

TROPICAL  
FORESTRY



Florencia Montagnini  
Carl F. Jordan

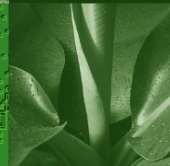
# *Tropical Forest Ecology*

The Basis for Conservation  
and Management



Springer

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FOREST



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## Tropical Forestry

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# Tropical Forest Ecology

The Basis for Conservation and Management

With 56 Figures and 24 Tables

 Springer

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## Preface

In 1973, a group of tropical ecologists gathered at Turrialba, Costa Rica, for a workshop to assess the knowledge of tropical forest ecology, and to make recommendations for future study. The proceedings were published in a volume entitled *Fragile Ecosystems* (Farnworth and Golley 1974). The book was called *Fragile Ecosystems* because many ecologists with experience in low latitudes suspected that tropical forests, especially rain forests, were particularly susceptible to disturbance. Recovery following activities such as logging and shifting cultivation was thought to be slower and more difficult than recovery of temperate zone forests. If, in fact, this were the case, it would have important implications for management of tropical forests. However, at the time, there was very little evidence that tropical forests were especially “fragile”.

In the intervening years, hundreds if not thousands of studies were published on rain forest ecology. Many have bearing on the question of whether tropical forests are more easily damaged than temperate forests and, if so, why. This question is particularly important for forest management, since tropical forest management is often carried out with methods developed for temperate zone forests. The purpose of this book is to bring together evidence that bears on the question of the uniqueness of tropical ecosystems, and to examine what this evidence means for the management of tropical forests in a way that does not diminish the ecosystem’s ability to maintain its structure and function.

Chapter 1 of this book reviews the values of tropical forests, both commercial and non-market values, that will disappear if tropical forests become extinct. To ensure that these values are not lost, we must make sure that tropical forests themselves are perpetuated.

In order to develop approaches to forest management that will promote forest survival, it is necessary to understand the characteristics of tropical forests that are important for maintaining their structure and function. Especially important is how tropical forests differ from temperate forests, since forest management techniques developed in the temperate zone may not be appropriate for the tropics. Chapter 2 describes these ecological characteristics.

Chapter 3 reviews several schemes of classification. Classification of tropical forests can be important in determining management plans. There are many

ways to classify tropical forests, but most are based either on climate or on stand structure. The problem is that within one climatic zone, there can be a variety of forest functions. Also, forests with similar structures can function differently. Because function is not taken into account, many traditional classification schemes are not useful at the stand level. Chapter 3 proposes other approaches that may complement the traditional classifications.

Social and economic factors usually play a more important role in management decisions than do ecological factors, and it is the social and economic pressures that are driving tropical deforestation. In Chapter 4 we examine the proximate and the underlying causes of deforestation, and its effects on the environment and on human populations.

Chapter 5 shows how the understanding of tropical forest ecology, together with considerations of local economy and culture can be applied to sustainable forest management. Methods of forest management are discussed, along with their effects on biodiversity.

Chapter 6 examines the multiple roles of plantation forestry: production of timber and fuelwood; a tool for development; and preserving or recovering biodiversity. Agroforestry systems are also put forward as an alternative to reconcile production with conservation and social needs. Plantation forestry, agroforestry, and other techniques are also presented as tools to aid in restoration of degraded forests and degraded agricultural and pasture lands.

Chapter 7 contrasts the impact of decisions made at the regional, national, and international levels with those made locally on sustainability of the forest. The top-down approach to development is contrasted with bottom-up approaches. Case studies where community forestry has been successful at implementing sustainable forest management are presented. Finally, Chapter 8 synthesizes what we have learned, and how that knowledge can be applied to future management decisions.

