

# FORESTS AND WATER

INTERNATIONAL MOMENTUM AND ACTION



# FORESTS

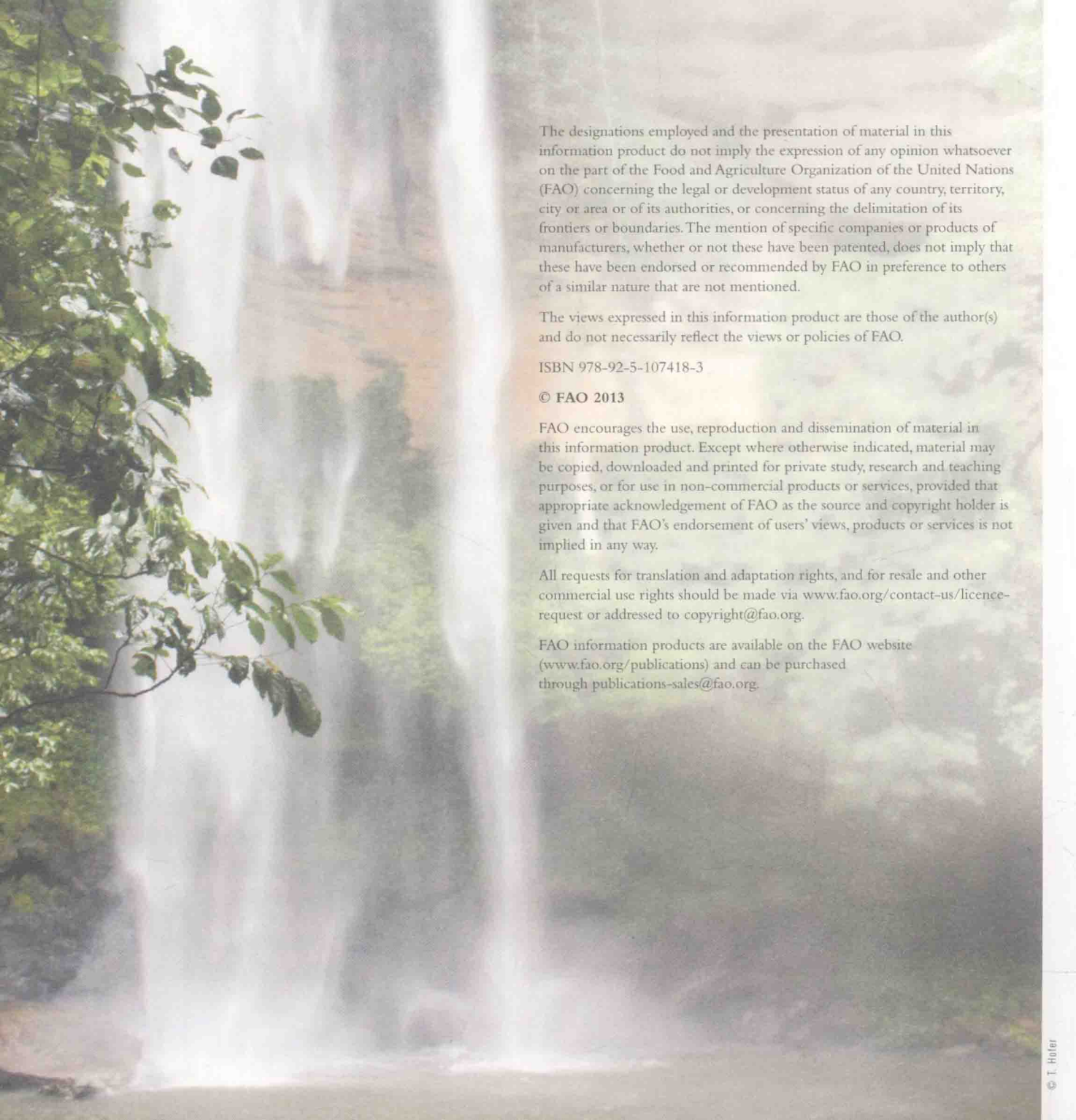
# AND

# WATER

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## INTERNATIONAL MOMENTUM AND ACTION

