1 Defining and debating the problem

Piers Blaikie and Harold Brookfield

1 Land degradation and society: initial statements

1.1 Land degradation as a social problem

Land degradation should by definition be a social problem. Purely environmental processes such as leaching and erosion occur with or without human interference, but for these processes to be described as 'degradation' implies social criteria which relate land to its actual or possible uses. Other processes, such as acidification and salinization, are only rarely recognized under natural conditions, at least in an acute form, and have a more directly human origin. The word 'degradation', from its Latin derivation, implies 'reduction to a lower rank'. The 'rank' is in relation to actual or possible uses, and reduction implies a problem for those who use the land. When land becomes degraded, its productivity declines unless steps are taken to restore that productivity and check further losses. In either case, the yield of labour in terms of production is adversely affected. Land degradation, therefore, directly consumes the product of labour, and also consumes capital inputs into production. Other things being equal, the product of work on degraded land is less than that on the same land without degradation.

It may be as well at the outset to face an objection to this statement, to which we return in chapter 5. It may be argued that, if there is abundant land or if losses in productivity can be made up by the provision of chemical fertilizers, degradation is neither an economic nor a social problem. However, this argument can be turned around: without degradation it would not be necessary to move to new land with the attendant costs; without degradation, such large inputs of chemical fertilizers would not be necessary in order to sustain production at constant levels, and efficiency of their use by plants would be greater. Either way, there are both economic and social costs. Also there are secondary costs, such as the nitrification of water supplies, which are purely social in nature in that they affect people and ecological conditions away from the site.

The social significance of degradation has been the subject of a wide variety of views rather than of engaged debate for reasons which are outlined by Blaikie (1985a: 12). We argue that under defined conditions it is a problem of a major order. Decline in the productivity of the land and of labour can be viewed as the 'quiet crisis' which nevertheless erodes the basis of civilization

– to adapt two phrases of Lester Brown (1981). This view claims that the problem is pervasive, often insidious but crucial to the future of humankind. There are elements of environmental fundamentalism in claims of this type – and we examine them in chapter 5 – but they underline the essentially social nature of the problem. Also, there is an important link between the chronic, slow-moving phases of the problem and the acute. When production conditions are adverse, as in a drought, the margin of productivity or of survival for a producer on degraded land is smaller than that of a producer on better managed land. When, as in large parts of Africa in recent years, climatic conditions remain adverse over a long period, farmers on badly degraded land suffer a particularly severe penalty. Land degradation, as well as drought, has been partly responsible for the severity of famine in agricultural areas of Ethiopia and Sudan (Eckholm 1976).

These simple considerations should alone be sufficient to establish land degradation as a problem of social significance. But it is also necessary to our argument to show that land degradation has social causes as well as consequences. While the physical reasons why land becomes degraded belong mainly in the realm of natural science, the reasons why adequate steps are not taken to counter the effects of degradation lie squarely within the realm of social science. Yet the problem of resource deterioration has been curiously neglected by the latter. There have been a few classic texts warning of the problems, such as Malcolm (1938), Jacks and Whyte (1939), Glover (1946), Rounce (1949) and Hyams (1952), but they are rarely cited in recent work. Also, neither classical nor Marxian economics have satisfactorily attacked the methodological problems of studying land degradation, thus depriving social scientists of a developed theoretical base. Seckler points out in chapter 5 that the problems of land degradation are as amenable to economic analysis as any other. But, for a variety of reasons, there has been remarkably little in the way of either empirical or methodological work on the economics of land and water conservation, by contrast with the economics of pollution which has a large literature. The *Journal of Soil and Water Conservation* and the output of some Departments of Agricultural Economics in the United States Midwest are perhaps honourable exceptions.

One of us (Blaikie 1985a) has recently sought to open the issue of degradation of land as a social problem. Essentially, that book built a number of theories to explain different aspects of degradation and conservation, drawn mostly from the standpoint of political economy. The present volume offers a greater diversity of approach, as well as a greater breadth of case-study material. A number of central social issues in land degradation which received only thematic treatment in the earlier book are discussed here in detail. These include the problems of measuring and economically appraising losses, and different institutional arrangements for land management, including common property and private property institutions and the state. More particularly, we also draw on a long and varied historical perspective in order to focus on the reasons why land management fails to be effective.

