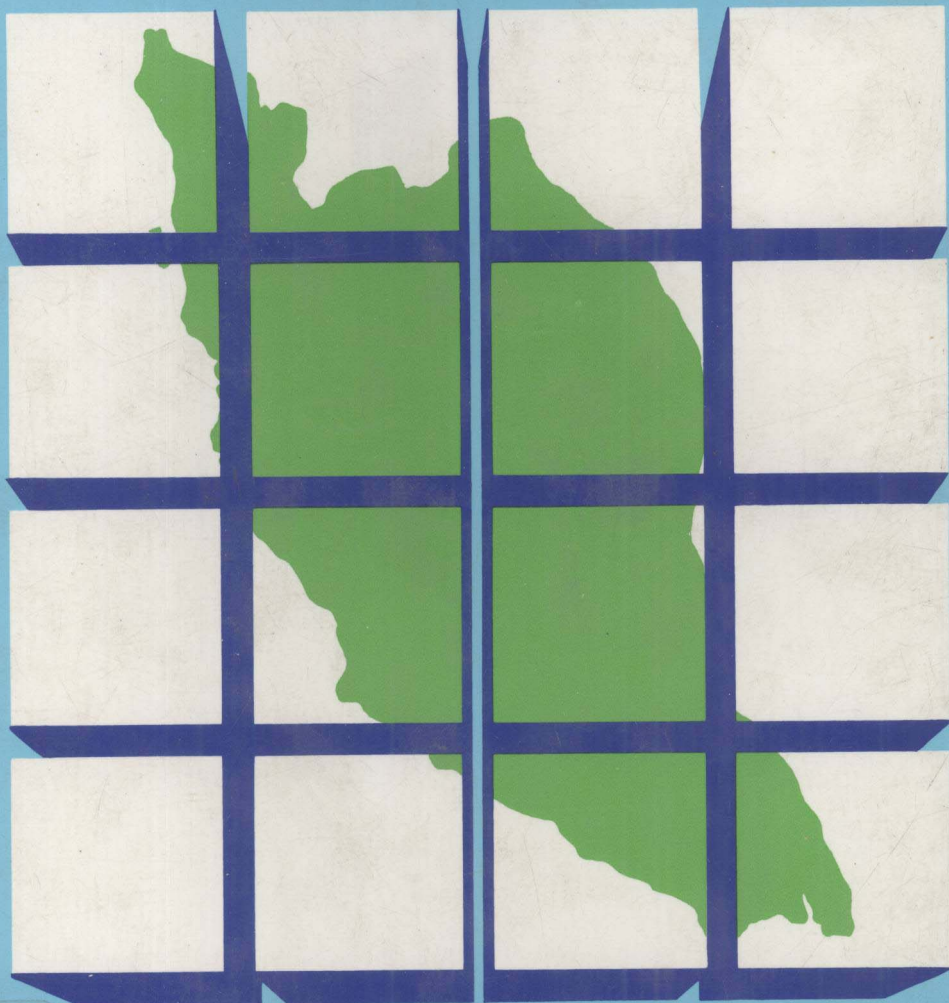


# Development and Environment in Peninsular Malaysia

S. ROBERT AIKEN  
COLIN H. LEIGH

THOMAS R. LEINBACH  
MICHAEL R. MOSS



McGraw-Hill Southeast Asia Series

# Development and Environment in Peninsular Malaysia

S. Robert Aiken, Colin H. Leigh,  
Thomas R. Leinbach, and Michael R. Moss

McGRAW-HILL INTERNATIONAL BOOK COMPANY

Singapore Auckland Bogota Dusseldorf Johannesburg London Madrid Mexico New Delhi New York  
Panama Paris San Francisco Sao Paulo Sydney Tokyo Toronto

Development and Environment in Peninsular Malaysia

Copyright © 1982 by McGraw-Hill International Book Company, 348 Jalan Boon Lay, Singapore 2261. All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photo-copying, recording, or otherwise, without the prior written permission of the publisher.

ISBN 0-07-99204-5

Printed in Singapore by Singapore National Printers (Pte) Ltd.

## ACKNOWLEDGEMENTS

We are grateful to the many people who assisted us during the planning and execution of this book. To our former Malaysian colleagues, our friends, and the government officials who helped us in various ways, we extend our thanks and appreciation. In particular we wish to thank the Departments of Geography of the University of Malaya and Universiti Sains Malaysia for their hospitality, assistance, advice, and research stimulation during our respective sojourns in Malaysia. The final stages in the preparation of the text were completed in Guelph and Montreal. Early drafts of the manuscript were typed by Becky Morrison and Jodi Murray at Guelph, and the final version was patiently and skillfully typed by Doris Lavigueur at Concordia University, Montreal. All cartographic work was completed by

the Cartographic Unit of the Geography Department at Guelph. David Bell provided some excellent advice and Bob McKay produced some early drafts. Marie Puddister industriously and cheerfully worked on the bulk of the maps and diagrams. Without the skill and help of Doris and Marie the final stages in preparing the book would have been infinitely more frustrating. We also wish to acknowledge the financial assistance secured for us through the good auspices of Dr. G.T. Bloomfield and Dr. Brian Slack, Chairmen of the Departments of Geography at Guelph and Concordia, respectively. Without their support our task would have been infinitely more difficult. To these and many others we offer our most grateful thanks.

