

# Contents

<b>1 Introduction</b> .....	1
1.1 Forest Ecosystems.....	2
1.2 Historic Development of Forest Ecosystems .....	3
1.3 The Global Carbon Cycle and Climate Change.....	5
1.4 Carbon Sequestration .....	11
1.5 Review Questions.....	17
References.....	17
<b>2 The Natural Dynamic of Carbon in Forest Ecosystems</b> .....	23
2.1 Carbon Input into Forest Ecosystems .....	24
2.1.1 Carbon Assimilation .....	26
2.1.2 Influx of Gaseous Carbon Compounds .....	37
2.1.3 Deposition of Dissolved and Particulate Carbon .....	37
2.2 Carbon Dynamics in Forest Ecosystems.....	39
2.2.1 Carbon Dynamics in Trees.....	39
2.2.2 Carbon Dynamics Outside of Trees .....	50
2.3 Carbon Efflux from Forest Ecosystems .....	69
2.3.1 Gaseous Carbon Efflux from Plants.....	70
2.3.2 Carbon Efflux from Organic Matter.....	76
2.3.3 Carbon Efflux from Soil Carbonates.....	81
2.4 Conclusions.....	81
2.5 Review Questions.....	82
References.....	83
<b>3 Effects of Disturbance, Succession and Management on Carbon Sequestration</b> .....	103
3.1 Effects of Natural Disturbances on Carbon Sequestration in Forest Ecosystems.....	104
3.1.1 Natural Disturbances.....	105
3.2 The Natural Successional Cycle of Forest Stand Development and Carbon Sequestration.....	115
3.2.1 Initiation Stage.....	117

3.2.2	Stem Exclusion Stage .....	118
3.2.3	Understory Reinitiation Stage.....	119
3.2.4	Old-Growth Stage .....	119
3.3	Forest Management and Carbon Sequestration .....	121
3.3.1	Management Activities in Natural Forests.....	123
3.3.2	Management Activities in Forest Plantations .....	133
3.4	Effects of Peatland, Mining and Urban Land Uses on Forest Carbon Sequestration .....	135
3.4.1	Forested Peatlands .....	135
3.4.2	Mining Activities in Forests.....	139
3.4.3	Urbanization and Forest Ecosystems .....	142
3.5	Conclusions.....	144
3.6	Review Questions.....	145
	References.....	146
<b>4</b>	<b>Carbon Dynamics and Pools in Major Forest Biomes of the World .....</b>	<b>159</b>
4.1	Boreal Forests .....	160
4.1.1	Carbon Dynamics and Pools.....	163
4.1.2	Effects of Climate Change .....	168
4.2	Temperate Forests .....	173
4.2.1	Carbon Dynamics and Pools.....	175
4.2.2	Effects of Climate Change .....	178
4.3	Tropical Forests.....	182
4.3.1	Carbon Dynamics and Pools.....	184
4.3.2	Effects of Climate Change .....	189
4.4	Conclusions.....	192
4.5	Review Questions.....	193
	References.....	194
<b>5</b>	<b>Nutrient and Water Limitations on Carbon Sequestration in Forests .....</b>	<b>207</b>
5.1	Nitrogen .....	208
5.1.1	Nitrogen Dynamics in Forest Ecosystems .....	208
5.1.2	Nitrogen Impacts on Biomass Carbon Sequestration .....	211
5.1.3	Nitrogen Impacts on Soil Organic Carbon Sequestration.....	215
5.1.4	Conclusions.....	217
5.2	Phosphorus.....	219
5.2.1	Phosphorus Dynamics in Forest Ecosystems.....	219
5.2.2	Phosphorus Impacts on Carbon Sequestration in Forest Ecosystems.....	221
5.2.3	Conclusions.....	222
5.3	Water .....	222
5.3.1	Water Cycle in Forest Ecosystems .....	224
5.3.2	Water and Carbon Sequestration in Forest Ecosystems.....	227
5.3.3	Conclusions.....	229

5.4	Review Questions.....	230
	References.....	230
<b>6</b>	<b>The Importance of Carbon Sequestration in Forest Ecosystems .....</b>	<b>241</b>
6.1	Bioenergy from Tree Plantations .....	242
6.1.1	Bioenergy and Biofuels from the Forest Sector.....	243
6.1.2	Genetic Modification of Dedicated Biomass Trees by Biotechnology .....	246
6.2	Forest Carbon Sequestration Under the United Nations Framework on Climate Change, the Kyoto Protocol and Post-Kyoto Agreements .....	249
6.2.1	Current Commitments for Forest Carbon Sequestration .....	250
6.2.2	Future Forest-Based Systems for Carbon Sequestration .....	251
6.3	Major Constraints on the Importance of Forest Carbon Sequestration: Tropical Deforestation, Perturbations in Peatlands and in Old-Growth Forests.....	257
6.3.1	Tropical Deforestation .....	258
6.3.2	Perturbations in Peatland Forests.....	259
6.3.3	Perturbations in Old-Growth Forests .....	260
6.4	Conclusions.....	261
6.5	Review Questions.....	262
	References.....	262
	<b>Index.....</b>	<b>271</b>