

tropical forest ecosystems

a state-of-knowledge report
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Preface

The organization and promotion of research on the natural resources of the tropical world, including the periodical assessment and evaluation of the state of knowledge in this field, has always figured prominently in Unesco's co-operative international scientific programmes. In 1956, at a time when Unesco's Arid Zone Research Programme was in full swing, a more modest programme of research on the humid tropics was launched. Apart from the intrinsic usefulness of establishing a synthesis and disseminating the results of research carried out in different parts of the world and covering a very wide range of topics, these efforts demonstrated the value of integrated resource research as opening the way to an interdisciplinary approach to the planning of development projects founded on a sound ecological basis; they also brought fresh recognition of the vital interplay between fundamental research and land-use requirements, in which human aspects are of the utmost importance.

Works such as *A Review of the Natural Resources of the African Continent* (1963) and *Natural Resources of Humid Tropical Asia* (1974) bear witness to Unesco's desire to present as full a picture as possible of world knowledge of natural resources in different regions and continents. These studies, however, were still sectoral in their approach and followed the lines of the major scientific disciplines and, in particular, maintained the classic separation between the social and natural sciences. Between 1961 and 1972, with the International Biological Programme, a serious effort was made to promote research on the productivity of terrestrial and aquatic ecosystems without regard to disciplinary boundaries, at least in the realm of biology; thus ecology and ecological methods came to the forefront of research at the regional and the international level; the most important results were obtained in the temperate zones, the tropical world having been the subject only of limited and specific research undertakings. There remained, however, the task of linking the knowledge acquired on the functioning of natural ecosystems to the various ways of development and management.

The time had therefore come to consider the whole question of making rational use of and of conserving the resources of the biosphere on the basis of scientific knowledge already possessed or likely to be acquired in the future. The intergovernmental *Biosphere Conference*, convened by Unesco in 1968, marked a turning point in this respect since it confirmed the view that social and economic development was intimately linked with the rational use of

renewable resources and that the conservation of these resources should be seen as an element of their rational use on a sustained yield basis, rather than as an obstruction to it. Thus the Conference gave a clear call for a new conception of man's relationship with his environment based on an approach to development that did not compromise resource renewal. This was the underlying theme that led to the launching, in 1970, of the intergovernmental Man and the Biosphere (MAB) Programme. The Biosphere Conference bore witness to the spread of ecological awareness throughout the world and to the need, first and foremost, to establish resource inventories and to broaden and to synthesize our basic knowledge. In this domain, Unesco, in co-operation with other United Nations Agencies, was actively preparing and publishing a series of thematic maps relating to the environment and its resources. This action was accompanied by the development of comparable methodologies and agreed nomenclatures, practical examples of which are to be found in regional vegetation maps, the FAO/Unesco *Soil Map of the World* and the WMO/Unesco climatic atlases. Direct assistance was given to various research institutes, such as those created under the Arid Zone Research Programme, and to scientists in developing countries not only to enable them to acquire the techniques of integrated natural resource survey, but also to ensure that the development of natural resources was more closely linked to socio-economic conditions whilst taking into account biological productivity and other ecological constraints.

Unesco's concerns and activities with regard to research and to the synthesis of knowledge relating to natural resources and their rational management were put before the United Nations Conference on the Human Environment (Stockholm, June 1972), which culminated in the creation of the United Nations Environment Programme (UNEP). In pursuit of its role of co-ordination and stimulation, UNEP gave priority to the study of the functioning of terrestrial ecosystems with a view to their rational management. In the UNEP plan of action, arid lands, rangelands and pastures, forests and tropical wooded areas were picked out for special study and urgent action. Thus there was complete accord with the themes of the MAB Programme the objective of which is 'to develop the basis within the natural and social sciences for the rational use and conservation of the resources of the biosphere and for the improvement of the global relationship between man and the environment; to predict the consequences of today's actions on tomorrow's world and thereby to increase man's

ability to manage efficiently the natural resources of the biosphere'. Two of these themes are particularly concerned with the tropical world.