## FRAMEWORK

In the early years of the present century, according to Sir George Maxwell (1907, p. 2), almost the whole of the Malay Peninsula was covered in forest. He wrote:

It is not that the country is uninhabited, for it has a population of some hundreds of thousands; but it is that the inhabited area, every yard of which has been won from, and hacked out of the forest, is infinitesimal in comparison with the extent of the forest that remains untouched.

By 1990 nothing may remain of the lowland rain forest (Marshall, 1973).

A century ago most of the Peninsula was undeveloped and largely unknown to the outside world (Skinner, 1878; Swettenham 1880, 1885; Bird, 1883; Tennison-Woods, 1884). Almost a hundred years later we are told, in the *Financial Times* of London (8 April, 1980), that

Malaysia is growing rapidly more prosperous and its people are growing steadily more self-confident at a time when many countries around the world are swamped with inflation and girding themselves to face economic recession.

The country's wealth traditionally rests on five basic commodities.

The world relies on the Malaysians for almost 60 per cent of its palm oil, more than 50 per cent of its rubber, 40 per cent of its tin and most of its pepper. Malaysia also exports more timber than any other country.

Considerable reserves of oil have been discovered in Malaysia and it is thought to have some of the largest known reserves of natural gas. In addition, the country is almost self-sufficient in rice.

Export income has risen substantially and the economy has managed to sustain gross national product growth at a steady 8 per cent during the past five years.

Change, especially in the country's most economically advanced region, Peninsular Malaysia, has been the order of the day. Once a seemingly impenetrable jungle fastness, a veritable *terra incognita*,

Peninsular Malaysia is now an important contributor to the world economic system. In achieving its current economic status the region has undergone far-reaching changes in habitat and society and in relations between the two. Certain spatial and temporal facets of those changes are the focus of this book. We have, in short, two major objectives, namely to describe the processes of development and modernization that have shaped the economy of Peninsular Malaysia, and to examine the impact of those processes on the natural, and increasingly on the man-made, environments of the region.

During the 1950s many Third World countries faced the dual challenge of development and nation building as they moved towards independence. The countries that developed most rapidly were those that deepened and broadened their specialization in agriculture. In the case of Malaya (later Peninsular Malaysia) agricultural production and exports were expanded in order to offset lost income due to adverse trade conditions. The country's greater commitment to agriculture was accompanied by diversification and modernization: replanting and new planting on rubber smallholdings and estates, greater emphasis on oil palm, and investments and innovations in padi production all helped to strengthen the agricultural sector of the economy. At the same time agricultural specialization supported relatively successful industrialization. Those who secured higher incomes from agricultural expansion provided a market for manufactured products, while increased agricultural production also sustained the rapid development of numerous local processing industries. Eventually primary exports were able to support the capital and necessary import requirements of the industrial sector (World Bank, 1979). Between 1960 and 1977 the contribution of manufacturing to Gross Domestic Product doubled, thereby increasing to 18 per cent. Within the large and heterogeneous developing realm of today Peninsular Malaysia stands out as a notable example of successful development. Compared to a number

of its Southeast Asian neighbours, Peninsular Malaysia is indeed a prosperous region. Only Singapore and Brunei had higher per capita incomes in the early 1970s (Yeung, 1976).

Despite its various successes, Peninsular Malaysia faces a variety of problems, some of them of long-standing, while others are more recent: regional and ethnic income disparities, shortages of housing, services, utilities, and employment in rapidly growing cities, rural poverty, concentration of industry in a few metropolitan areas, and persistent disease hazards are some important examples. At the national level (Peninsular Malaysia together with Sabah and Sarawak) there are socio-economic, cultural, and political problems of integration to be solved. In recent years in particular the environmental consequences of rapid economic growth have become increasingly evident in both rural and urban areas.

Everywhere and at all times man has brought about selective changes in his surroundings or environment. Indeed some of the world's most admired landscapes, such as the picturesque English countryside or the dramatic rice terraces of the Orient, are very largely the product of human energy and ingenuity. It is worth keeping in mind, then, that man's role as an agent of environmental change is an enduring facet of human history and one that need not result in aesthetic or ecological impoverishment.

Since the onset of the Industrial Revolution, however, the pace of environmental change has greatly speeded up. Man's new-found knowledge and techniques and his more complex socio-economic and political organization have given him ever greater control over the natural world. Increasingly we live amidst our own creations. Man's ability to manipulate the environment, however, as we know from the voluminous literature of recent years and the seminal work of Marsh (1864) and others in the past, must be balanced against his capacity to create widespread and serious environmental degradation. Although there is a very substantial literature on various facets of the land and life of Peninsular Malaysia, no previous work has attempted to draw together the multifarious environmental consequences of man's activities in the region. This we attempt to do in the context of both past and present.

In Peninsular Malaysia, as elsewhere, flagrant disregard of or failure to understand natural processes may result not only in problems of air and water pollution, soil erosion, flooding, and destruction of living things, but may also give rise to various

forms of human hardship. *The Far Eastern Economic Review* (1 September, 1978), quoting an ecologist, provides an example:

No one has seriously considered the effect of a damaged environment upon the rural dweller. Suddenly he can no longer depend upon a prime source of protein — fish. He cannot bathe in the river because he gets ill. With heavy siltation, the river is no longer an effective sewage disposal system. What does his life in the village become but a nightmare? He moves away.