1.2 *Issues of significance*

Central to the issues discussed in this volume is the role of the 'land manager'. Land managers may find themselves responding to changes in their social, political and economic circumstances quite independently of changes in the intrinsic properties of the land which they employ. They may be denied access to common resources, or be forced to grow crops by landlords, market or social demand, or by the state. They have to find a strategy with which to meet such pressures, and do this on land which itself changes in nature. The intersection of circumstances and strategies forms our subject matter.

Any interference by humans with the natural processes of soil formation, evolution and erosion has an effect upon these processes, often unforeseen. Leaching, compaction and erosion of the soil, changes in plant cover and hydrological regime, changes in soil and water chemistry all take place naturally in the absence of any human intervention or even presence; in some environments these processes take place quite rapidly under natural conditions. Violent atmospheric events can cause rapid changes in environments empty of people. In some islands of recent geological origin, it can be shown that the soil had been eroded and/or become able to support only a limited biota long before the arrival of people. Yet human interference has modified and usually accelerated all these processes and has created the conditions under which new sets of processes, previously absent or insignificant, come into play. With the exception of the work of bulldozers, explosives, trail-bikes and other tools of malice, all the processes of land degradation occur in nature, but human activity on the land changes the conditions of their operation. The task of land management is to recognize these changes and find some means of bringing them under control.

However, the effect of human interference is not the same at all times and in all places. Human management of the land without leading to degradation is not only possible in a great majority of environments, but has been frequently accomplished in human history. However, the same human skills are not useful and effective in all places; under similar systems of management the productivity of some land is well sustained, while that of other land deteriorates rapidly. The problem is further compounded by the fact that degradation has occurred at one period but not at another on the same land. Agro-technology has not only changed through time, but has also been applied with differing degrees of care and perception.

Human-induced degradation occurs when land is poorly managed, or where natural forces are so powerful that there is no means of management that can check its progress. Some degradation is caused when land that should never have been interfered with is brought into use, but most land now subject to accelerated degradation is capable of more effective management than it receives. Our basic question is why these failures have occurred, and whether or not the problem has been perceived as such by those responsible at the place and time.

Since land degradation has occurred in such a wide variety of social and ecological circumstances, it is clearly futile to search for a uni-causal model of explanation. Equally, there is a number of hypotheses which have useful explanatory power, such as 'population pressure' or the exploitation by people of people, and these are examined in this volume. However, we shall see that while there are many causes where 'population pressure' has contributed to land degradation, in others a marked *decrease* in population densities has led to the same result. Likewise, an onerous burden of taxes, inequitable distribution of landholdings, corvée labour systems and the like, have probably led to declining management on the part of the exploited, but not invariably. On the other hand, there are many examples where very favourable prices for agricultural commodities or for timber have led to accumulation of profits, but also to land degradation. This complexity leads us away from any single theory of land degradation, since there are so many conjunctural factors operating at one place and time. Rather, case-study material and discussion of methodological issues together suggest a general approach to the problem of land degradation to provide an illustrated manual with which readers can approach their own empirical evidence.

2 Definitions of value, capability and degradation

2.1 Choices in defining degradation

As the opening paragraph of this chapter states, the dictionary meaning of degradation is 'reduction to a lower rank'. The term is therefore perceptual and implies at least a 'rank' scale of relative measurement. As a perceptual term, however, it is open to multiple interpretations. To a hunter or herder, the replacement of forest by savanna with a greater capacity to carry ruminants would not be perceived as degradation. Nor would forest replacement by agricultural land be seen as degradation by a colonizing farmer. Usually there are a number of perceptions of physical changes of the biome on the part of actual or potential land-users. Usually, too, there is conflict over the use of land – whether it be between farmers and conservationists, pastoralists and peasants, small farmers and the state, developers and concerned landholders. Since degradation is a perceptual term, it must be expected that there will be a number of definitions in any situation. It is, therefore, essential that the researcher recognizes any such conflict over the use of land and, therefore the definition of degradation. Sometimes the definition is given to the researcher as the 'ruling' one or the state-supported one, in the sense that land should be used in a certain way and degradation is, therefore, defined as reduction in capability to fulfil this demand. Sometimes the researcher will wish to supply other criteria derived from her/his own political and technical viewpoint.