F. MONTAGNINI  
C. F. JORDAN

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## 1.1

### Functions of Tropical Forests

The functions of tropical forests can be productive (timber, fiber, fuelwood, and non-timber forest products), environmental (climate regulation, carbon sequestration and storage, reserve of biodiversity, and soil and water conservation), and social (subsistence for local populations and cultures). Forests serve a combination of functions and can generate additional revenue for local populations and national economies through ecotourism. Forests also have aesthetic, scientific, and religious values. In this chapter, we examine the principal productive and environmental services of tropical forests.

---

## 1.2

### Economic

#### 1.2.1

##### Forest Products

##### 1.2.1.1

###### Timber

Wood is one of the most useful and versatile raw materials. Compared to most available materials, wood is stronger, more workable, and more aesthetically pleasing (Wadsworth 1997). Wood is also warm to the touch, which makes it preferable for flooring and other house construction purposes. In addition, wood products are biodegradable, which is an added environmental advantage.

Commercial timber production is a major global industry. In 1998, global production of industrial roundwood (all wood not used as fuelwood) was 1.5 billion m<sup>3</sup> (FAO 2000a). In the early 1990s, production and manufacture of industrial wood products contributed about US\$ 400 billion to the global economy, or about 2% of global GDP (World Resources Institute 2000).

Although the roundwood timber market is dominated by North America and Europe, the timber industry is of greater economic importance to developing countries such as Cambodia, the Solomon Islands, and Myanmar, where wood exports account for 30% of all international trade. On average, timber constitutes about 4% of the economies of developing countries (Myers 1996).

Furthermore, the global demand for timber is expected to increase over the next decade. There have been signs of scarcity in some of the more precious woods. Production of tropical wood products has recently fallen below earlier levels, and some Asian countries have experienced difficulties in reaching their expected volumes of exports (FAO 2001 b). Forest industries continue to adapt to changes in raw materials, namely the increased supply of plantation wood from a wider variety of species (Figs. 1.1 and 1.2).

For most developing nations, there is a lack of reliable data on net annual forest growth, removal rates, and the age of trees – information that is needed to accurately assess the long-term conditions of forests. Even so, there is considerable evidence that, in some regions, harvest rates greatly exceed regrowth (World Resources Institute 2000). Certain valued species such as mahogany (*Swietenia macrophylla*) and teak (*Tectona grandis*) are harvested at rates that will eventually lead to depletion of these species from the forest. For example, in Thailand, forest cover diminished from 53 to 28% between 1961 and 1988, with much of the loss in the teak forests of the north (Phothitai 1992). In response, private industry initiated a teak reforestation program.



**Fig. 1.1.** Timber scarcity has led to the utilization of smaller diameters and shorter logs in many tropical regions. These logs were extracted from natural forests for their use for furniture in Petén, Guatemala (Photo: F. Montagnini)



**Fig. 1.2.** In many developing countries timber exports are not just roundwood but processed timbers as in fine furniture. In this furniture factory in Guatemala they manufacture house furniture for export to retailers in the USA (Photo: F. Montagnini)

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#### 1.2.1.2

##### **Fuelwood**

Fuelwood, charcoal, and other wood-derived fuels (collectively known as woodfuels) are the most important form of non-fossil fuel. The world production of fuelwood for 1999 was about 1,700 million m<sup>3</sup>, of which roughly 90% was produced and consumed in developing countries (FAO 2001 a). Biomass energy, which includes woodfuels, agricultural residues, and animal wastes, provides nearly 30% of the total primary energy supply in developing countries. More than 2 billion people depend directly on biomass fuels as their primary or sole source of energy.

In developing countries, woodfuels account for more than half the biomass energy consumption (World Resources Institute 2000). At least half the total timber cut in these countries is used as fuel for cooking and heating. Scarcity is more acute in the Indian subcontinent and in semiarid regions of Africa below the Sahel. In Latin America, firewood scarcity is a problem in the Andean region, Central America, and the Caribbean (Fig. 1.3). Whether a regional or even global fuelwood crisis will develop depends on a variety of factors, such as the increase in the area of plantations for fuelwood, the use of more efficient burning stoves, and the availability of alternative sources of