The relations between economic development and environmental change are highly complex. Consider the following brief example. The rapid growth of the timber industry in Peninsular Malaysia has resulted in rapid deforestation. To come to grips with this process would require, among other things, an understanding of the timber industry as an economic enterprise, the techniques it employs, its role in the national economy and in world trade, and its ability to generate rural employment. Consideration, in turn, must be given to the environmental consequences of this activity: What is the impact of the timber industry on the hydrological cycle? Specifically, what does this activity imply in terms of surface runoff, river water volumes, the frequency of flooding, the quality of water in coastal and riverine settlements, and the supply of water to rapidly growing towns and cities? What kind of impact does forest exploitation have on the flora and fauna of the Peninsula? How will the stability of the rain forest environment be affected? To answer these and related questions would require an appreciation of the functionally interrelated components of the biophysical environment of the region, and a yardstick against which to measure the environmental impact of timber exploitation.

Relations between 'development and environment' are further complicated by rural and urban poverty and by the general absence of environmental awareness. Poverty gives rise to its own environmental problems, such as the faecal contamination of rivers, ponds, and wells, and the generally poor living conditions that are experienced in urban squatter settlements and slums. To those who are poor, what is "a bit of landscape, a wild river, or a country's wildlife when its destruction may mean the betterment of their life, even if only for a short period of time?" (Smith, 1972, p. 400). If poverty is to be reduced, priority must be given to quantitative increases in jobs, housing, schools, hospitals, roads, cash crops, industrial output, and to more and better food, all of

which will inevitably result in environmental change.

On the other hand, it is possible to regulate development so that environmental impact is minimized, controlled, and effectively managed. In many cases economic development is accompanied by insufficient environmental care and inadequate knowledge of the biophysical environment. As a result, environments are sometimes created that deny the benefits of economic programmes to certain groups of people, and perhaps, ironically, to those groups specifically intended to benefit from development strategies.

Interest in environmental quality in Peninsular Malaysia is confined to a small number of government officials, academics, and special interest groups. (We should keep in mind that widespread interest in environmental matters is a relatively recent phenomenon even in so-called developed societies.) Because environmental awareness is only now beginning to emerge in Peninsular Malaysia, it will be necessary for the government to bear the major responsibility for environmental protection. Its task, however, is an extremely difficult and sensitive one, because somehow it must balance its avowed aims of achieving rapid economic development and societal change against the need to preserve, conserve, and manage the environment for present and future generations. As MacAndrews (1976, p. 12) has observed, the important issue that must be resolved in the near future is "*how* to devise economic yet effective environmental controls."

This book is a study in man/environment relationships, its major emphasis being on the environmental impact of different economic activities. At this point we should clarify what we mean by these terms and concepts. 'Man' does not refer to mankind, but rather to specific groups of people — farmers, fishermen, urbanites and others — in their social and physical milieu. 'Environment' is understood to mean that which surrounds; as such it embraces not only the natural habitat of soil, rock, air, water, and living things, but also man's various alterations of and additions to the surface of the earth, or in other words, the man-made or cultural landscape. The distinction that is often drawn between the natural landscape and the cultural landscape is usually more convenient than real. Rather than a polarized distinction, it is perhaps more useful to think of a landscape continuum, the primitive or wild landscape being at one end of the spectrum, the city

at the other, with the rural, domesticated scene forming a kind of middle-earth. At any rate, even in the most primitive societies (of which there are few remaining), man induces change in the natural world. In varying degrees, then, man lives in association with the natural and man-made elements that constitute his surroundings or environment (Hewitt and Hare, 1973).

The discipline of Geography has traditionally claimed the study of man/environment relationships as one of its major preoccupations (eg. Pattison, 1964). Consequently a substantial literature has grown around the themes of man's impact on the natural world, the evolution of cultural landscapes, and, in recent years, on the values, attitudes, and intentions that different groups of people attach to their surroundings (Manners and Mikesell, 1974; Tuan, 1974). Although much of this work has been focused on environments and societies of the economically and technologically developed realm, geographers have also been interested in man's impact on humid tropical environments (eg. Moss and Morgan, 1977). In general, however, geographers and other scientists have been slow to appreciate our need, first, to understand the operation of natural processes, and secondly, to comprehend and measure the impact of man's activities on these processes. The crucial point to emphasize here is that only with such knowledge can we begin to devise appropriate resource management strategies.

This is not to claim that we do not know a good deal about the nature of the tropical rain forest, tropical soils, weathering, fluvial erosion, and some of the environmental consequences of human action in the humid tropics, but rather that the interconnectedness of these various components and processes has not, at least until recently, been fully appreciated. Perhaps the main reason for this situation is that no academic discipline has been effectively concerned with the biophysical environment as a whole, and least of all with man's role as an agent of change within such a holistic framework. Geography, with its roots in both the natural and social sciences, might have carved out — in cooperation with other disciplines — such a holistic niche for itself, but largely because of its internal divisions has failed to do so (Mikesell, 1974).

Because of the general absence of a holistic approach to the study of the humid tropical environment, our understanding of process inter-

relationships has tended to be based on unsatisfactory assumptions derived from resource inventories or rather simplistic descriptions of soils, climate, landforms, and other individual components of the biophysical environment. Furthermore, since many inventories and descriptions were based on concepts developed in the mid-latitudes or for arid regions, they have generally proven to be inappropriate in the context of the humid tropics. If our realization of the importance of interrelatedness in the biophysical environment has been rather slow to emerge, so too has our understanding of how, in precise terms, human activities affect natural processes and systems and how the biophysical world adjusts to the impact of human interference.