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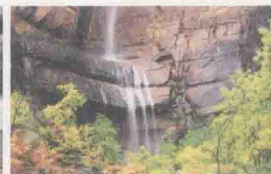
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# SUMMARY

ACCESS TO CLEAN WATER IS ONE OF THE MOST FUNDAMENTAL HUMAN RIGHTS. WORLDWIDE, MORE THAN ONE IN SIX PEOPLE STILL DO NOT HAVE ACCESS TO SAFE DRINKING WATER AND APPROXIMATELY 80 PERCENT OF THE GLOBAL POPULATION LIVE IN AREAS WHERE WATER RESOURCES ARE INSECURE.

Pressure on water resources is expected to increase in the future. By the year 2025, 1.8 billion people will be living in regions with absolute water scarcity and two-thirds of the world's population might experience water stress conditions. We are witnessing increasing problems with extreme events such as droughts and floods. The availability and quality of water in many regions of the world is increasingly threatened by overuse, misuse, pollution and projected negative impacts of climate change.

Forests play a crucial role in the hydrological cycle. They influence the amount of water available and regulate surface and groundwater flows while maintaining high water quality.





Moreover, forests and trees contribute to the reduction of water-related risks such as landslides, local floods and droughts and help prevent desertification and salinization. Forested watersheds supply a high proportion of the world's accessible fresh water for domestic, agricultural, industrial and ecological needs in both upstream and downstream areas.

A key challenge faced by land, forest and water managers is to maximize the wide range of forest benefits without detriment to water resources and ecosystem function. This challenge is particularly relevant in the context of adaptation to climate change, which increasingly reinforces the importance of sustainable forest management.

To address this challenge, enhanced synergy is needed between the water and forest communities through institutional mechanisms aimed at implementing action programmes at the national and regional levels. Similarly, there is an urgent need for an even better understanding of the interactions between forests and water, and for embedding the research findings into policy agendas.

The International Expert Meeting on Forests and Water held in November 2002 in Shiga, Japan, in the context of the 3<sup>rd</sup> World Water Forum was a fundamental step towards improved understanding of forest and water interactions and their implications for policy and management. The Warsaw Resolution 2 on Forests and Water, adopted on the occasion of the 5th Ministerial Conference on the Protection of Forests in Europe held 5-7 November 2007 in Warsaw, Poland, was another milestone marking the path for the development of an international process focusing on forests and water.

