## CONTENTS

Preface

Introduction

*37* 

2.2 Origins and impacts of agriculture and water use

Hunter-gatherer communities

LAND

iii

1.1	An Australian perspective 3	
1.2		
	An astronomical perspective 9	
	A geological perspective 9	
	A geographical perspective 10	
1.3	Biogeochemical cycles and biophysical systems 12	
	Some natural constraints 12	
	Understanding the biosphere 17	
	People and biosphere 18	
1.4	Human society 18	
	Population growth, poverty and environmental change	2
	Economic factors 24	
	Science and technology 30	
	Politics 31	
1.5	Sustainable development 33	
1.6	Conclusion 33	

Agriculture as environmental exploitation

Scale and geography of supply problems

Simple agricultural settlement in villages

37

38

42

40

		Grazing systems 44
		Modern systems of agriculture and water use 46
	2.3	Land degradation 50
		Soil erosion 51
		Loss of soil fertility 52
		Soil structural change 54
		Salinisation 54
		Soil pollution 56
		Desertification 57
	2.4	Water degradation 57
		Impacts of forestry 58
		Impacts of agriculture and grazing 58
		Impacts of industry 61
		Loss of amenity: rivers, wetlands, and wildlife 61
	2.5	Future directions 62
		Doubling production 63
		Balancing the budgets 67
		Reducing soil loss and restoring land condition 70
		Improving access to clean water and sanitation 70
		The wildcard of climate change 72
		The human dimension 73
	2.6	Some Australian responses 75
	2.7	Conclusion 76
3	FORES	TS
	3.1	The world's forests 79
		Forest types and characteristics 81
		How much forest is there? 83
	3.2	Dimensions of deforestation 86
		Forest losses in history and prehistory 87
		Forest change in the modern world 92
		Reafforestation 95
	3.3	Consequences of deforestation 95
		Biophysical consequences of deforestation 97
		Consequences for peoples and cultures 103
	3.4	Causes of deforestation 104
		Population 105
		Economy 109
		Technology 116
		Politics and political systems 118
	3.5	Conclusion 124

4	URB	AΝ	ENV	<b>IRO</b>	NMEI	NTS
	0110	$\sim$ 11	F 14 A	$\cdots$	14141 - 1	

ΤH

4.1	Urban growth and urbanisation 130
4.1	Urban growth and urbanisation 130 Global trends 130
4 9	
4.2	
	The urban system 133 Inheritance of location 135
4.0	City structure 136
4.3	· -
	Energy 138
	Food 138
	Clean water and air 139
	Construction materials 139
	Land 140
	Waste products 143
4.4	Cities and the biophysical environment 147
	Energy flows and climate 147
	The impact of cities on water: urban hydrology 154
4.5	Air and water quality 158
	A breath of fresh air 158
	Fresh water 167
4.6	Challenges and solutions 170
	Low-income countries 171
	High-income countries 175
4.7	Conclusion 180
E (C	LOBAL ATMOSPHERE
	LOBAL ATMOSPITERE
5.1	Introduction 182
<b>5.2</b>	Ozone depletion 182
	Atmospheric chemistry and the ozone 'hole' 182
	Effects of ultraviolet radiation 186
5.3	The enhanced greenhouse effect 186
	What happens in the atmosphere? 187
	Sources and sinks of greenhouse gases 192
5.4	Consequences of the enhanced greenhouse effect 202
5.5	Predicting greenhouse changes 204
	Global climate model predictions for an effective doubling
	of CO <sub>2</sub> 204
	Predictions for Australia 207
	Other effects of greenhouse change 209
F C	Demonstration of greenhouse change 207

Do nothing 214

	Take preventative action 215
	Prepare for the consequences 218
5.7	Planning for the enhanced greenhouse effect 219
	International agreements 219
	The Australian response 220
5.8	Conclusion 226
INTER	NATIONAL CO-OPERATION
6.1	Global commons 230
6.2	The oceans 231
	The need for international co-operation 231
	The International Law of the Sea 235
	Australia, the Law of the Sea, and fisheries agreements 237
	The International Whaling Commission 239
	Ocean pollution 242
6.3	Antarctica 250
	The Antarctic Treaty 250
	World Park or mining lease? 253
6.4	The atmosphere 254
	The Montréal Protocol 254
	The Toronto Conference and the Hague Declaration 254
	UNCED Framework Convention on Climate Change 255
6.5	Deforestation and desertification 256
	Forests 256
	Drought and desertification 259
6.6	The Earth Summit (UNCED) 259
	Events leading to the Earth Summit 259
	UN Conference on the Environment and Development 261
	Achievements and failures of UNCED 267
	Australia's role in the UNCED Process 268
6.8	Conclusion 270
SOME	WAYS FORWARD
7.1	Integration 272
7.2	Scale 273

7.5 Resource use and management 283 Resource and environmental management 283 Consumption, waste and recycling

278

274 7.4 International trade and finance 276 Trade

276 International financial issues

7.3 Inequalities

7.6	Science and technology 285		
	Understanding and knowledge	285	
	Technology 285		
	Transfer of information technol	ogy	286

- 7.7 Population issues 287
- 7.8 Sustainable development 289

The concept 289

Australian implementation 291

7.9 Environmental integrity and development for all? 294

Glossary 298

Definitions 298

Acronyms and abbreviations 305

Units of Measurement 307

Index 308

# FIGURES, PLATES, TABLES AND BOXES

#### **FIGURES**

- 1.1 The Earth's biophysical system.
- 1.2 Dynamic equilibrium, perturbations and feedbacks.
- **1.3** Global energy cycle.
- 1.4 Global water cycle.
- 1.5 Interlinked biophysical and human Earth systems.
- 1.6 World population growth.
- 1.7 Global distribution of gross national product per capita, 1991.
- 2.1 Centres for domestication of plants and animals.
- 2.2 Natural ecosystems, monocultures and polycultures.
- 2.3 Land degradation in New South Wales, 1987–88.
- **2.4** Main factors of soil formation and degradation.
- **2.5** Development of soil salinity.
- 2.6 The Great Artesian Basin of Australia.
- 2.7 Development of integrated pest management.
- 2.8 Conventional cultivation and minimum or zero tillage.