The biophysical environment of Peninsular Malaysia is currently being altered at an unprecedented pace. Given that many of man's activities in the region are environmentally disruptive, there is an urgent need to adopt systems of economic production and resource management strategies that would result in a balanced relationship between habitat and society. A more meaningful stewardship of the region's natural heritage will require comprehensive knowledge about the operation of natural processes and the results of man's impact upon them. This book is a contribution to that knowledge.

The concepts of development/underdevelopment, modernization, and economic growth are complex and subject to varying interpretations. Thus, for example, some scholars contend that underdevelopment is an active *process*, a state of dependency, largely the outcome of imperialism, and as such must be understood in the light of the structure and functioning of the world's political economy, whereas others claim that underdevelopment is a *condition* which will hopefully be eradicated by emulating the course of Western development and through assistance from the rich nations. In blunt terms, however, the gap between rich and poor countries is widening (Jenkins, 1970; Myrdal, 1971). Modernization usually implies transition from 'traditional' to 'modern' ways of life, modern commonly being understood to mean Western. Social change, however, is invariably more complex than this simple dichotomy implies, and the whole notion of modernization is fraught with the problem of ethnocentrism. In the rich multicultural setting of Peninsular Malaysia, modernization presumably means different things to different people.

Development is not synonymous with economic growth. Development implies a range of possibilities for a more decent existence. Down-to-earth development goals have been spelled out by de Souza and Porter (1974). Their list includes the following: a healthful balanced diet throughout the year, medical care and disease control, environmental sanitation, job opportunities, adequate housing, economic systems that are in balance with the environment, and social, political, and economic equality. Economic growth "is not development, except insofar as it enables a country to achieve [its] human goals. . . (de Souza and Porter, 1974, p. 4).

Prior to the 1960s social scientists gave only passing attention to the problems of development that faced the Third World. By the mid-1970s, however, spatial models of modernization and concepts of development/underdevelopment were of such number and divergence that they seemed to warrant critical examination (eg. Brookfield, 1975). The argument in much of the literature at this time suggested that the 'Western approach' to development, which supports, for example, the importance of industrial growth and innovation diffusion through an urban hierarchy, simply fails to provide adequate explanation of the process. Similarly, deficiencies in the 'modernization paradigm,' in terms of both planning prescription and as predictor of change, were recognized (Freeman, 1979).

The foregoing brief discussion is intended to clarify what this book is and what it is not. It is not a text on development and modernization *per se*. Our objectives are much more modest. The bulk of the work is devoted to an examination of the relationships between specific economic activities — rubber, oil palm, padi, timber exploitation, tin mining, industrialization — and their environmental consequences, both past and present. Since our emphasis is on temporal as well as spatial change, we have traced the origins and growth of the aforementioned activities and examined their current importance in the space economy of the Peninsula. Although economic activities are emphasized, we do include a brief discussion of the spatial diffusion of modernizing institutions. While such diffusion should not be viewed as evidence of thorough and widespread change at all socio-economic levels, we believe that these patterns are an integral part of development in terms of the spatial extension of potential social, cultural, and political as well as economic change. In our

discussion of current urban and regional development policy, we recognize that the growth centre concept may, for a variety of reasons, fail in carrying out its intended function. Malaysian development policy, however, in its attempt to bring about growth in those regions which lag well behind the major urban cores, continues to utilize this notion.

It should be emphasized that our intention is not to explain changes in development and environment within a model building or theoretical framework. Nor, for that matter, do we offer any prescription for alternative regional development policies. What we do provide are some new insights and descriptions of the environmental consequences of certain forms of economic activity within the humid tropical setting of Peninsular Malaysia.

Why have we chosen Peninsular Malaysia for this study? The immediate response must be that we know it better than any other part of the so-called Third World, each of us having lived in and conducted research on the region for varying periods of time. Two other considerations render Peninsular Malaysia a particularly favourable locale for the kind of work we have undertaken: the first is that it has undergone rapid transformations in both society and habitat, the consequences of which in terms of changing man/environment relationships are worthy of study in their own right; while the second — and it is by no means of minor importance — is the wealth of available published information about the region. Since, for the most part, these various considerations do not hold for Sabah and Sarawak (East Malaysia), we have chosen to centre our attention exclusively on Peninsular Malaysia. It is our hope, however, that this book will be of some value in guiding the development process in East Malaysia, and, more generally, that it will be of interest to students, planners, and administrators in other countries of the humid tropics.

How is the book organized? Having stated our objectives above, Chapters One and Two establish broad societal and environmental contexts for the subsequent discussion of economic activities, modernization, and environmental change. Chapter One outlines the growth of population in Peninsular Malaysia from prehistoric times to the present, describes the distribution of population and its ethnic diversity, and briefly examines some population-related problems in the region. The emphasis in Chapter Two is on the components of

the biophysical environment and the processes that operate within it, these being of crucial importance in understanding the consequences of man's role as an agent of change in the region.

