

# FOREST

Resources and natural environment



## FOREST AND WATER

### An integrated management crucial to cope with global changes in the Mediterranean region

Forests use water. And forests provide water. This relationship between forests and water provokes debate among scientists, land managers, and policy makers. The stakes are particularly high in the Mediterranean region already facing water shortages (especially in its southern and eastern part) or disasters related to flooding. The demographic and climate projections only increase these issues and stress the importance of taking into account the water-related ecosystem services from forests and integrating the management of both resources. This note builds on the conclusions of the “Forests and Water” session organized during the IVth Mediterranean forest week in Barcelona. This session was designed as a cross-sectoral dialogue on the water-related ecosystem services from forests, and tackled the importance of developing the science-policy, provider-consumer, and policy-people interfaces. The integrated management of water and forest is necessary for sustainable development in the Mediterranean region.

#### Forest and Water: An undeniable link

Mediterranean forests generate a wide range of ecological services related to water, soil, and health protection and maintenance. They play a crucial role in the hydrological cycle both at global and local levels. In this region, mountains are numerous and work as “Water Tank”, forests are generally located on the upstream parts of the watersheds, they therefore regulate hydrological flows and water quality, intercept and store rainfall and moisture, supply water (surface

drainage and infiltration to groundwater), regulate river flow, hinder water and wind-induced erosion, and reduce soil loss and sedimentation (Albergel *et al.*, 2011). In managed forests, these ecosystem services depend on adequate forest management.

#### Forest and water resources under climate change pressure

As per the 5<sup>th</sup> IPCC assessment report, the Mediterranean basin is a climate change hotspot, where temperature is expected to rise by an average of 2°C to 4°C, and rainfall drops by 4% to 30%. According to a trend scenario that sees a continuation in the use efficiency of the existing

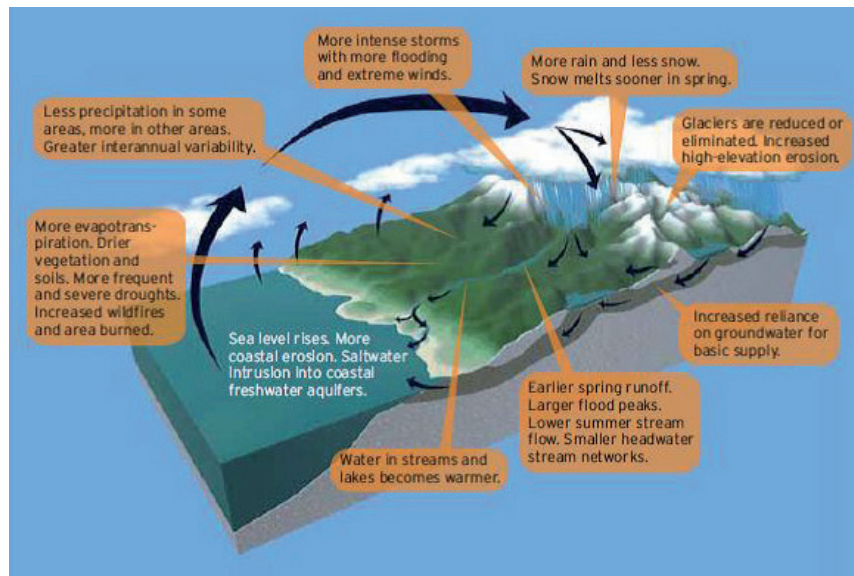
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Figure 1: Examples of potential direct and indirect effects of climate change on the hydrologic cycle



Source: Furniss et al., 2010

water (losses, waste, irrigation techniques) by 2050, water withdrawals could double or even triple in the Southern and Eastern basins (Milano, 2012). Effects of climate change will disturb the relationships between forests and water; moderate reductions in precipitation might have dramatic effects in the water flows generated by forested basins. Climate change can also have indirect effects on water resources, such as increased extent and severity of wildfire and forest mortality as this can also increase the erosion risk.

### Forest and water resources under anthropogenic pressure

The Mediterranean region is approaching 500 million inhabitants. The northern rim of the Mediterranean basin experiences a natural plant re-colonization due to rural areas abandonment and society urbanization. In contrast, the eastern and southern rims are characterized by a high pressure from human populations on forest and woodland ecosystems leading to overexploitation, overgrazing and biological degradation. Such a situation is explained by a high population growth, low income per capita and a marked rural population density. In addition, most countries on the southern and eastern shores of the Mediterranean are in "water stress" with less than 1000 m<sup>3</sup>/capita/year. These changes in the landscape have far reaching consequences for water availability and quality.