It is of course more usual to employ the language of natural science to describe degradation, from the perspective of the soil scientist or agronomist.

However, the processes are varied and, from a social point of view, their impact may be felt in very different ways. Erosion, especially gully erosion and massive sheet or rill erosion, is very obvious, although the role of human agency may not be. Modification of horizon structure, partial removal of fine particles, pan formation, podsolization, compaction and similar changes are less obvious and have only a more gradual effect on the productivity of the land. Changes in hydrology affect the flow of streams and ground water, affecting storage and the supply of water to livestock and people as well as to the soil. Impoverishment of vegetation, the invasion of weeds and the selective elimination of soil fauna and the larger fauna which live on them affect the whole quality of environment as well as of the land; new environments, such as the Mediterranean *maquis*, may be created and come to be regarded as natural. Among more insidious processes, salinization becomes persistently severe in dry areas and periodically severe where drought is of irregular incidence, where it is seen as a problem mainly at such times. Acidification, on the other hand, affects the rooting depth of plants in a more lasting manner, but its build-up is very slow and it is not at once perceived as a problem.

These physical changes have to be evaluated also in social terms. The first step is to estimate reductions in yields of crops, livestock or useful vegetation resulting from these changes. A useful review can be found in Stocking and Peake (1985). This is a relationship which researchers are only beginning to be able to quantify, and there are many crucial gaps in both our basic understanding and in orders of magnitude under different conditions. The second step is the evaluation of degradation in economic terms. As chapter 5 indicates, there are on-site and external dis-benefits of degradation, now and in the future; however, these are generalized income benefits expressed in money terms. Although these are of obvious and overriding importance in assessing the impact of degradation, they leave unanswered the problem of varying and competing perceptions of degradation. For example, a reduction in income for agriculturalists may result in an increase for herders. Also there are issues of the distribution of losses from degradation between different groups, and access to alternative means of livelihood (e.g. new land) or to new technologies to limit the effects of degradation or to reverse them – all these affect the boundary conditions for accounting the social impact of land degradation.

2.2 The 'value' of land

There is also another issue which should be discussed before proceeding to a definition of land degradation, and this concerns the 'value' of land, which in some way is reduced for the user by degradation. It raises a number of theoretical problems. In none of its forms does the theory of value take adequate account of the 'value' contained in the natural source of all energy in the ecosystem, the sun's energy and of the stored products of that energy,

which include the weathered material and nutrients which constitute the soil. Such 'value' cannot be said to be created by labour, does not have a cost of production, and is priced by the market according to a mixed set of utilities, including location, which often ranks higher than quality. Insightful comment on the failure of economics, specifically but not only Marxian economics, to take account of the physical processes underlying production is provided by Alier and Naredo (1982), Alier (1984) and Gutman (1985). While these authors, and the nineteenth-century socialist, Podolinsky, also fail to consider land degradation, they call attention to the failure of economics to consider energy flows or to come to terms with the notions of energy, except in a very imperfect manner.

Marx did, in fact, come somewhat closer to an appreciation of the role of land in production than did most other classical writers. He recognized that:

> Man ... can work only as nature does, that is by changing the form of matter. Nay more, in this work of changing the form he is constantly helped by natural forces ... labour is not the only source of material wealth, of use-values produced by labour. (Marx 1887/1954: 50)

But while there is a recognition of land as the product of natural forces, land – and other natural resources – were considered 'free' inputs into production and did not produce value since it was only labour that was considered to perform this function. On the contrary, it is clear that land may need to be 'paid' a great deal in order to continue to 'exist' at the same quality, as this book seeks to demonstrate. Even modern resource-depletion models fail almost entirely to consider the environment itself as a degradable resource (Hufschmidt *et al.* 1983: 57). It is difficult, therefore, to use the term 'value' in relation to land, and even Robinson's (1963: 46) cop-out in regarding value as a metaphysical concept without empirical meaning does not help; we therefore avoid the term.