Chapters Three and Four trace the economic development of Peninsular Malaysia from the time of earliest colonial contact down to the present. This historical approach, which emphasizes the cumulative impact of change, is retained in Chapters Five through Seven, which discuss, respectively, the nature and extent of environmental change down to independence in 1957 (Chapter Five), the major agents of rural land use change in the post-independence period (Chapter Six), and the environmental consequences of various human activities in recent decades (Chapter Seven).

In Chapters Eight and Nine the focus of attention shifts from the largely rural setting to that of towns and cities. The growth of the settlement system, trends in urbanization, urban population growth, and the demographic, economic, and societal components of urbanization are discussed in Chapter Eight, while in Chapter Nine some of the relatively new and rapidly growing environmental problems of urban areas are discussed in the context of the nation's largest conurbation — the Klang Valley. Chapter Ten places the major themes discussed throughout the book in the context of national development policy, planning, and environmental legislation. Finally Chapter Eleven provides a summary of the main topics raised in the text, emphasizes the role and significance in national development of Peninsular Malaysia's natural endowment, and discusses, with respect to landscape and life, some of the continuing contrasts between the western and eastern parts of the Peninsula.

The spelling of Malaysian place names varies from source to source. We have adopted as our guide to toponyms the English version of the *Third Malaysia Plan*. All monetary values, unless otherwise stated, are in Malaysian dollars (1 M\$ = U.S. 47¢). The emphasis throughout the text is on metric units of measurement. In the great majority of cases these are followed by non-metric equivalents in brackets, the only exceptions occurring in Chapter Six (see p. 130) and in those cases where non-metric measurements are now rarely employed. In the alphabetical listing of references at the end of the book, five year plans and reviews of the plans appear under Government of Malaysia; all other government

publications are listed by Department or Ministry. These entries are followed by a separate list of items pertaining to 'environmental legislation,' environment here being given a rather broad

meaning. The legislation is ordered by subject and by date (from earliest to latest) within each subject category.

# CONTENTS

List of tables	viii	2.2.2 Moisture	35
List of figures	x	(i) Precipitation	38
List of plates	xii	(ii) Interception	41
Acknowledgements	xiii	(iii) Infiltration	41
Framework	xv	(iv) Moisture loss: evapotranspiration	43
		(v) Runoff	46
		(vi) Summary: hydrological balance	46
Chapter 1: Population and society	1	2.2.3 Nutrients	48
1.1 Population trends in the Third World	1	2.3 Spatial expression of the biophysical system	49
1.2 Population: the Southeast Asian context	4	2.4 The stability of the humid tropical environment	52
1.3 The population of Peninsular Malaysia	7	2.5 Conclusions	54
1.3.1 Origins and growth	7		
(i) The prehistoric era	7	Chapter 3: The origins of development in Peninsular Malaysia.	55
(ii) The period of Indian contact and Indonesian migration	8	3.1 The growth of the port of Malacca and European entry	55
(iii) The beginnings of pluralism, 1786-1874	9	3.2 The origins of British administrative control	56
(iv) The period of mass immigration, 1874-1921	9	3.3 The spatial extension of British influence	57
(v) Immigration and natural increase, 1921-1947	10	3.4 Transport, mining, and administration, 1870-1911	61
(vi) The period of rapid natural increase, 1947-1970	12	3.5 Rubber and road-rail competition, 1911-1940	61
1.3.2 Population distribution	14	3.6 The emergence of industry and rural modernization, 1940-1970	64
(i) The western zone of concentration	14	3.7 Complements to development: the spread of modernizing institutions	70
(ii) The northeast belt and areas of low population density.	17	3.7.1 The diffusion of commercial banking	70
1.3.3 Distribution of ethnic groups	17	3.7.2 The diffusion of postal services	73
(i) The Malays	17	3.8 Development as a diffusion process, 1911-1960	80
(ii) The Chinese	18		
(iii) The Indians	18	Chapter 4: Emerging spatial and structural patterns of development	81
1.4 Population problems, economic development, and environment	19	4.1 Sectoral contributions to income.	81
1.4.1 Pluralism	19	4.1.1 Agricultural production	81
1.4.2 Poverty	19	4.1.2 Developments in timber production and impact	85
1.4.3 Population composition and growth	22	4.1.3 Mining	86
		4.1.4 Developments in manufacturing	86
Chapter 2: The biophysical environment	24	4.2 Spatial adjustments in manufacturing	87
2.1 The major components of the biophysical system	24	4.3 Small-scale industries and bumiputra participation	91
2.1.1 The natural vegetation.	24	4.4 Regional development strategy	92
2.1.2 The soils	29	4.4.1 Regional income and production changes	92
2.2 Inputs and processes	33	4.4.2 Policies for regional change	94
2.2.1 Energy	33	4.5 Transport linkages in regional development	97
(i) Spatial and temporal variations in solar energy supply	33		
(ii) Energy conversion; temperature and evaporation.	34		
(iii) Energy conversion; photosynthesis	34		
(iv) Summary	35		