1. Ecological effects of increasing human activities on tropical and subtropical forest ecosystems.
2. Impact of human activities and land use practices on grazing lands: savanna and grassland (from temperate to arid areas).

Thus the joint action of Unesco and UNEP in preparing this state-of-knowledge Report on tropical forest ecosystems can be seen as a natural outcome of the desire to provide better guidance to research that is vital for the satisfactory management of these ecosystems and to contribute to the training of specialists in the various scientific fields involved. Not only does this initiative follow logically from the priority accorded by Unesco and UNEP in their respective programmes to tropical forest ecosystems, it also provides another opportunity for Unesco to underline its preoccupation with the synthesis and diffusion of knowledge. For this reason the Report attempts to summarize the results of research undertaken over the past two decades, to point out gaps in knowledge and to sketch out the lines of future research. It is therefore intended as a tool for action while at the same time offering teachers and students a valuable source of information and documentation.

Another similar report on tropical grazing land ecosystems is in preparation.

The elaboration of this world Report was a complex operation in which many experts from the tropical regions as well as the non-tropical world took part. It also involved the invaluable co-operation of the United Nations Specialized Agencies, in particular FAO with whom Unesco also collaborates closely in a number of activities under the MAB Programme. Unesco, UNEP and FAO wish to express their gratitude to all those who helped in the preparation of this work. Final editing and the many revisions required to ensure a homogeneous presentation were carried out by A. Sasson (Division of Ecological Sciences, Unesco) with the assistance of B. Hopkins (New England College, Tortington Park, Arundel, Sussex, United Kingdom).

The designations employed and the presentation of the material in this work do not imply the expression of any opinion whatsoever on the part of the Secretariats of Unesco and UNEP concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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1. Mr R. G. FONTAINE, (past director of the) Forest Resources Division of FAO, Via Lidia 73, Rome, Italy, and Mr J. P. LANLY, Forestry Department, FAO, Via delle Terme di Caracalla, Rome 00100, Italy.
2. Prof. A. BAUMGARTNER, Meteorologisches Institut, Amalienstrasse 52, Forstliche Forschungsanstalt, 8 München 40, Federal Republic of Germany, and Prof. E. F. BRÜNIG, Institut für Weltforstwirtschaft, Bundesforschungsanstalt für Forst und Holzwirtschaft, Leuschnerstrasse 91, 2050 Hamburg 80, Federal Republic of Germany.
3. Prof. D. A. LIVINGSTONE, Department of Zoology, Duke University, Durham, North Carolina 27706, U.S.A., and Prof. T. VAN DER HAMMEN, Hugo de Vries Laboratorium, Universiteit van Amsterdam, Afdeling Palynologie, Sarphatistraat 221, Amsterdam 4, The Netherlands.
4. Dr R. LETOUZEY, Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle, 16, rue Buffon, 75005 Paris, France.
5. Dr B. ROLLET, 7, Villa Cœur de Vey, 75014 Paris, France.
6. Prof. G. H. ORIAN, University of Washington, Department of Zoology, Seattle, Washington 98195, U.S.A.
Dr C. R. CARROLL and Dr B. CARROLL BENTLEY, Department of Ecology and Evolution, Division of Biological Sciences, State University of New York at Stony Brook, Stony Brook, N.Y. 11794, U.S.A.
Dr T. W. SCHOENER, Harvard University, The Biological Laboratories, 16 Divinity Avenue, Cambridge, Massachusetts 02138, U.S.A., and
Dr T. ZARET, Department of Zoology, University of Washington, Seattle, Washington 98105, U.S.A.
7. Prof. O. J. SEXTON, Washington University, Department of Biology, St Louis, Missouri 63130, U.S.A.
8. Dr P. S. ASHTON, University of Aberdeen, Department of Botany, St Machar Drive, Aberdeen AB9 2UD, United Kingdom.
9. Mr R. G. FONTAINE and Prof. A. GÓMEZ-POMPA and Mrs B. LUDLOW, Instituto de Biología, Departamento de Botánica-Universidad Nacional Autónoma, Apartado Postal 70-268, Mexico, 20 D.F., Mexico.
- 10 and 11. Dr F. B. GOLLEY, Institute of Ecology, The Rockhouse, University of Georgia, Athens, Georgia 30602, U.S.A.
12. Dr F. FOURNIER, ORSTOM, 24, rue Bayard, 75008 Paris, France (and Unesco's Division of Ecological Sciences).
13. Dr F. GOLLEY
Prof. B. HOPKINS, New England College, Tortington Park, Arundel, Sussex BN18 ODA, United Kingdom, and
Mme F. BERNHARD-REVERSAT, Laboratoire de Botanique, ORSTOM, B.P. 1386, Dakar, Senegal.
14. Dr B. GRAY, P.O. Box 61, Beerwah, Queensland 4519, Australia.
15. Dr. P. KUNSTADTER *et al.*, East West Population Institute, 1777 East West Road, Honolulu, Hawaii 96822, U.S.A.
16. Dr J. V. G. A. DURNIN, Institute of Physiology, University of Glasgow, Glasgow, United Kingdom.
17. Prof. R. S. DESOWITZ, Department of Tropical Medicine and Medical Microbiology, School of Medicine, University of Hawaii, 3675 Kilauea Avenue, Honolulu - Hawaii, U.S.A.
18. Dr O. G. EDHOLM, School of Environmental Studies, University College of London, Gower Street, London WC1E 6BT, United Kingdom.
19. Prof. G. SAUTIER, Département de Géographie, Université de Paris I, 12, place du Panthéon, 75231 Paris Cedex 05, France.
Prof. J. BARRAU, Laboratoire d'Ethnobotanique, Muséum National d'Histoire Naturelle, 57, rue Cuvier, 75231 Paris Cedex 05, France.
Prof. P. GOUROU, 13, place Constantin Meunier, 1180 Bruxelles, Belgique.
20. Mr R. G. FONTAINE
Prof. D. J. GREENLAND, Department of Soil Science, The University of Reading, London Road, Reading RG1 5AQ, United Kingdom.