The already vulnerable water resources are under increased pressures. Despite the increase of reliance on alternative sources, forest catchments supply a large proportion of water used for domestic, agricultural, industrial and ecological needs. There might soon be a situation where decisions need to be taken in the allocation of water resources.

### An urgent need for integrated management

Even if forests are well known for playing an important role in the production of water, in terms of quality, quantity and seasonality, water and forest policies remain quite disconnected. In the Mediterranean region, where water is the main limiting

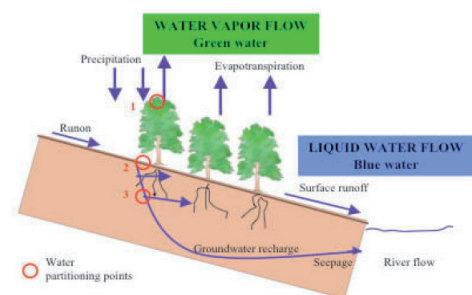
factor, decisions on improving water and forest resources management have to be taken. This can be done through the improvement of three types of interactions among players: science-policy, provider-consumer, and policy-people.

## Science-policy interface: forest impact on water resources

### Blue vs. green water

The evaporation and transpiration constitute the green water while surface runoff and deep percolation form blue water (Biro et al., 2011). This concept can be explained in terms of use as follow: the direct use of blue water is related to the intake of water for food production in irrigated agriculture, industrial production, domestic and local communities use. The indirect use of blue water is related to the supply of goods and services by wetlands and freshwater aquatic ecosystems. The direct use of green water ensures directly consumable goods and services (e.g. food, fiber, wood), which are provided by rainfed agriculture and livestock, forests and other ecosystems. Finally, the indirect use of green water is linked to ecosystem goods and services provided by wetlands, grasslands, forests, which the society benefits indirectly.

Figure 2: The hydrological cycle: Blue vs. Green water



Source: Falkenmark et al., 2005

### Gaps in research findings

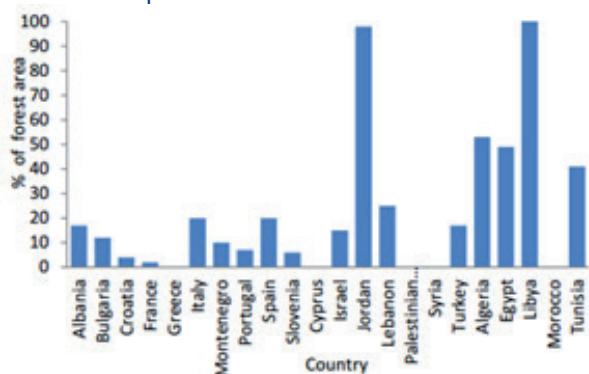
Despite a substantive volume of scientific knowledge on the interactions between forest and water, some difficulties persist. For example, forests are believed to improve water quality, but this is only true under certain circumstances. There are examples where non-conservative forestry activities have led to a decline in water quality. Moreover, there is still no scientific consensus on how forests influence water quantity: some valuation studies consider that forests provide positive benefits related to water quantity (e.g. Mavsar and Riera, 2007), while some other estimate negative values (e.g. Merlo and Croitoru, 2005). The effects of forests on large catchments are especially difficult to assess. It is necessary to have a better and shared understanding of the interactions between forests and water, be there synergies or trade-offs, in order to be able to develop the necessary institutional arrangements and for embedding the research findings into policy agendas (FAO, 2013).

### Provider-consumer interface: what value to give water-related forest services

#### Economic valuation methods

Recognizing the role forests play in soil and water protection, "protective forests" have been designated worldwide to prevent soil erosion and preserve water resources (FAO, 2010; Forest Europe et al., 2011). According to official data, in the Mediterranean, "protective forests" represent about 80 million ha.

Figure 3: Percentage of forest area formally designated for soil and water protection in Mediterranean countries in 2010



Source: adapted from FAO, 2010

In order to integrate forest and water management, it is essential to know the economic value of water-related forest services. The watersheds protection services value can be estimated in terms of:

- replacement (avoided) costs: the reduced cost to society where forests regulate runoff hence lowering flood risks and the need for flood prevention.
- willingness to pay: the extent to which individuals are willing to pay for marginal increases in security of supply or improved supply of services such as soil protection and water quality.