2.3 *Capability' of land*

The term used instead is *capability*. When land is degraded, it suffers a loss of intrinsic qualities or a decline in capability. This term is not one within the economic literature. It is, however, in modern agronomic literature with something like the sense which is required. As a first step towards clarification, degradation is defined as a reduction in the capability of land to satisfy a particular use. If land is transferred from one system of production or use to another, say, from hunter-gathering to agriculture, or from agricultural to urban use, a different set of its intrinsic qualities become relevant and provide the physical basis for capability. Land may be more or less capable in the new context. This is important, because it must not be supposed that deforestation *necessarily* constitutes degradation in a social sense, even though it certainly leads to changes in micro-climate, hydrology and soil. Socially, degradation must relate to capability, and it is only if the

degradation process under one system of production has reduced the initial capability of land in a successor system, actual or potential, that degradation is, as it were, carried across the allocation change. In actual practice, this is often the case, since more serious degradation reduces capability for most, if not all, future possible land uses.

2.4 *A definition of degradation*

We have noted that the effect of human interference need not always be deleterious. It is also possible to restore and improve land, and to create new productive ecosystems of which the outstanding example is the irrigated rice-terrace. The land itself also has its own means of repair: new soil is formed, gullies grass over and become graded; nutrient status is restored under rest. Just as we need to take account both of the interaction between natural processes and human interference in degrading land, so also we must recognize both natural reproduction of capability and of human artifice in assisting this reproduction. Bidwell and Hole (1965) made a useful distinction between 'beneficial' and 'detrimental' effects of human works on the soil. So also should we distinguish between the beneficial and detrimental processes in nature.

Degradation is, therefore, best viewed not as a one-way street, but as a result of forces, or the product of an equation, in which both human and natural forces find a place. We could say that:

Net degradation = (natural degrading processes + human interference) – (natural reproduction + restorative management)

A neat example of the variation of natural reproduction and its impact upon net degradation is provided by a comparative study of Hurni (1983) in which he compares the soil-loss tolerance in the mountains of Ethiopia and the hills of Northern Thailand. In the former case, cultivation has been going on for 2000 years with a fairly low rate of soil loss. However, the cumulative loss and slow rates of natural soil formation have both served to produce very serious land degradation. In Northern Thailand, however, with higher rates of soil loss, the local land-management system has 'compensated' for this and the capability of the land, in which soil formation is more rapid than in Ethiopia, is maintained.

3 The role of land management

3.1 *Ways of managing land*

With a definition of degradation as a reduction of capability, the role of land management becomes clear. Land management consists of applying known or discovered skills to land use in such a way as to minimize or repair degradation, and ensures that the capability of the land is continued beyond

the present crop or other activity, so as to be available for the next. There is no system of land use, anywhere in the world, that does not have agro-technical means with which to achieve or at least approach these ends, provided they are practised in natural environments suitable for their employment.

At the simplest level, rotational grazing and shifting cultivation are effective strategies if well managed, with sufficient land over which they can be applied. Both are 'avoidance' rather than 'control' strategies (Kellman 1974) in that they leave reproduction of capability to natural repair, and avoid the need for intensive inputs on site. Many control strategies are, however, incorporated into modifications of these simple and ancient methods of management; slope control and water control are both employed in association with shifting cultivation, and so also is the addition of fertilizer. Rotational grazing is more easily managed with the addition of fencing and tethering. The major step forward from these strategies in temperate lands was mixed farming, in which both cultivation and grazing were rotated in relation to one another. Thus, perhaps as early as from the eighth century onwards, the two-, three-, and four-field systems of Europe emerged from an essentially shifting-cultivation base. In the humid tropics, mixed rotational farming was less widely suitable and wholly arable technologies evolved, generally involving massive inputs of human labour aided by livestock and their manure to make possible the permanent cultivation of land. Modern technology has added a range of artificial fertilizers, leguminous crops employed in rotation, and the ability to undertake much larger site-management works. We encounter some of this range of practices in the following chapters.