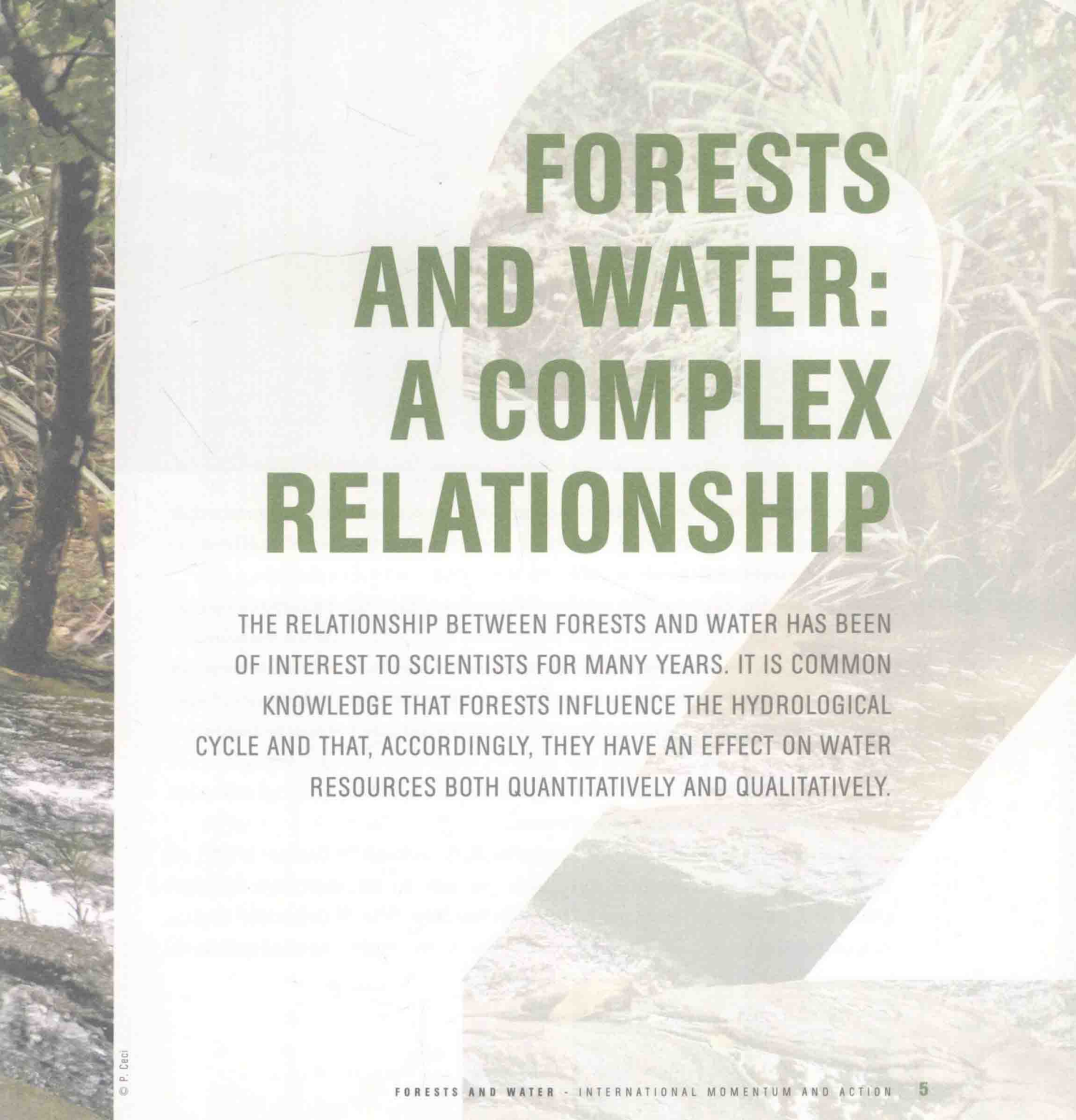
As part of the follow-up to the endorsement of the Warsaw Resolution 2, many events on forests and water were organized by FAO and other institutions between 2008 and 2011. These events were essential in furthering the dialogue on forests and water. Key partners in this process included the Government of Switzerland, the Government of Turkey, the Finnish Forest Research Institute (METLA), the Polish Forest Research Institute (IBL), the United Nations Economic Commission for Europe (UNECE), the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, the Ministerial Conference on the Protection of Forests in Europe (FOREST EUROPE), the Mediterranean Regional Office of the European Forest Institute (EFIMED), the Red Latinoamericana de Cooperación Técnica en Manejo de Cuencas Hidrográficas (REDLACH) and the United Nations University.

Presenting experiences ranging from research to project implementation worldwide, these events provided new, up-to-date insight into the topic as well as important recommendations for the way forward. However, in spite of its importance and the many conferences and workshops in recent years, forests and water are still not receiving adequate attention by the international community and there is a need to move from conceptual discussion to concrete action. FAO is fully committed to help move this agenda forward.

In close collaboration with the key partner institutions which were the drivers of the different events organized in past years, FAO took the initiative of synthesizing the main outcomes and recommendations resulting from this process to develop a comprehensive and practical international forests and water agenda to address a future course of action. This publication provides an overview of forest and water interactions and describes the increasing international momentum gained by this topic. It then presents, in chronological order, summaries of the various events held between 2008 and 2011, as well as their main outcomes and recommendations. It concludes with the most important part of the publication; namely, the analysis of the key recommendations and the forests and water agenda for the next years.







# FORESTS AND WATER: A COMPLEX RELATIONSHIP

THE RELATIONSHIP BETWEEN FORESTS AND WATER HAS BEEN OF INTEREST TO SCIENTISTS FOR MANY YEARS. IT IS COMMON KNOWLEDGE THAT FORESTS INFLUENCE THE HYDROLOGICAL CYCLE AND THAT, ACCORDINGLY, THEY HAVE AN EFFECT ON WATER RESOURCES BOTH QUANTITATIVELY AND QUALITATIVELY.