Dr R. HERRERA, Instituto Venezolano de Investigaciones Cientificas, Centro de Ecología, Apartado 1827, Caracas 101, Venezuela.

Dr G. W. IVENS, Agronomy Department, Massey University, Palmerston North, New Zealand, and
Mr J. PALMER

21. Mr R. G. FONTAINE
Dr J. P. MILTON, Threshold, Suite 113, 1785 Mass. Ave., N.W., Washington, D.C. 20036, U.S.A.
Mr J. PALMER and Mr S. L. PRINGLE, Forestry Department, FAO, Via delle Terme di Caracalla, Rome 00100, Italy.

Regional contributions

Africa

Office de la recherche scientifique et technique outre-mer (ORSTOM), 24, rue Bayard, 75008 Paris, France.

Centre technique forestier tropical, 45 bis, avenue de la Belle Gabrielle, 94130 Nogent-sur-Marne, France.

Land Resources Division, Ministry of Overseas Development, Tolworth Tower, Surbiton, Surrey KT6 7DY, United Kingdom.

Asia and Oceania

Dr S. K. SETH, Ministry of Agriculture and Irrigation, Department of Agriculture, Krishi Bhavan, New Delhi, India, and
Dr O. N. KAUL and Dr P. B. L. SRIVASTAVA, Forest Research Institute and Colleges, P.O. New Forest, Dehra Dun, Uttar Pradesh, India.

Dr S. SABHASRI and Dr S. AKSORNKOAE, National Research Council, Paholyothin Road, Bangkok 9, Thailand.

Prof. P. HO, Université de Saïgon, Faculté des Sciences, Département de Botanique, Boîte postale A-2, Ho Chi Minh (Saïgon), Viet Nam.