#### "Protective forest" value

In countries such as Syria, watershed protection is the most valuable benefit of forests while in the Maghreb countries, it is only second in value after grazing (Croitoru et al., 2013).

Daly-Hassen et al. (2012) showed that forests reduced sedimentation in the Siliana water reservoir in Tunisia by 12.9 m<sup>3</sup> per ha per year: Based on the cost of removing sedimentation from the reservoir it was estimated that forests saved 1.2 million Tunisian dinars per year (51.4 Tunisian dinars per ha of forest area per year).

A preliminary assessment done in the framework of a FGEF project<sup>1</sup> implemented by Plan Bleu in the Chrea National Park in Algeria, found that the avoided cost of water purification for the Oued Chifa (main hydrological axis) was around 32 Algerian Dinar per cubic meter.

Mavsar and Riera (2007) estimated that, on average, residents in Spain would be willing to pay €3.90 for a 1-percent increase in the availability of drinking water in the country's Mediterranean region.

Knowing the value of water-related ecosystem services from forests is important in the management integration of both resources, however, there are a number of difficulties in estimating benefits related to watershed protection due to the unclear cause-and-effect relationships between forests and water, and the complexity of water-related functions. For example, the avoided costs method used for estimating benefits, might capture only part of the services provided full value (Plan Bleu and FAO, 2013).

#### Facts and Numbers

The Mediterranean is home to 60% of the world's "water poor", disposing of less than 1000 m<sup>3</sup> /inhab/yr

20 millions of Mediterranean without access to drinking water, especially in Southern and Eastern Mediterranean countries

470 km<sup>3</sup>/year of green water in the Mediterranean region

More than 1/3 of the world's major cities rely on drinking water from forested areas

### Policy-People interface: participatory approaches for an integrated management

Watersheds have multiple owners with multiple interests. They can be managed only through collaborative efforts. A broad range of stakeholders need to be engaged throughout all phases of resources management. Successful and sustainable management plan will be developed and implemented only through integrated and participatory approaches, in which an understanding by all stakeholders of the inherent capacity of various watersheds to produce resources and the factors limiting resource production is necessary.

In the framework of the FGEF project, participatory approaches are developed and disseminated to facilitate consultation and participation of all wooded areas stakeholders (owners, managers, local decision makers, users of goods and services, etc.) to these territories management decisions and their implementation. Those approaches are implemented in 5 pilot sites around the Mediterranean Basin (Düzlerçami forest in Turkey, Jabal Moussa in Lebanon, Barbara Watershed in Tunisia, Chrea National Park in Algeria, and Maâmora forest in Morocco).

<sup>1</sup> Project funded by the French Global Environment Facility (FGEF) over the period 2011-2016, jointly entrusted to Plan Bleu and FAO (Secretariat of *Silva Mediterranea*), and called "Optimizing the production of goods and services by Mediterranean forests in a context of global changes"

They involve multiple users of a territory in its management and planning, taking into account both their needs in terms of services provided by ecosystems and raising awareness as to their vulnerability. They strengthen dialogue and collaboration between all sectors involved in the woodlands management, especially between forest and water sectors.

Participatory approaches include a prospective dimension in bringing multiple stakeholders to understand the management of their territory with a long term vision and better anticipating the impacts of exogenous factors (climate change, for example) or endogenous decisions (forest management modes and human activities affecting forests) on the ecosystem and the services it provides, providing valuable insights in guiding strategic choices towards sustainability.

These approaches allow for collectively reflecting on the long term and integrating both forest and water sectors management strategies.

## References to forests and water in the international agenda

Having a better integration of water and forest management is of prime importance as both sectors need to shape their response to global changes. To do so, gaps in science-policy interface have to be bridged, the relationship between provider and consumer has to be developed through economic incentives, and dialogue among people and policy has to be strengthened through innovative institutional mechanisms and adoption of policies for sustainable forest management to safeguard water resources. At the Mediterranean level, the implementation of Mediterranean Strategy for Sustainable Development, currently under review, will be an opportunity to improve this integration and to bridge those gaps.

At the global level, the Sustainable Development Goals, currently being negotiated, provide an appropriate framework for this integration; Goal 6.6 "by 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes", Goal 15.1 "by 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands [...]".

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