<b>Chapter 5: The changing rural environment: historical perspective</b>	101	<b>7.2.1 Hydrological and erosional changes</b>	169
5.1 The Orang Asli	101	(i) Runoff and erosion prior to crop establishment	169
5.2 Traditional Malay agriculture	102	(ii) Interception and overland flow under tree crops	169
5.3 Nineteenth-century plantation agriculture	105	(iii) Rates of soil loss under rubber	173
5.4 The tin mining industry	109	(iv) Rates of soil loss under other crops	173
5.4.1 Mining techniques	110	<b>7.2.2 The effects of pesticides</b>	176
5.4.2 Environmental deterioration and preventive action	112	(i) Arboricides and herbicides	177
5.4.3 Rehabilitation	116	(ii) Insecticides	177
5.5 Twentieth-century agriculture: the first sixty years	120	<b>7.2.3 Water pollution by agro-based industries</b>	179
5.5.1 Rubber: a new enterprise	120	(i) Rubber processing factories	179
(i) The growth of the industry	120	(ii) Palm oil processing mills	183
(ii) Environmental impact and conservation practices	122	(iii) The utilization of waste products	186
(iii) Environmental change and malaria	123	<b>7.3 The composite impact of change</b>	186
5.5.2 Oil palm	125	<b>7.3.1 Changes in river basin hydrology</b>	186
5.5.3 Padi	126	(i) Rainfall-runoff relationships	188
5.5.4 Other activities	127	(ii) Peak discharges and flooding	188
5.6 The impact of rural development on the fauna of the Peninsula	127	(iii) River sediment loads	188
<b>Chapter 6: Post-independence rural development: the agents of change</b>	130	<b>7.3.2 The impact of change on the fauna and flora</b>	192
6.1 The Federal Land Development Authority (FELDA)	131	(i) Loss of faunal habitats	192
6.1.1 Regional distribution	133	(ii) Hunting and collecting	195
6.1.2 Site selection	135	(iii) Pollution and wildlife	195
6.1.3 Settlement characteristics	136	(iv) Wildlife protection	196
6.1.4 FELDA land use	136	(v) The flora	196
6.2 Other land development agencies	140	(vi) Conservation	197
6.3 Major regional land development projects	140	<b>Chapter 8: The growth of towns, the urban population, and urbanization</b>	200
6.3.1 Pahang Tenggara	140	8.1 Context: the Third World and Southeast Asia	200
6.3.2 Johor Tenggara	146	8.2 The growth of towns and the settlement system	203
6.3.3 Trengganu Tengah	146	8.2.1 The emergence and growth of towns: a historical sketch	203
6.3.4 West Johor Agricultural Development Project	149	8.2.2 The growth of urban centres, 1957-1970	206
6.4 Padi	151	8.2.3 Kuala Lumpur and the emerging conurbation	207
6.5 Forests and forest land use	153	8.2.4 Recent changes in the settlement system	209
6.6 Current land use: ecological considerations	156	8.3 The urban population	212
6.7 Conclusions	157	8.4 Trends in urbanization	214
<b>Chapter 7: Post-independence rural development: the environmental impact of change</b>	159	8.5 Urbanization, urban growth, and societal change	218
7.1 The impact of selective logging	160	8.5.1 The demographic components of societal change	219
7.1.1 The impact of timber harvesting	160	8.5.2 The economic components of societal change	219
7.1.2 Some long-term implications of forest exploitation	166	8.5.3 Pluralism and societal change	221
7.2 The impact of agricultural systems	168	8.5.4 Emerging urban problems	222
		<b>Chapter 9: Emerging urban problems: the case of the Klang Valley</b>	224
		9.1 Some human consequences of rapid urban growth	224
		9.1.1 Squatters, squatter settlements, and slums	224

9.1.2	Health hazards	228	10.1.3	Policy considerations	255
9.1.3	New suburbs: the visual scene	230	10.2	Rural land use policy	256
9.1.4	Traffic congestion	231	10.2.1	Rural land use development: policies for productive land	256
9.1.5	Parks and open spaces	232	(i)	Rural land evaluation	257
9.2	Some environmental consequences of rapid urban growth	233	(ii)	Land capability classification	258
9.2.1	Soil erosion, sedimentation, and flooding	233	10.2.2	Rural land use: non-productive land	259
(i)	Urbanization and soil erosion	233	10.2.3	Policy considerations	259
(ii)	Urbanization and stream sediment loads	234	10.3	Environmental legislation	260
(iii)	Urbanization and hydrological changes	236	10.3.1	Legislation and natural resources	260
9.2.2	Water pollution	237	(i)	Soil and water conservation	260
(i)	Sewage disposal and pollution	237	(ii)	Minerals	261
(ii)	Industrial development and water pollution	240	(iii)	Forests	262
(iii)	Legislation and water pollution	242	(iv)	Wildlife and national parks	262
9.2.3	Air pollution	243	10.3.2	Environment, health, and legislation	264
9.3	Planning strategies	244	10.3.3	The Environmental Quality Act, 1974	265
<b>Chapter 10: National development and the environment: legislation, policy, and planning</b>			<b>Chapter 11: Development and environment in Peninsular Malaysia: retrospect and prospect</b>		
10.1	Urban and regional development issues	247			267
10.1.1	Urban planning and legislation	248	Appendix A:	Environmental legislation	
10.1.2	Urban and regional development policy	250	Appendix B:	Wild animals protected and totally protected under the Protection of Wild Life Act, 1972	279
(i)	Urban policy in the Penang metropolitan area	251			
(ii)	Growth centre strategies	252	Bibliography		283
(iii)	Industrial estates and free trade zones	253	Index		303