Dr T. C. WHITMORE (for the Malay and Melanesian archipelagos), Commonwealth Forestry Institute, South Parks Road, Oxford OX1 3 RB, United Kingdom.

Dr B. L. LIM (Malaysia), Institute of Medical Research, Department of Medical Ecology, Jalan Pahang, Kuala Lumpur 02-14, Malaysia.

Dr J. A. BULLOCK (for Malaysia), Department of Zoology, School of Biological Sciences, University of Leicester, Adrian Building, University Road, Leicester LE1 7RH, United Kingdom.

Dr F. L. DUNN (for Malaysia), Department of International Health, University of California, San Francisco, California 94143, U.S.A.

Dr D. SASTRAPADJA and Dr K. KARTAWINATA, Indonesian Institute of Sciences, Botanical Garden, Djl. Teuku Tjihk Ditiro No. 43, Jakarta, Indonesia.

Prof. T. SHIDEI, Department of Forestry, Faculty of Agriculture, Kyoto University, Kyoto 606, Japan.

Prof. J. D. OVINGTON, Atmospheric, Marine and Living Resources Division, Department of the Environment and Conservation, P.O. Box 1937, Canberra City, A.C.T. 2601, Australia.

Prof. R. W. HORNABROOK (for South-East Asia and Melanesia), Institute of Medical Research, P.O. Box 60, Goroka E.H.D., Papua New Guinea.

Latin America

Dr S. CAPOTE, Laboratorio de Fisiología Vegetal, Instituto de Botánica de la Academia de Ciencias de Cuba, Calzada del Cerro n° 1257, La Habana, Cuba.

Prof. E. F. BRÜNIG, Institut für Weltforstwirtschaft, Bundesforschungsanstalt für Forst und Holzwirtschaft, Leuschnerstrasse 91, 2050 Hamburg 80, Federal Republic of Germany, and

Dr H. KLINGE (for South America), Abteilung Tropenökologie, Max-Planck-Institut für Limnologie, Postfach 165, Plön 232, Federal Republic of Germany.

Dr J. MURÇA-PIRES, Instituto de Pesquisas Agropecuárias do Norte, Caixa Postal 48, Belém, Pará 66000, Brasil.

Dr W. A. RODRIGUES, Instituto Nacional de Pesquisas de Amazonia, Rua Guilherme Moreira no. 112/116, Manaus, Brasil.

Prof. R. CRIST, Department of Geography, University of Florida, Gainesville, Florida, U.S.A.

Participants to the synthesis workshops

Besides some of the authors already cited, the following consultants attended the two synthesis workshops and their comments and contributions were very helpful.

Prof. J. N. ANDERSON, Department of Anthropology, University of California, Berkeley, California 94720, U.S.A.

Prof. G. AUBERT, Office de la recherche scientifique et technique outre-mer (ORSTOM), 70/74, route d'Aulnay, 93140 Bondy, France.

Dr J. AVE, Rijksmuseum Voor Volkenkunde, Steenstraat 1, Postbus 212, Leiden, The Netherlands.

Prof. P. T. BAKER, Department of Anthropology, Social Sciences Building 511, University Park, Pa. 16802 U.S.A.

Prof. F. BOURLIÈRE, INSERM, Centre de Gérontologie, Unité de recherche 118, 29, rue Wilhem, 75016 Paris, France.

Prof. N. A. BURGESS, New University of Ulster, Coleraine, County of Londonderry, United Kingdom.

M. R. CATINOT, Centre technique forestier tropical (CTFT), 45 bis, avenue de la Belle Gabrielle, 94130 Nogent-sur-Marne, France.

Dr. M. GODELIER, Collège de France, 11, place Marcelin Berthelot, 75005 Paris, France.

Dr R. M. LAWTON, Land Resources Division, Ministry of Overseas Development, Tolworth Tower, Surbiton, Surrey KT6 7DY, United Kingdom.

Prof. G. LEMÉE, Université de Paris XI, Laboratoire d'Ecologie, Faculté des Sciences, 15, rue Georges Clemenceau, 91405 Orsay, France.