Fundamentally, the land manager's job is to manage natural processes by limiting their degrading consequences, both 'on-site' and 'downstream'. By 'downstream' is meant external effects away from the site, whether actually downstream, downslope or downwind, or effects which undermine the efforts or exacerbate the problems of neighbours, wherever located. The natural processes involved fall into two main groups, the mainly biological/biochemical and the mainly physical. They have a different range of impact, and present different, though related, management problems. The main problems of biological/biochemical management are on-site, though they have important 'downstream' consequences through the movement of mobile ions which can lead to salinization. The basic problem is to cope with the fact that purposive plant growth and removal for use tends to extract mineral and organic elements from the soil faster than they can be reproduced. Natural replacement requires a rest period or the planting of crops and trees which often have a low value in use. Reproduction of the capability of the land itself is usually the secondary objective of farming systems, but it is a vital objective and one that can absorb a great deal of labour.

The natural rate of soil formation varies enormously over the world, from close to zero in a thousand years in parts of Africa and much of Australia, to

the formation of a capable solum in as little as ten years on some volcanic ashfalls under humid tropical climates. The impact of the cumulative loss of soil upon crop yields is also probably extremely variable. It has been estimated that a 15 mm loss from an Oxisol in an experiment in Indonesia (Suwardjo and Abyamia 1983, reported in Stocking and Peake 1985) caused a 40 per cent yield reduction, while a mere 2 mm loss from an Ultisol caused a 15 per cent yield reduction. Also, if these results are compared with data from the United States, it appears that the tropical Oxisol suffered a yield reduction ten times that of temperate soils and the tropical Ultisol twenty times that of temperate Ultisols, with similar soil loss. Even if these preliminary data are only approximately correct, they indicate great variation in the manager's task of maintaining land capability.

3.2 *Landesque capital*

It is important to distinguish between land management in relation to the current crop, the object of which is the production of that crop and the consequences of which are incidental, and purposive land management designed to secure future production. In the nature of things, most of the latter is in the physical area, though if a clearing for shifting cultivation is to last two or three crops, then a part of the labour put into initial clearing creates 'capital' for the second and third crops. The institutional costs of the reorganization of land tenure to make the installation of the three-field system possible in ancient Europe constituted 'capital' which endured for centuries. However, there is a class of works, including stone walls, terraces and such improvements as field drains, water meadows, irrigation systems and regional drainage and reclamation systems which is much more purposive in intent, the specific object of which is to create capital for the future maintenance of land capability. Investments of this nature have a long life and are sometimes described as *landesque capital*, which refers to any investment in land with an anticipated life well beyond that of the present crop, or crop cycle. The creation of landesque capital involves substantial 'saving' of labour and other inputs for future production. There is very little literature on this subject, and what there is suggests that the private benefits to land managers of costly landesque investments are seldom enough over the term of typically perceived discounting rates. We therefore have to supplement these (rather sparse) economic explanations with others to explain why landesque capital is (and was) created at all. As we shall see later in this volume, sheer necessity created by a lack of other options (in order to ensure the survival of the land managers themselves) and particular coercive relations of production are two of the most common explanations, amongst other social and political reasons.

There is a need to be aware that conservation decisions, including the investment in landesque capital, are not often made by individual decision-makers, who will bear all the costs and reap all the benefits. Therefore, one must be able to identify clearly the land manager(s) or hierarchy of land

managers, whoever they may be – farmer, developer, landlord, agri-business, manager, government official or whoever. This issue of identification is discussed more fully in chapter 4 but it is enough to say here that managers may have different decision-making environments and different claims or demands upon the same tract of land.

4 Conceptualizing the role of land management

While this larger question of defining the 'land manager' may be deferred until chapter 4, there remains a need to define briefly the task of land management in relation to the natural processes which require to be managed. These are two-fold and concern the role of land management respectively in checking the natural processes of degradation and in aiding the natural processes of repair. What we need to do is to define, simply and unambiguously, the characteristics of the land that is being managed in such a way that will specify the nature of the land-management task.