# TABLES

1.1	The human population by major region, 1973.	2	4.5	Peninsular Malaysia: gross domestic product by major sector of origin and state, 1970 and 1975.	93
1.2	Population, area, and rate of growth of Southeast Asian countries, 1968.	7	4.6	Peninsular Malaysia: average annual rate of growth in per capita income, 1976-78.	94
1.3	Growth of the Indian population in various states and total acreages under rubber.	10	4.7	Malaysia: social indicators of standards of living, 1975.	96
1.4	Peninsular Malaysia's plural society.	11	6.1	Agricultural land use in Peninsular Malaysia, 1970 and 1975.	131
1.5	Peninsular Malaysia: crude birth, death, and natural increase rates, 1950-70.	12	6.2	Acreages of FELDA land use by state: main crop and total number of schemes.	133
1.6	Population growth in Peninsular Malaysia, 1947-70.	15	6.3	Pahang Tenggara: land use allocation	142
1.7	Peninsular Malaysia: some demographic characteristics, 1970.	16	6.4	Pahang Tenggara: land use in 1966.	143
1.8	Peninsular Malaysia: households living in poverty by ethnic group, 1970.	20	6.5	Trengganu Tengah: agricultural development by sector, management type, and crop, 1970-90.	149
1.9	Peninsular Malaysia: mean household incomes, 1970.	20	6.6	Trengganu Tengah: agricultural development programme by crop, 1973-90.	150
1.10	Peninsular Malaysia: employment by ethnic group and sector, 1970.	21	6.7	Trengganu Tengah: agricultural development by agency in the five year plans, 1973-90.	151
1.11	Peninsular Malaysia: ownership pattern of modern agriculture and industry, 1970.	22	6.8	Summary of forest areas by forest type and region, c. 1972.	154
2.1	Typical soil profile description and analysis, Durian Series, Pasoh Forest Reserve, Negri Sembilan.	32	7.1	Volumes of earth moved in road and track construction.	164
2.2	Rainfall regions of Peninsular Malaysia according to Dale (1959) and Chia (1977).	40	7.2	Effect of cover crops on runoff and erosion.	171
2.3	Infiltration rates on several Malaysian soil series.	43	7.3	Canopy interception by rain forest vegetation and rubber clones.	172
3.1	Straits Settlements: trade and population.	57	7.4	Volumes of overland flow collected on forested and rubber covered slopes in Peninsular Malaysia.	174
3.2	Federated Malay States: roads and rubber, 1910 and 1930.	62	7.5	Rates of suspended sediment transport on rubber covered and forested slopes.	175
3.3	Distribution of value added by manufacturing and number of establishments (%) in 1968.	70	7.6	Soil losses under mature rubber trees.	176
4.1	Peninsular Malaysia: gross domestic product by major industry of origin, 1970-90.	83	7.7	Insecticides recommended for pest control on rubber estates.	179
4.2	States of Peninsular Malaysia: manufacturing establishments and gross value of output, 1965 and 1972.	87	7.8	Principal sources of organic pollution in Malaysia.	180
4.3	Peninsular Malaysia: gross value and rank of principal manufacturing districts, 1965 and 1972.	88	7.9	Chemical and bacteriological composition of rubber factory effluent.	181
4.4	Pioneer establishments, 1972.	91	7.10	Effluent standards for palm oil mills and block rubber factories.	182
			7.11	Estimated water use and effluent discharge from palm oil processing mills.	185
			7.12	Composition of palm oil processing mill effluents.	185

7.13	Rainfall-runoff relationships for some Peninsular Malaysian catchments.	189	8.7	Peninsular Malaysia: the urban population by size of urban centre, 1970	214
7.14	Rates of suspended sediment removal by some Peninsular Malaysian rivers.	193	8.8	Peninsular Malaysia: the ethnic composition of the urban population, 1931-70	214
7.15	Estimated changes in sediment load in the Sungai Pahang.	193	8.9	Peninsular Malaysia: changes in ethnic composition by size of urban centre, 1957-70.	215
7.16	Density of trees with horticultural or pharmacological potential in Ulu Kelantan	197	8.10	Peninsular Malaysia: urbanization, 1911-70.	215
7.17	National parks, nature reserves, nature monuments, and wildlife sanctuaries in existence in Peninsular Malaysia in 1976.	198	8.11	Peninsular Malaysia: Urbanization by state, 1911-70.	217
7.18	National parks, nature reserves, nature monuments, and wildlife sanctuaries proposed in the Third Malaysia Plan.	199	8.12	Peninsular Malaysia: Urbanization by ethnic group, 1947-70.	218
8.1	Urban indices in major world regions, 1975.	201	8.13	Peninsular Malaysia: gross domestic product by sector of origin, 1960-70	218
8.2	Levels and rates of urbanization in Third World regions, 1960-70.	202	9.1	Imperviousness as a function of land use.	236
8.3	Levels of urbanization in Southeast Asian countries and percentage differences, 1960-70.	202	9.2	Runoff coefficients for urban centres	238
8.4	Peninsular Malaysia: growth of towns by size class and the growth of selected urban centres, 1957-70	207	9.3	Methods of domestic waste water disposal in urban areas.	239
8.5	Urban population change in the Klang Valley, Selangor, 1957-90.	211	9.4	Chemical quality of effluents discharged from industrial premises in Petaling Jaya during 1975.	241
8.6	The urban and rural populations, growth rates, and the number of urban centres, 1921-70.	213	10.1	Federal and state responsibility for subjects of environmental significance.	249
			10.2	Availability of suitable land for agriculture, 1975.	257
			11.1	The nature of environmental impact by major development type and land use sector.	274