Dr J. MOUCHET, Office de la recherche scientifique et technique outre-mer (ORSTOM), Services scientifiques centraux, 70-74, route d'Aulnay, 93140 Bondy, France.

Prof. P. W. RICHARDS, University College of North Wales, School of Plant Biology, Memorial Buildings, Bangor LL57 2UW, Now: 14 Wootton Way, Cambridge CB39LX, United Kingdom.

Dr A. P. VAYDA, Department of Human Ecology, Cook College, P.O. Box 231, Rutgers University, New Brunswick, N.J. 08903, U.S.A.

Foreword

Forests and woodlands form the natural type of vegetation cover in most of the humid and subhumid parts of the tropical world. They are important for many reasons, not least because of their role in meeting man's needs for timber, food and other economic, environmental and socio-cultural values. For many developing countries, the wise use of the resources provided by tropical forests, and the balanced rural development of zones covered by them, lie at the heart of their national development strategies and programmes. One aspect of these strategies and programmes is the search for improved silvicultural and afforestation techniques, as well as ways and means for more effective use of tropical hardwoods, including the marketing of tropical timbers and pulping. Another aspect concerns the conversion of tropical forests on a sustained yield basis to tree crop plantations and to mixed agricultural systems, particularly at the village level.

Some progress has been made in certain of these problem areas in particular parts of the world. In most areas, however, sound scientific information on which optimal development can be based is lacking or is not readily available in useable form. In many areas of the humid and subhumid tropics, there is a clear need for much greater information on the quality and availability of terrestrial biological resources, and on the ecological and social constraints to successful change in land use and enhanced productivity on a sustained yield basis. Assessments are particularly needed on the ecological and social implications of different land-use options and management practices in specific situations.

At the same time, better use should be made of the information that is already available on tropical forest ecosystems. Mechanisms are needed for the effective and rapid communication of relevant scientific information, and its timely insertion in the key policy-making processes. These mechanisms must be developed primarily at the local and national levels, since it is at these scales that the problems of resource use and ecosystem management have essentially to be tackled.

In addition, the synthesis and exchange of information between and among countries which share similar ecological conditions and comparable socio-economic and land-use problems, must be encouraged if more efficient use is to be made of existing knowledge. It is here that international organizations have a traditional role to play and a particular function to fulfil. Recognition of this role and function led Unesco, UNEP and FAO to agree to undertake a

collation and synthesis of existing information on tropical forest ecosystems, and to make this information available in a single volume. The present publication represents the result of this co-operative venture, which was undertaken in consultation with other international intergovernmental and non-governmental organizations and with a large number of national institutions and individual scientists.

This Report aims to provide a clear summary of knowledge of the structure, functioning and evolution of tropical forest ecosystems and of the human populations that live within and around these ecosystems. It also describes some of the main patterns of use by man of these ecosystems. In presenting this information, the Report attempts: to identify gaps in knowledge; to present recommendations for future research; to indicate appropriate methodologies for problem-oriented studies on tropical forest ecosystems; to describe examples of land and resources management, and to examine some of the reasons for success or failure in specific concrete situations; and thus to highlight needs for future orientation in land-use development and management strategies.

Even a report as large as this one cannot be an exhaustive and encyclopaedic work. In the areas of management, marketing, economic development, etc., the main facts have been summarized. It was neither possible nor desirable to enter into great detail; this is especially so as FAO is preparing a publication on these aspects, which will complement this state-of-knowledge report; it is anticipated that the two studies will together adequately cover the subject of tropical forest ecology, exploitation, management and development.

The Report does not give equal emphasis to the various types of tropical forest ecosystems. It is mainly concerned with the lowland evergreen rain forests of the humid tropics, but whenever possible other types of dense tropical humid forest ecosystems are included. The so-called semi-deciduous and deciduous or seasonal moist forests are therefore mentioned in several parts of the Report. Apart from a case study on the African miombo, the dry tropical forests—whether open or closed in structure—are generally excluded. They will to a certain extent be treated in another state-of-knowledge report on tropical grazing land ecosystems, to be published by Unesco in 1978.