Forests are crucial to the sustainable management of water ecosystems and resources, while water is essential for the sustainability of forest ecosystems. Policy-makers should be aware of the important interactions between forests and water.

**THE BENEFITS  
OF FORESTS  
FOR THE  
SUPPLY OF  
WATER ARE  
MULTIPLE**

The benefits of forests for the supply of water are multiple. It is by maintaining high water quality that natural and managed forests make their most significant contribution. Forest management usually results in low input of nutrients, pesticides and other chemicals compared to more intensive land uses such as agriculture. By minimizing erosion, forests reduce the impairment of water quality due to sedimentation. By trapping sediments and pollutants from up-slope land uses and activities, forests help protect water bodies and watercourses. Through the stabilization of river banks, tree and shrub roots reduce erosion in riparian zones, preventing siltation downstream.

A meta-study conducted in 2003 for the World Wide Fund for Nature (WWF) on the role of forest protection in drinking water provision showed that about one-third (33 of 105) of the world's biggest cities, including New York, Mumbai and Bogotá, obtained a significant portion of their drinking water directly from forested watersheds





and protected areas. This statistic emphasizes the role of forests in providing high quality water and shows that the proper maintenance of forested areas can be a cost-effective way to ensure a steady provision of safe drinking water.

Forests are important water users. Water use by forests is influenced by the seasons, climate, topography, soil, forest composition (age and tree species) and forest management practices. With the exception of cloud forests, forests return less water to the soil than, for example, well-managed grassland or cultivated areas, as a greater quantity of water is given back to the atmosphere through evapo-transpiration. However, the dense and deep root system of forest soils and the high porosity of its essentially organic horizons make for excellent water infiltration and retention capacity. Surface runoff is minimal and groundwater recharge more efficient, resulting in regular stream flow during the year.

Besides influencing water resources, forests provide a wide range of ecosystem services:

- ✱ Forests protect soils and reduce erosion rates. Deep tree roots stabilize slopes and give the soil a certain amount of mechanical support which can help to prevent shallow mass movements. However, deep-seated landslides are not noticeably influenced by the presence or absence of a well-developed forest cover, but rather by tectonic and geological factors.
- ✱ Forestry operations such as cultivation, drainage, road construction or timber harvesting increase the risk of erosion. The implementation of best management practices and a commitment to ensuring forest cover on erosion-prone soils and run-off pathways can help control this risk.
- ✱ Forests have been found to be able to mitigate small and local floods but do not appear to impact either extreme flood events or those at a large catchment/river basin scale.
- ✱ Forest cover influences all variables of microclimates: solar radiation, air and soil temperature, wind and air humidity. Compared to the open ground, forest cover generally buffers the daily and seasonal temperature differences and thereby alleviates microclimatic extremes.

**FORESTS PROVIDE  
A WIDE RANGE OF  
ECOSYSTEM SERVICES**

## CLARIFYING TERMINOLOGY

IN ORDER TO CLARIFY THE CONCEPTS AND THE FOCUS OF THIS PUBLICATION, THIS BOX DEFINES AND DISCUSSES TWO IMPORTANT TERMS: FOREST HYDROLOGY AND WATERSHED MANAGEMENT.