# FIGURES

1.1	Population density in Southeast Asia, c. 1970.	5	3.6	Industrial establishments by district, 1968.	68
1.2	Orang Asli tribal groups in Peninsular Malaysia.	6	3.7	Industrial net value added by district.	69
1.3	Population density in Peninsular Malaysia, 1970.	13	3.8	Diffusion of commercial banks, 1890-1950.	71
2.1	a. Major vegetation types and forest associations of Peninsular Malaysia.	27	3.9	Commercial banks, 1970.	72
	b. Forest structure and altitudinal variations.	27	3.10	Diffusion of postal facilities, 1890-1955.	74
2.2	Major soil associations of Peninsular Malaysia.	28	3.11	Postal facilities, 1969.	75
2.3	a. Typical soil profile of the Durian Series developed on Triassic Shales, Negri Sembilan.	30	3.12	Postal facilities and road mileages, 1890-1970.	76
	b. Relationship between major soil types of the lowland areas showing appropriate nomenclature (USDA terminology in brackets).	30	3.13	Modernization surface, 1911.	77
2.4	Relationship between surface topography and laterite in central Peninsular Malaysia.	31	3.14	Modernization surface, 1931.	78
2.5	Moisture flow in the tropical rain forest.	36	3.15	Modernization surface, 1968.	79
2.6	Mean annual rainfall in Peninsular Malaysia (in mm).	37	4.1	Major rubber and palm oil producing districts, c. 1970.	82
2.7	Relationship between rainfall and topography.	39	4.2	Major irrigation schemes and padi districts.	84
2.8	Rainfall regions of Peninsular Malaysia.	42	4.3	Average annual percentage growth by manufacturing.	90
2.9	Moisture loss by forest evapotranspiration.	45	4.4	Regional development schemes in Peninsular Malaysia.	95
2.10	Moisture balance at selected sites in Peninsular Malaysia and Singapore.	47	4.5	Peninsular Malaysia: road network improvements and expansion.	98
2.11	Calculated rates of potential primary productivity, decay, and decomposition and their relationship to elevation above sea level.	51	5.1	Gambier and pepper plantations in Johor.	108
2.12	Relative importance of and changes to ecosystem processes before and after forest clearance for agriculture.	53	a.	The distribution of <i>Kangkar</i> settlements in Johor.	
3.1	Malaya: spread of British administration.	58	b.	Gambier and pepper plantations in the Muar Valley, 1904.	
3.2	Road density in Peninsular Malaysia, 1911.	60	5.2	Active tin fields in the mid-1960s.	111
3.3	Road density in Peninsular Malaysia, 1939.	63	5.3	Plant succession on tin tailings.	115
3.4	Road density in Peninsular Malaysia, 1968.	65	5.4	Rubber acreages in Peninsular Malaysia, 1897-1974.	119
3.5	Peninsular Malaysia: Industrial estates, 1970.	66	5.5	Rubber, oil palm, and padi growing areas, 1966. Generalized distribution.	121
			5.6	Some early conservational practices employed on rubber estates in Malaya.	124
			a.	Contour drains with bunds below.	
			b.	Contour drains with bunds above.	
			c.	Echelon drains.	
			d.	Contour terracing with drains on terrace.	
			6.1	Location and spread of FELDA settlements 1960, 1966, and 1977.	134
			6.2	a. Diagrammatic representation of a typical FELDA scheme.	138
			b.	Typical FELDA village layout.	138

6.3	Planned layout and land use of the Jengka Triangle Project.	139	7.6	Sources of effluent in a palm oil processing mill.	184
6.4	Pahang Tenggara: phasing of land use and development, 1971-1991.	144	7.7	Flow chart of a fermentation process for converting palm oil effluent into commercial by-products.	187
6.5	Pahang Tenggara: proposed land use pattern.	145	7.8	Flood peaks in catchments with different vegetation cover.	192
6.6	Johor Tenggara: proposed land use pattern.	147	8.1	Growth of the settlement system, 1911-1970.	205
6.7	Trengganu Tengah: proposed land use pattern.	148	8.2	The emerging Klang Valley conurbation, 1974-1990.	208
6.8	West Johor Agricultural Development Project: extent of area and planned phases.	155	8.3	The growth of Kuala Lumpur, 1895-1974.	209
6.9	Existing and proposed acreages of forest land.	157	8.4	Rank size graphs, 1911-1970.	212
7.1	The distribution of rain forest in Peninsular Malaysia in 1954, 1969, and 1972.	161	9.1	Squatter settlements in the Federal Territory of Kuala Lumpur, 1973.	229
7.2	The extent of forest harvesting and land clearance, 1971-1990.	162	10.1	Growth centres and industrial estates, 1979.	254
7.3	Suspended sediment concentrations in Freshwater Creek, Queensland, during a heavy storm.	165	10.2	Free Trade Zones, 1979.	255
7.4	Sources of effluent in a latex-concentrate factory.	180	10.3	Structure of the Federal Division of the Environment, 1977.	266
7.5	Schematic flow diagram of an experimental rubber effluent treatment plant.	183	11.1	Schematic diagram to suggest the changing land use and landscape unit interrelationships in Peninsular Malaysia since 1850.	271