2012a):

- Watershed management has been successfully used to restore and maintain the agro-ecological viability and production potential of various watersheds throughout the world, using land-use management techniques that integrate across sectors and also address socio-economic concerns of local populations. Decades of strong technical support and lessons learned in the process have led to increased awareness by decision-makers of the importance of supporting integrated watershed management programmes and projects that engage local stakeholders in participatory planning and management (FAO, 2006). Watershed management is also increasingly recognized as an appropriate approach in disaster risk management, particularly related to landslides, avalanches and floods.

- Fire management has recently undergone a transition away from a sector approach to a broader landscape approach, in which agriculture, forestry and rangeland concerns are considered simultaneously in order to better identify the causes and ultimately prevent destructive vegetative fires that often cross the boundaries of different land-use systems. An integrated approach of fire management supports building higher resilience and adaptive capacity of communities and ecosystems to the effects of vegetation fires.

Landscape approaches are also quite well developed in arid zones – such as the "gestion de terroirs" approach in West Africa, dating to the early 1990s, in which natural resource management at the village or community level links technical interventions, socio-economic factors and the legal and administrative functions. Sustainable land management for soil and water conservation is increasingly being planned and managed with the scale and principles of the landscape approach in mind. Sustainable mountain development and integrated coastal zone management are other examples of the landscape approach in action.

Political support for and the importance of cross-sectoral approaches at the landscape level is growing. Institutions, networks and partnerships have emerged in recent years aiming to improve rural livelihoods, land-use planning and management by adopting integrated approaches to land use. Examples include (FAO, 2012a):

- The Global Partnership on Forest and Landscape Restoration (GPFLR),[8] that aims to catalyse support for the restoration of forests and degraded lands to ensure that forests, trees and the functions that they provide are effectively restored, conserved and employed to help secure sustainable livelihoods and ecological integrity for the future.
- The International Model Forest Network (IMFN),[9] which supports the establishment of Model Forests, based on an approach that combines the social, cultural and economic needs of local communities with the long-term sustainability of large landscapes in which forests are an important component. By design they are voluntary, broad-based initiatives linking forestry, research, agriculture, mining, recreation, and other values and interests within a given landscape.
- The Landscapes for People, Food and Nature Initiative,[10] a collaborative three-year process of research, discussion, knowledge-sharing and advocacy that aims to develop action agendas for policy, investment, capacity building and research and to support their implementation through action and advocacy within UN conventions and key regional platforms.

In summary, adopting the landscape approach for planning and implementing climate change adaptation measures is a valid way forward. There is a body of knowledge, tools and partnerships that can be drawn upon to facilitate this.

[8] http://www.ideastransformlandscapes.org/
[9] http://www.imfn.net
[10] http://www.landscapes.ecoagriculture.org/

BUILDING FOREST-RELATED INSTITUTIONS AND GOVERNANCE MECHANISMS TO SUPPORT RESILIENCE

National institutions, policies and laws need to support actions to build resilience in the forestry sector at local level. Once an understanding is reached of the needs related to building resilience (of forests, trees and people), the institutional framework for forests and related sectors should be reviewed to see where adjustments are needed for the support of efforts to build resilience (FAO, 2011a).

In order to support landscape restoration, cross-sectoral coordination is essential. Agencies often work in relative isolation, and even at cross-purposes. This is at least partially due to the institutional structure and the lack of capacity of these institutions to cooperate closely in land-use planning and management (FAO, 2012a). There is a need – and real scope – for institutions dealing with ecosystem and land-use issues to integrate the management of natural resources (in particular forests, trees, soil and water) through improved, multisectoral land use.

The real action in building resilience, however, is on the ground. Building or reinforcing local governance mechanisms that engage local stakeholders is essential. These must exist to support appropriate and timely decision-making and action to develop and sustain resilient forest systems. They can provide the flexibility and responsiveness to react quickly and effectively to respond to climate change. Lessons from experience over the past decades have shown that forests can be well managed and degradation can be reversed by involving local communities, supported by legitimate decentralized institutional arrangements developed through consultative processes (FAO, in preparation [a]). There are many examples of farm foresters' producer groups (FAO and AgriCord, 2012) and community forestry groups (e.g. Nepal's Community Forest User Groups).

Social networks are also important components of local governance that can help provide for effective responses to climate change. Traditional forms of reciprocal and mutual work (e.g. in soil and water conservation work, in labour in shifting cultivation systems) have been partially or totally abandoned in many areas owing to social and economic changes (FAO, in preparation [a]). Encouraging the perpetuation or reactivation of these where appropriate for restoration work may be beneficial. Encouraging informal social networks for sharing information and experience on forests and trees may also help to build social resilience to climate change.

CONCLUSIONS

Building climate change resilience around forests and trees entails a suite of actions. These include adapting the conservation, management and use of forests to reduce risk and confer resilience on forests and trees and on people vulnerable to the negative impacts of climate change. It requires building national and particularly local institutions that can support participatory and responsive decision making processes leading to equitable outcomes. Sustainable forest management provides a sound conceptual framework for building resilience. There is a body of knowledge and expertise, a number of well-tested approaches for integrated and landscape level planning and management, and a wide variety of tools available to assist with this work.

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