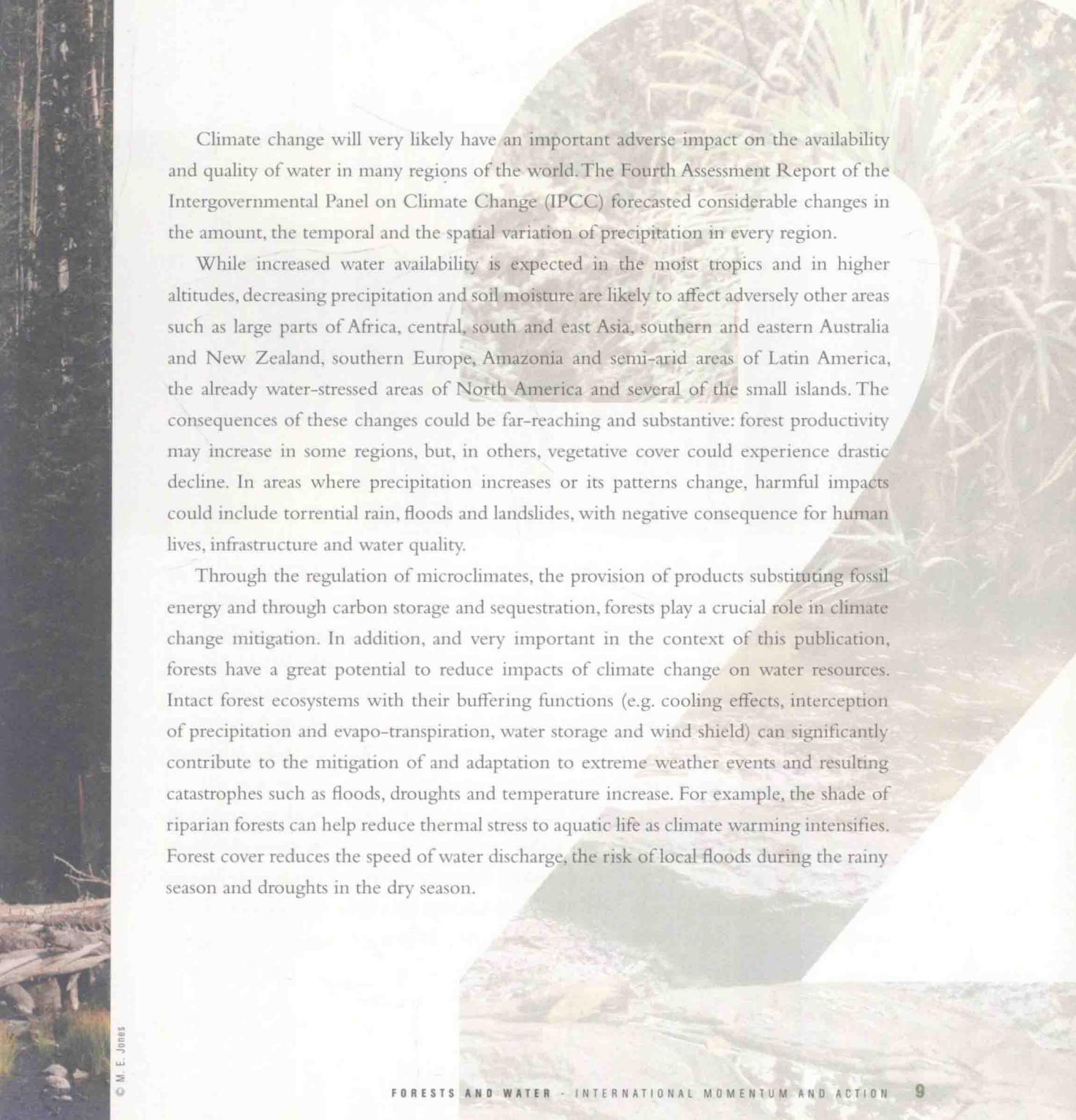
A **WATERSHED** IS A GEOGRAPHICAL AREA WHICH IS DRAINED BY A WATER COURSE. WATERSHED MANAGEMENT ENCOMPASSES ANY HUMAN ACTION AIMED AT ENSURING A SUSTAINABLE USE OF WATERSHED RESOURCES.

Watershed management considers the management and conservation of all available natural resources in a comprehensive way. It establishes the link between natural resources management, agricultural production and livelihoods. It provides a framework to organize different land uses (forestry, pasture, agriculture) in an integrated way and by following a landscape approach. Watershed management involves the local population, politicians and technicians in decision-making processes. Although watershed management is space-bound, geographically circumscribed and mostly applied to upland and mountain areas, it is conceptually very broad.

**FOREST HYDROLOGY** IS A DISCIPLINE THAT DEALS WITH THE INTERACTIONS BETWEEN FORESTS AND THE WATER CYCLE. FOREST HYDROLOGY PROVIDES USEFUL INFORMATION FOR THE MUCH-NEEDED EFFORTS TO MAINTAIN AND RESTORE WATER-RELATED ECOSYSTEMS.

