
Contents

1	Importance of Tropical Forests	1
1.1	Functions of Tropical Forests	1
1.2	Economic	1
1.2.1	Forest Products	1
1.2.1.1	Timber	1
1.2.1.2	Fuelwood	3
1.2.1.3	Non-Timber Forest Products	4
1.2.2	Ecotourism	9
1.3	Environmental Services	9
1.3.1	Reserve for Biodiversity	9
1.3.2	Regulation of Climate	10
1.3.2.1	Local Effects	10
1.3.2.2	Global Effects	12
1.4	Social	14
1.4.1	Subsistence for Local Populations	14
1.5	The Need for an Integrated Approach to Forest Conservation and Management	16
2	Characteristics of Tropical Forests	19
2.1	Characteristics Relevant to Management and Conservation	19
2.2	High Diversity	19
2.2.1	Latitudinal Gradients of Species Diversity	21
2.2.1.1	The Latitude Effect	22
2.2.2	Effects of Elevation on Species Diversity	24
2.2.3	Effects of Soil Fertility on Species Diversity	25
2.2.4	Influence of Stress on Species Diversity	26
2.2.4.1	Other Factors Influencing Diversity	26
2.2.5	Theories to Explain High Diversity in the Tropics	27
2.2.6	Benefits of High Diversity	30
2.2.6.1	Defense Against Pests and Diseases	30
2.2.6.2	Complementarity	32
2.2.7	Implications of High Diversity for Forest Management	34

2.3	Reproductive Ecology of Tropical Trees	35
2.3.1	Timing/Frequency of Flowering and Seed Production	35
2.3.2	Modes of Reproduction of Tropical Trees	36
2.4	Species Interactions in the Tropics	37
2.5	Energy Flow	40
2.5.1	Delineation of the Tropics	40
2.5.2	Primary Production	41
2.5.2.1	Production Patterns Within the Tropics	43
2.5.3	Light Environment of Tropical Forests	46
2.5.3.1	Availability of Light	47
2.5.3.2	Responses of Plants to Light	48
2.5.3.3	Light Distribution in the Forest	49
2.5.4	Herbivory	50
2.5.5	Decomposition	51
2.6	Nutrient Cycling	53
2.6.1	Cycling Rates in the Tropics	53
2.6.2	Leaching and Weathering	57
2.6.3	Nutrient-Conserving Mechanisms	58
2.6.3.1	“Direct” Nutrient Cycling	58
2.6.3.2	Concentration of Roots Near the Soil Surface	61
2.6.3.3	Nutrient Storage in Wood Biomass	63
2.6.3.4	Other Nutrient-Conserving Mechanisms	65
2.6.3.5	Role of Soil Organic Matter in Nutrient Conservation	67
2.6.4	Effects of Disturbance on Nutrient Stocks in the Soil	68
2.6.4.1	Implications for Forestry	73
2.7	Conclusion	73
3	Classification of Tropical Forests	75
3.1	Classification Based on Forest Structure	75
3.2	Classification Based on Forest Function	78
3.2.1	Climatic Classifications	78
3.2.1.1	Functional Variation Along Climatic Gradients	82
3.2.2	Classification Based on Species	83
3.2.2.1	Classification at the Community Level	83
3.2.2.2	Classification Based on “Temperament” of Species	85
3.2.2.3	Classification Based on Successional Stage	86
3.2.3	Forest Classification Based Upon Soil Nutrient Status	88
3.2.3.1	Implications for Management	89
3.2.3.2	The UNESCO Classification System	90
3.3	Conclusion	96