4.1 Sensitivity and resilience of land

There are two qualitative terms which are useful in describing the quality of land systems (soil, water, vegetation) and these are *sensitivity* and *resilience*. A number of other terms have been used, including 'susceptibility' and 'fragility' (Winiger 1983; Glaser 1983), but some of these are loaded terms. The first term chosen here is sensitivity and it refers to the degree to which a given land system undergoes changes due to natural forces, following human interference. The term used here refers to sensitivity to erosion as well as to other forms of damage, such as the accumulation of mobile ions (which can give rise to salinization).

The second group of land characteristics of importance in land management concerns the ability of land to reproduce its capability after interference, and the measure of need for human artifice toward that end. This restoration of capital in the form of organic matter, nutrients and soil structure occurs naturally under forest or grassland fallow, as Nye and Greenland (1960) demonstrated in a manner that is still relevant. It occurs, however, at very different rates in different situations, while the depletion under cultivation which creates the need for restoration also takes place at very different rates. Certain ecosystems offer high initial productivity but this is rapidly depleted; in others, productivity is better sustained under repeated use. This property of standing up to, or absorbing the effects of interference, is only partly correlated with what is loosely termed 'fertility' of the soil.

Broadly following Holling, we propose to term this property *resilience*. Holling wrote of the resilience of a natural system where 'resilience is a property that allows a system to absorb and *utilize* (or even benefit from) change' (1978: 11). Where resilience is high, it requires a major disturbance

to overcome the limits to qualitative change in a system and allow it to be transformed rapidly into another condition. Also, resilience is independent of the quantitative primary productivity of the site, be it small or great.

It will be apparent that, where a site is highly resilient and also insensitive to the forces of damage, the task of land management is relatively easy. Many wetlands, even though they require some initial drainage and may be liable to occasional flood, have both these properties, as do alluvial plains in humid climates. It may be for this reason that, as recent research has established, most early agriculture in southern Europe and the Middle East, and perhaps elsewhere also, was on moist land; it was fixed-plot cultivation on land easy to manage, from which there has been subsequent differentiation into various forms of wetland and dryland farming (Sherratt 1980, 1981). Even shifting cultivation, adapted to land of low resilience, is seen as a subsequent development in this argument.

Usually the resilience of land has limits, and the task of land management becomes one of supplementing natural resilience with devices such as land- and crop-rotation, manuring and fertilization, the planting of legumes and a range of tillage and land-preparation methods, many of which are also linked in part to the control of sensitivity to damage. It is a part of our argument to show that almost all land other than the most infertile or least capable, least resilient and most sensitive, can be managed at some level of production wherever there is water and a sufficient growing period. Recent research even in the Amazon basin has shown that only about 3 per cent of its soils are incapable of management in some form, despite the acidity and low fertility of 75 per cent of the remainder (Sanchez *et al.* 1982; Wade and Sanchez 1983). The cost of management may, however, be very high whether in terms of labour or material inputs.

To summarize the 2 × 2 table of characteristics of land and the implications of land use and management:

(a) a land system of low sensitivity and high resilience only suffers degradation under conditions of very poor land management and persistent practices which remove soil, increase compaction, salinity, etc.;
(b) a land system of high sensitivity and high resilience suffers degradation easily but responds well to land management designed to aid reproduction of capability;
(c) a land system of low sensitivity and low resilience is initially resistant to degradation but, once thresholds are passed, it is very difficult for any system of land management to restore capability;
(d) a land system of high sensitivity and low resilience easily degrades, does not respond to land management, and should not be interfered with in any major way by human agency, except (paradoxically) where major works create the landesque capital of a wholly new agro-ecosystem. The comparison between the impact of soil loss on productivity in temperate

and tropical soils indicates that the latter tend, as a class, to have a relatively high sensitivity and low resilience and, hence, present more difficult management problems.