Forest hydrology is thematically and conceptually narrower than watershed management. It focuses mainly on the physical interactions between forests and water. However, forest hydrology covers a much broader geographical scope since it can apply to contexts which go beyond watersheds, such as swamp forests, riparian buffer zones or forests on saline-susceptible soils. This publication deals exclusively with forest hydrology as defined in the description provided above.





Climate change will very likely have an important adverse impact on the availability and quality of water in many regions of the world. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) forecasted considerable changes in the amount, the temporal and the spatial variation of precipitation in every region.

While increased water availability is expected in the moist tropics and in higher altitudes, decreasing precipitation and soil moisture are likely to affect adversely other areas such as large parts of Africa, central, south and east Asia, southern and eastern Australia and New Zealand, southern Europe, Amazonia and semi-arid areas of Latin America, the already water-stressed areas of North America and several of the small islands. The consequences of these changes could be far-reaching and substantive: forest productivity may increase in some regions, but, in others, vegetative cover could experience drastic decline. In areas where precipitation increases or its patterns change, harmful impacts could include torrential rain, floods and landslides, with negative consequence for human lives, infrastructure and water quality.

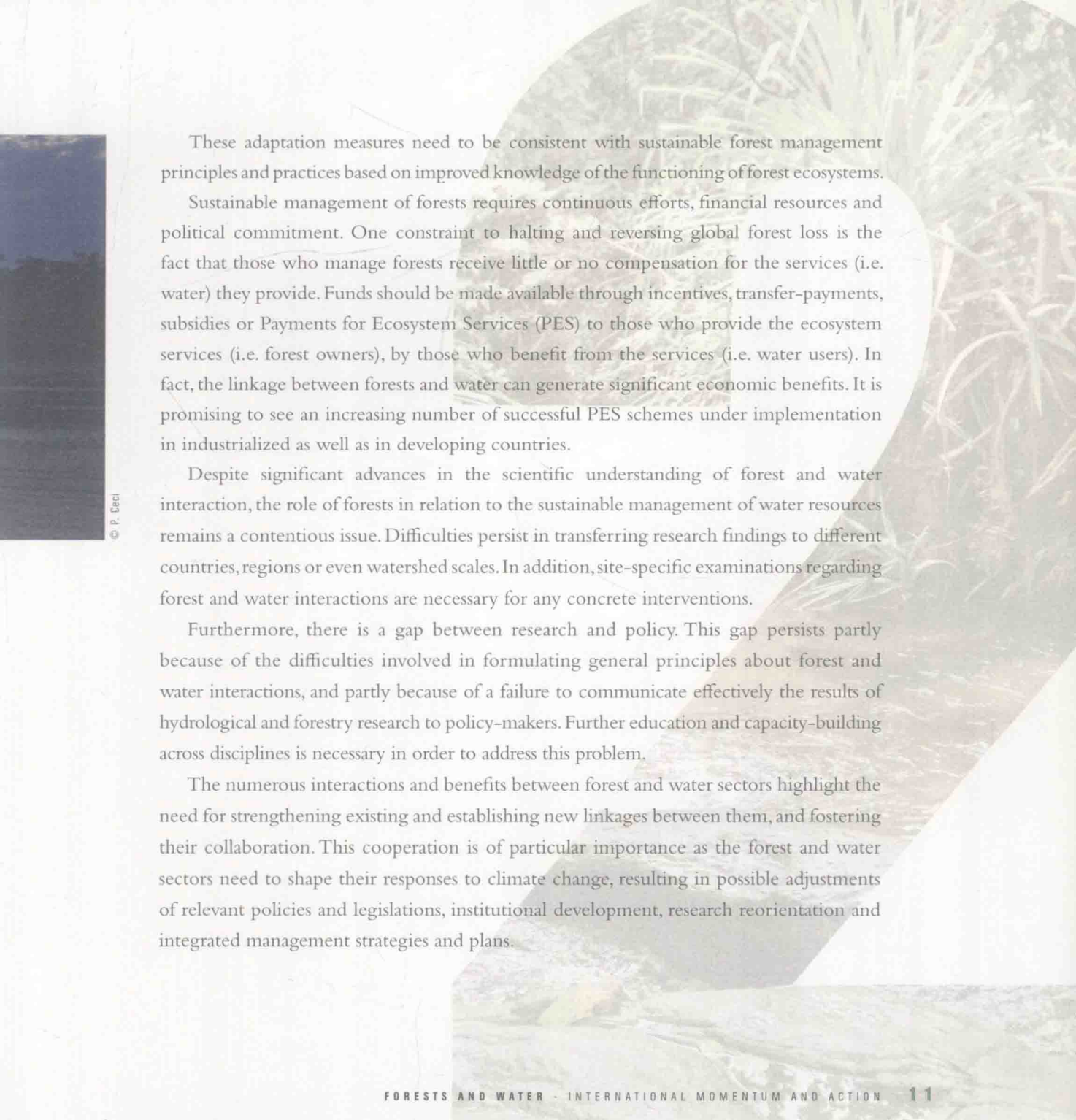
Through the regulation of microclimates, the provision of products substituting fossil energy and through carbon storage and sequestration, forests play a crucial role in climate change mitigation. In addition, and very important in the context of this publication, forests have a great potential to reduce impacts of climate change on water resources. Intact forest ecosystems with their buffering functions (e.g. cooling effects, interception of precipitation and evapo-transpiration, water storage and wind shield) can significantly contribute to the mitigation of and adaptation to extreme weather events and resulting catastrophes such as floods, droughts and temperature increase. For example, the shade of riparian forests can help reduce thermal stress to aquatic life as climate warming intensifies. Forest cover reduces the speed of water discharge, the risk of local floods during the rainy season and droughts in the dry season.