4	Deforestation in the Tropics	97
4.1	Rates of Deforestation	97
4.2	Causes of Deforestation	100
4.2.1	Proximate Causes of Deforestation	100
4.2.1.1	Expansion of Agriculture	100
4.2.1.2	Wood Extraction	103
4.2.1.3	Development of Infrastructure	103
4.2.2	Underlying Causes of Deforestation	104
4.2.2.1	Economic	104
4.2.2.2	Political and Institutional Factors	107
4.2.2.3	Technological	112
4.2.2.4	Cultural	112
4.2.2.5	Demographic	113
4.2.3	External Debt and Deforestation	114
4.3	Effects of Deforestation	115
4.3.1	Environmental Effects of Deforestation	115
4.3.2	Social and Economic Effects of Deforestation	117
4.3.2.1	Effects on Indigenous Peoples	117
4.3.2.2	Effects on Traditional Rural Peoples	123
4.3.2.3	Effects on Recently Arrived Rural Peoples	125
4.3.3	Benefits and Costs of Deforestation at the International and National Levels	129
4.3.3.1	International	129
4.3.3.2	National	129
4.4	Conclusion	129
5	Management of Tropical Forests	131
5.1	Introduction	131
5.2	Natural Forest Management	131
5.2.1	Sustainable Forest Management	133
5.2.2	Systems Used in Management of Natural Forests in Tropical Regions	134
5.2.2.1	Natural Regeneration Systems	134
5.2.2.2	Partial Clearing Systems	137
5.3	Reduced Impact Logging (RIL)	139
5.4	Ecological and Economic Feasibility of Methods of Management of Natural Tropical Forests	142
5.4.1	Criteria and Indicators of Sustainable Forest Management	143
5.4.2	Certification of Forest Management	144
5.4.3	Obstacles to Sustainable Forest Management	146
5.5	Management of Secondary Forests	146
5.5.1	Techniques for Management of Secondary Forests	148

5.6	Management for Non-Timber Forest Products (NTFPs)	150
5.7	Is Forest Management Compatible with Conservation of Biodiversity?	154
5.7.1	Effects of Forest Management on Wildlife	157
5.8	Reserves	158
5.8.1	Setting Priorities	160
5.9	Conclusion	161
6	Plantations and Agroforestry Systems	163
6.1	Introduction	163
6.2	Plantation Forestry: Alternative to Supplying the World's Timber Demand?	163
6.2.1	Plantation Productivity	166
6.2.2	Sustainability of Forest Plantations	170
6.2.3	Plantations of Native Tree Species	171
6.2.4	Mixed Species Plantations	176
6.2.5	Plantations and the Conservation of Biodiversity	183
6.2.6	Plantations in the Landscape	184
6.2.7	Plantations as a Tool for Economic Development	184
6.3	Agroforestry	189
6.3.1	Most Frequently Used Agroforestry Systems	190
6.3.2	Functions of Agroforestry Systems	197
6.4	Restoration of Degraded Tropical Forest Ecosystems	199
6.4.1	Recovery of Degraded Forests	200
6.4.1.1	Enrichment Planting of Degraded and Secondary Forests	200
6.4.2	Rehabilitation of Degraded Pasture and Cropland	205
6.4.2.1	Recovery of the Soil's Productive Capacity	205
6.4.2.2	Restoration of Areas Invaded by Aggressive Vegetation	207
6.4.2.3	Recovery of Biodiversity in Degraded Lands	210
6.5	Conclusion	215
7	Approaches for Implementing Sustainable Management Techniques	217
7.1	Introduction	217
7.2	Top-Down Development	218
7.2.1	Top-Down Conservation Planning	220
7.3	Bottom-Up Development	223
7.3.1	Participatory Action	223
7.3.2	A Case Study of Participatory Action Research and Development	224
7.3.2.1	Case I: Uruará: Where PAR Failed	226
7.3.2.2	Case II: Porto de Moz: Where PAR Succeeded	228
7.4	Community Forestry	230

7.5	Globalization	238
7.5.1	Globalization and Forest Resources	240
7.5.2	Case Study of Globalization	241
7.6	Locally Centered Development and Integrated Natural Resource Management (INRM)	243
7.7	Importance of Scale in Efficiency of Production	247
7.8	Conclusion	249
8	Conclusions	251
8.1	Introduction	251
8.2	Tropical Forest Classification	252
8.3	Tropical Deforestation	252
8.4	Management of Tropical Forests	252
8.5	Plantations and Agroforestry Systems	253
8.6	Political and Economic Development Strategies for Sustainable Forest Development	254
	References	255
	Subject Index	281

Tropical Forest Ecology
The Basis for Conservation and Management
Montagnini, F.; Jordan, C.F.
2005, XI, 295 p., Hardcover
ISBN: 978-3-540-23797-6