Forest, Water and People in the Humid Tropics
Past, Present and Future Hydrological Research for Integrated Land and Water Management

Forests, Water and People in the Humid Tropics is the most comprehensive review available of the hydrological and physiological functioning of tropical rainforests, the environmental impacts of their disturbance and conversion to other land uses, and optimum strategies for managing them.

The authors review existing guidelines for timber harvesting, land clearing and post-forest agriculture, and seek ways to enhance their application. The book also examines the possibilities of restoring the hydrological functioning of degraded areas. New techniques that may help researchers and managers to understand better the hydrological consequences of land management decisions are discussed. The editors have supplemented the individual contributions with invaluable overviews of the main sections and provide key pointers for future research.

This book brings together leading specialists in such diverse fields as tropical anthropology and human geography, environmental economics, climatology and meteorology, hydrology, geomorphology, plant and aquatic ecology, forestry and conservation agronomy. Specialists will find authenticated detail in chapters written by experts on a whole range of people–water–land use issues, and managers and practitioners will learn more about the implications of ongoing and planned forest conversion, while scientists and students will appreciate a unique review of the literature.

MIKE BONELL is Chief of the Hydrological Processes and Climate Section at the UNESCO Division of Water Sciences. He is the managing series editor of the International Hydrology Series, and is leading editor of *Hydrology and Water Management in the Humid Tropics* (1993; Cambridge University Press).

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Foreword

Management problems of water-source areas in developing countries show, within my experience, a characteristic pattern. For familiar ecological reasons, streamflow from forested hills supports the economic development of populations of the valleys and plains below. The protection of water source areas is therefore accepted, in principle, as necessary to national development. Such protection of remote areas is difficult to fund and to staff. The rapid growth of tropical populations has, however, resulted in large-scale invasion and destruction of upper-watershed forests by subsistence cultivators and graziers. Deterioration of streamflow regulation has become an all-too-familiar result, with regular flow replaced by flood flows and dwindling dry-season supply.

Authority resides in cities, but administration strong enough to protect these watershed forests must be resident in the hills. For the administrator, a posting to the remote hills is effectively a banishment to a life far from schools and other amenities as well as from opportunities for recognition and promotion. Thus although Forest Departments maintain their protective patrols by devoted staff, they are, in many countries, inadequately supported by the administration of the law.

Technical reports by hydrologists and land-use specialists, after making systematic surveys paid for by governments, have spelled out the critical importance of watershed protection, but the necessary following action has been neglected in at least a score of countries that I have been privileged to study. An important result of the compelling evidence described in this book will, I hope, be not only higher priority for funding the protection of watershed forests, but stronger interest in the more effective use of the funds provided.

Sir Charles Pereira

Preface

Although the areal extent of tropical rainforests has changed markedly through natural fluctuations in climate at a geological time scale, the rate of tropical forest harvesting and clearance during the second half of the twentieth century, has been unprecedented. Fuelled by the soaring demands for tropical hardwoods by 'northern' economies, timber harvesting relies heavily on the use of mechanised felling and extraction. This, in turn, has greatly disturbed the remaining vegetation, the soils and therefore the hydrological functioning of the forest. Further, the economic necessity for an adequate return on the capital invested in equipment, vehicles, roads and wood-processing mills makes it desirable to harvest all marketable logs during a single felling cycle, often at the cost of future growth. At the same time, traditional shifting cultivation practices of local communities have become unsustainable in many places due to the increased pressure on the land exerted by a growing population, resulting in gradual degradation or even total disappearance of closed forest. In addition to such 'unplanned' forest degradation and conversion there is an increasing trend towards planned, government-led conversions of tropical forest to apparently more profitable cattle ranching or commercial plantations.

The extensive disappearance of tropical forests during the last five decades has raised global alarm over the threats to climatic stability and the hydrological functioning of river basins posed by continued forest conversion, next to the well-being of forest dwellers and the conservation of biodiversity. Although the wave of publicity on rainforest conservation and related environmental issues has stimulated some changes, notably the development and testing of reduced-impact logging (RIL) techniques and timber certification schemes, their application is still the exception rather than the norm.

To discuss these issues, a symposium and workshop was organized jointly by the International Hydrological Programme (IHP) of UNESCO and the International Union of Forestry Research Organizations (IUFRO), which was hosted by Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia between 30 July and 4 August 2000. The event, *Forest–Water–People in the Humid Tropics: Past, Present, and Future Hydrological Research for Integrated Land and Water Management*, provided a state-of-the-art overview of current knowledge on tropical forest hydrological functioning, the environmental impacts of forest disturbance and conversion, and the best ways to minimise these impacts. The meeting brought together some 94 people from 27 countries, representing a judicious mixture of senior professionals approaching the end of their research and management careers, and younger aspirants eager to follow in their footsteps. This book is based on contributions made to the Kuala Lumpur meeting, although several chapters dealing with specific topics not covered in detail by the symposium were added at a later stage.