Increasingly, the role of forests in climate change mitigation is recognized and there are ambitious initiatives, in particular those related to Reducing Emissions from Deforestation and Forest Degradation plus (REDD+), to tap into the opportunities offered by forests and forestry. It should be emphasized, however, that forests can only take up carbon if they take up water at the same time. Since part of the price of carbon sequestration is paid in water this will also accentuate the debate about the role of forests in the hydrological cycle; in particular, the trade-offs between the water consumption of forests and the ecosystem services (including climate change mitigation) they provide.

Forests themselves are vulnerable to climate change. Reduced and more erratic rainfall and runoff will influence the vitality, resilience and even survival of trees and forest ecosystems. Action needs to be taken to reduce the vulnerability of forests and enhance their resilience to climate change with the aim of ensuring the continued provision of vital ecosystem services and protective functions ensured by forests.



These adaptation measures need to be consistent with sustainable forest management principles and practices based on improved knowledge of the functioning of forest ecosystems.

Sustainable management of forests requires continuous efforts, financial resources and political commitment. One constraint to halting and reversing global forest loss is the fact that those who manage forests receive little or no compensation for the services (i.e. water) they provide. Funds should be made available through incentives, transfer-payments, subsidies or Payments for Ecosystem Services (PES) to those who provide the ecosystem services (i.e. forest owners), by those who benefit from the services (i.e. water users). In fact, the linkage between forests and water can generate significant economic benefits. It is promising to see an increasing number of successful PES schemes under implementation in industrialized as well as in developing countries.

Despite significant advances in the scientific understanding of forest and water interaction, the role of forests in relation to the sustainable management of water resources remains a contentious issue. Difficulties persist in transferring research findings to different countries, regions or even watershed scales. In addition, site-specific examinations regarding forest and water interactions are necessary for any concrete interventions.

Furthermore, there is a gap between research and policy. This gap persists partly because of the difficulties involved in formulating general principles about forest and water interactions, and partly because of a failure to communicate effectively the results of hydrological and forestry research to policy-makers. Further education and capacity-building across disciplines is necessary in order to address this problem.

The numerous interactions and benefits between forest and water sectors highlight the need for strengthening existing and establishing new linkages between them, and fostering their collaboration. This cooperation is of particular importance as the forest and water sectors need to shape their responses to climate change, resulting in possible adjustments of relevant policies and legislations, institutional development, research reorientation and integrated management strategies and plans.