  Restoration of fragmented landscapes and sustainable.
- **2.9** Restoration of fragmented landscapes and sustainable land use.
- 3.1 Forest and woodland as a percentage of area by country, 1989–91.
- 3.2 Tree loss in the Murray-Darling Basin.
- 3.3 Pristine forests in Sumatra since the 1930s.
- 3.4 Net change in area of forest and woodland by country, 1979–81 to 1989–91.
- **3.5** Roundwood use, 1991.
- 3.6 International trade in coniferous sawlogs and in non-coniferous sawlogs and veneer logs.
- 3.7 The Wet Tropics of Queensland World Heritage Area.
- **4.1** Urban population growth, 1950–2025.
- 4.2 The urban system.
- **4.3** Location of quarries in the Sydney region.
- **4.4** Sydney's expansion, 1788–1981.
- **4.5** Waste products in the urban environment.
- **4.6** Hypothetical urban heat island.
- **4.7** Concentrations of sulphur dioxide across country income groups.
- **4.8** Concentrations of suspended particulate matter across country income groups.
- **5.1** October ozone concentration over Halley Bay, Antarctica, 1958–94.
- 5.2 Theoretical Planck curves and actual radiation for the Sun and Earth.
- **5.3** The greenhouse effect.
- **5.4** The electromagnetic spectrum.

- **5.5** Major greenhouse gases, 1965–90 and 1980–90.
- **5.6** The positive feedback between water vapour and temperature.
- **5.7** Changing atmospheric CO, concentration.
- **5.8** Atmospheric methane variations from 1600.
- **5.9** Nitrous oxide concentrations in the atmosphere.
- 5.10 Concentrations of CFC-11 and CFC-12 above Cape Grim, Tasmania, 1978-85.
- **5.11** Changes in the global temperature, 1900–92.
- **5.12** Temperature increases predicted by climate models for Australia.
- **5.13** Winter precipitation changes predicted by climate models for Australia.
- **5.14** Direct and indirect climatic effects on asthma.
- **5.15** Possible planning responses to the enhanced greenhouse effect.
- **6.1** Time-line of international environmental agreements.
- **6.2** Area of the oceans covered by actual and potential 200 nm EEZs.
- **6.3** Exclusive Economic Zones in the Australian and South Pacific regions.
- **6.4** Number of whales killed by species, 1925–70, and estimated Southern Ocean populations, 1900–80.
- 6.5 Southern Whale Sanctuary agreed to in May 1994.
- **6.6** Pathways taken by oil released in a marine spill.
- 6.7 MARPOL limits for ocean dumping.
- **6.8** Some key facilities under the Mediterranean Plan.
- **6.9** Territorial claims and major topographical features of Antarctica.
- 6.10 General structure of Agenda 21.
- 7.1 Scales at which environmental decisions and actions take place.
- 7.2 Per capita public and state-guaranteed private foreign debt, c. 1990.

#### **PLATES**

- A Global distribution of forests.
- **B** Forests and woodlands in Australia, c. 1788.
- C Forests and woodlands in Australia, c. 1988.
- **D** Tropical deforestation in an area of the Amazon, 1975–86.
- **E** Development of the ozone 'hole' over Antarctica, 1980–92.
- F Change in annual mean air temperature due to a doubling of CO,.
- **G** Change in annual total precipitation due to a doubling of CO<sub>2</sub>.

#### **TABLES**

- **1.1** Global population changes, 1950–2025.
- 1.2 Some key national indicators 1990–95.
- **3.1** Distribution of the world's forest and woodlands.
- 3.2 Land use in selected areas of South and South-east Asia.
- **3.3** Use of forest resources.
- 3.4 Major producers of industrial roundwood, annual average 1989–91.
- 3.5 An illustrative typology of strategies for forest management.
- 4.1 1992 populations of megacities and estimates for AD 2000.
- 4.2 Urban anthropogenic and net radiation energy fluxes.
- 4.3 Major sources and impacts of water pollution.
- **4.4** Examples of sanitation and water-supply facilities in low-income nations.
- **5.1** Anthropogenically enhanced greenhouse gases and their concentrations, c. 1991.
- **5.2** Cuts in emissions needed for stabilisation of greenhouse gases.

### FIGURES, PLATES, TABLES AND BOXES

#### **BOXES**

- 1.1 Murray-Darling Basin Commission.
- **1.2** Measuring economic activity and welfare.
- 2.1 Woody weeds on Australian rangelands.
- 3.1 Types of forests.
- 4.1 Acid rain.
- 4.2 Radiation.
- 4.3 Air pollution in Australian cities.
- **5.1** Sources and sinks of CO<sub>2</sub>, 1980–89.
- 5.2 Sources and sinks of methane.
- 5.3 Estimated sources and sinks of nitrous oxide.
- **5.4** Planning for greenhouse in New South Wales.
- **6.1** Spills from two oil tanker accidents.
- **6.2** Major provisions of the Antarctic Treaty.
- **6.3** The *Rio Declaration*: abridged principles.
- **7.1** National Strategy for Ecologically Sustainable Development key concepts.