There are some departures from the planned shape. Initially, the idea was to base the Report on information from integrated studies on man's relationships with tropical forests in specific geographic areas. At an early stage, it

became apparent, however, that there were very few published studies on tropical forest ecosystems which had economic, social, cultural, biological, and physical dimensions. There was, and is, a general lack of case histories of assessments of land-use options and management strategies which incorporate short- and long-term ecological and social constraints and which operate at ecologically and socially acceptable scales in time and space. This lack of published information from interdisciplinary research meant that a somewhat traditional and sectoral structure was adopted for this Report—a structure which reflects the main groupings of disciplines involved.

The Report comprises three principal parts. Part I chiefly contains the research results of biologists and other natural scientists. Fourteen chapters deal with the description, functioning and evolution of tropical forest ecosystems, covering both disturbed and undisturbed situations. It includes information on composition, structure, biomass, primary and secondary productivity, water budgets, nutrient cycling, energy flow, stability, species interactions, succession, growth, regeneration, pests and diseases. In certain chapters, some comparative data are presented for food and tree crops which have replaced tropical forests in many lowland areas.

Part II will be of particular interest to demographers, social anthropologists, ethnologists and other scientists, as well as resource managers and land planners. It is mainly concerned with the biological behaviour and socio-cultural aspects of the human populations living in and around tropical forest ecosystems and with their patterns of use and management. In several chapters, attention is drawn to the role that the understanding of traditional resource use strategies of local populations can play in the development of new management techniques. Emphasis is also given to the key relationship that exists between traditional land-use systems and their associated social systems on the one hand, and the ecological constraints of the biological and physical environments in which they exist on the other. Part II ends with an exposé of the policies of forest protection, conservation, management and development, as they are related to scientific and technical knowledge and to socio-economic considerations.

Part III of the Report contains eight regional case studies which describe specific tropical forest ecosystems from various viewpoints (either basic research or utilization and management) to illustrate the kind and orientation of research.

The preparation of the Report was started in 1974. Following discussions between the international organizations concerned, contacts were made with a wide range of national and regional institutions and individual scientists concerned with various aspects of research and management of tropical forest ecosystems, and their inputs to the Report were solicited. These contributions were passed on to consultants who, working at world level, drafted the various chapters of the Report. Subsequently two workshops were held in June 1975, at Unesco's headquarters in Paris, to assess and review the various contributions and to try to achieve an integrated and balanced presentation of the information which would meet the requirements of the Report. The final editing of the work started in 1976.

In editing contributions to the Report, an attempt was made to achieve harmony in presentation and consistency in the use of terms and abbreviations, without suppressing individual styles. Each chapter bears the individual stamp of its author. In some cases, authors have inclined towards particular viewpoints which may prove provocative. The primary editorial aim has been to ensure accuracy of facts while retaining the privilege of authors to draw inferences. As in any multi-author book, there is inevitably a certain unevenness in the comprehensiveness and detail of the various chapters. In order to help the specialist, an effort has been made to give each chapter some autonomy, while linking it to the general requirements of the Report. Each chapter ends with a concise conclusion, an identification of gaps in knowledge, recommendations for future research and a selective bibliography. For several chapters, the major references are indicated in the bibliography with an asterisk; the absence of asterisks in other bibliographies indicates that these are already selective. Furthermore, for documentation purposes, several references of general interest, not quoted in the text, are added in the bibliographies.

It is hoped that this Report will provide, for a number of years, a useful source of facts and ideas for all those interested in tropical forest ecosystems. In particular, it is hoped that the Report will prove of practical value to those concerned with the design and conduct of research and management programmes in the countries and regions concerned. The Report should also be helpful to a variety of national and international activities in the fields of training, education and information exchange.

Part I

Description, functioning and evolution
of tropical forest ecosystems