Like the humid tropical environment it seeks to understand, tropical forest hydrology is changing. The relatively straightforward study of how water moves through forested catchments is rapidly giving way to a far wider approach embracing not just the physical aspects of water movement, but also how forest lands should be managed to optimise the environmental services and benefits they bring to all people living in, or downstream of forested catchments. Most importantly, the overriding need to alleviate poverty in many tropical countries requires the interfacing or even integration of the socio-economic, cultural and governance aspects when discussing forest–land–water management issues and seeking optimum solutions. The structure of the book reflects this importance.

The first global scientific programme devoted to hydrology and water resources, the UNESCO International Hydrology Decade (1965–74), provided an international impetus to the creation of long-term, hydrological data collection networks. In more recent times, however, there has been a progressive erosion of this long-term vision. Despite the threat of climate change, the need for long-term monitoring and research to address environmental and water resources management issues is no longer routine policy of most national governments, both within and outside of the humid tropics. Instead, there has been a drift towards funding short-term, high-visibility projects. The new UNESCO-led HELP (Hydrology for the Environment, Life and Policy) programme aims to promote just the type of integrated, interdisciplinary approach called for in this book.

There are some who argue that we know enough already and that there is little need for much more additional 'science'. Indeed, it is true that there is sufficient technical knowledge to minimise the adverse hydrological impacts associated with mechanised timber harvesting or land clearing and subsequent agricultural cropping. Thus the application of 'best management practices' is largely a matter of socio-economic acceptance and political will. At the same time, however, there are several important unanswered questions that require additional research. Two such issues that are of vital importance to the sustained livelihoods of countless upland farming communities and, indirectly, a great many more people living downstream, are:

(1) Will dry-season flows or even annual water yields decrease after clearing tropical montane headwater areas with cloud forest?
(2) Can the much reduced dry-season flows in heavily degraded areas be boosted, and if so, how?

Moreover, are we now in a position to predict the hydrological consequences of various management practices and land-use changes, including deforestation? Can we make these predictions in sufficient detail to be used by land users, managers or policy-makers wishing to avoid adverse hydrological consequences? And is the new hydrological knowledge uncovered by researchers being passed on to these stakeholders in a form they can?

We need to shift the emphasis back towards the longer-term vision necessary to solve the pressing environmental issues faced by tropical governments and their populations. This time, however, it is crucial that researchers involve local communities (who are often the de facto resource managers) and any non-governmental organisations representing them, as well as institution-based resource managers and policy-makers to help set the research agenda and translate the results of such research into concrete guidelines and tangible benefits.

We hope that this book will provide inspiration to all people involved in forest–land–water–people issues in the humid tropics and so contribute to a better management of precious natural resources to the benefit of people, animals, plants and their surroundings.

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Symposium and Workshop

This book is based on contributions made at the joint UNESCO International Hydrological Programme (IHP) – International Union of Forestry Research Organization (IUFRO) Symposium and Workshop *Forest–Water–People in the Humid Tropics: Past, Present, and Future Hydrological Research for Integrated Land and Water Management*, hosted by Universiti Kebangsaan Malaysia, 30 July – 4 August 2000.

Our grateful thanks are due to all those – authors, delegates and organizers – whose efforts made the Kuala Lumpur event so successful. In particular, we wish to acknowledge that the Symposium would not have happened at all without the valiant efforts of six persons. Aminata Diaby and Nayla Naourfal of the UNESCO Division of Water Sciences, Paris, who provided more than two years of support in the preparations of the Symposium and Workshop at the international level as well as supporting the Technical Organizing Committee. Special mention must be made of Dr Mushrifah Idris (on secondment to UNESCO in 1999–2000 from the Universiti Kebangsaan), who unexpectedly appeared in Senior Editor's Office, just at the right time in May 1999, and offered the Universitit Kebangsaan as the suitable venue for the meeting, when previously all seemed lost. She quickly became the focal point of all local arrangements. The Vice-Chancellor of Universiti Kebangsaan Malaysia, Professor Anwar Ali, and the Deputy Vice-Chancellor, Professor Datuk Dr Zakri A. Hamid, kindly facilitated the symposium in support of Dr Mushrifah Idris. In addition, Mr Shamad Hussein, the Permanent Delegate from Malaysia to UNESCO in Paris until July 2000 also took a very close interest in the preparations of the symposium and on behalf of the government of Malaysia, provided the necessary support to the UNESCO IHP Secretariat and Mushrifah Idris.

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Dr Mike Bonell, UNESCO–Paris, Division of Water Sciences, France
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