Two examples may serve to illustrate further the implications of different degrees of sensitivity and resilience for land. The first concerns the middle hills of the Nepal Himalaya, where some of the world's worst induced erosion is said to be taking place (e.g. Eckholm 1976). It is now established that the Tibetan plateau has been uplifted some 1000 m over the past 100,000 years (Ives 1981). Over the whole period, this is a mean rate of 1 cm/year. The Himalayan face has been uplifted at a lower rate, creating high natural erodibility as the slope becomes steeper, but an estimate of current uplift in the middle hills is 1 mm/year (Iwata, Sharma and Yamanaka 1984). In a small catchment in central Nepal, Caine and Mool (1982) calculate an annual lowering rate from mass wasting of 1.2 cm/year, while Williams (1977, cited in Carson 1985) calculates total denudation rates in four large catchments ranging from 0.51 to 2.56 mm/year. Regional uplift and regional degradation are natural processes, and the effect of terracing for agriculture has often been to check natural surface erosion rates, though with no significant effect on the more sporadic and localized mass wasting processes (Carson 1985). The management of such terrain presents enormous problems. This is an example of land with high sensitivity and of variable resilience. We return to this example in chapter 2, section 5.

The second example is from the lowlands of western and central Europe, which would seem on *prima facie* grounds to present a much less sensitive environment, with geological stability, a climate of low erosivity, and low relief. However, the whole region is mantled by a loess-type periglacial *limon*, of low permeability and, in the absence of management designed to ensure such permeability, has been subject to substantial erosion, leading to the redeposition of colluvial material. Discussed further in chapter 7, this region has been shown to have quite high sensitivity and to be subject to episodic damage. Sensitivity is not always readily explained and the less obvious it is, the greater perhaps the danger that a relaxation of management might lead to damage. However, under better management, the land system was able to reproduce its capability and even to increase it as a result of the degree of its resilience.

4.2 A summary

At the outset, the problem was posed as the search for social causes within the interaction between natural and human causes of degradation. In order to undertake this task, a definition of degradation was needed, which is a loss of capability to satisfy the demands made upon it. These may be competing, hypothetical or future ones, and it is important to specify against which of them a loss of capability is being measured. Noting that most processes of both damage and reproduction are natural but that their operation is greatly influenced by human interference and artifice, the problem can be summarized by an equation in which degradation becomes a net function, both of human and natural forces, both of damage and repair.

This led us to the consideration of the role of land management and of the importance of the land manager – an issue which we sidestepped at this stage. In order to define the task of land management and the means of encapsulating the work of natural scientists, simple terms were required. *Sensitivity* to physical and other forms of damage and *resilience* of the site characteristics in the face of use were identified as the two most relevant characteristics.

5 Relationships between society and land degradation

Having defined our key terms, the next task is to outline the main characteristics of the relationship between land degradation and society, and then to draw conclusions about an appropriate method of analysis. We identify three main characteristics: the interactive effects of degradation and society through time; the crucial considerations of geographical scale and the scale of social and economic organization; and the contradictions between social and environmental changes through time.

5.1 Interactive effects

As in many complex issues of social or physical change, there is a reflexive and two-way relationship between land degradation and society. To take the similar case of population growth and development, for example, rapid population growth can, under certain conditions, adversely affect economic development and the living standards of the majority of the population unless the economy can be expanded at a comparable or greater rate. Conversely, however, many aspects of poverty lead couples to have large families, and thus encourage a high population growth rate. In the same way, land degradation can undermine and frustrate economic development, while low levels of economic development can in turn have a strong causal impact on the incidence of land degradation. Blaikie (1985a: 117) offers examples of 'desperate ecocide' by peasants and pastoralists under extreme pressure to survive, and chapter 2, section 4 in this book gives a further illustration.

These interactive effects also take place through time. A period of rapid degradation may reduce the range of options over the possible uses to which land can be put in the future, unless there is effective repair. The future history of the affected region therefore takes a different course. This simple observation is somewhat complicated when establishing the impact of such land degradation upon the future history of the relevant people who use, or would have used, the land. The problem revolves around the convenient

word 'relevant'. First of all, land degradation can affect, presumably adversely, the options of people living in the afflicted area, and future generations. However, if these future generations have the option of migrating elsewhere the issue becomes hypothetical. If, on the other hand, they do not have this option – perhaps because of national barriers as in the case of the Sotho of Lesotho, if the option of working in the South African gold mines is closed in the future – then the impact of degradation of a region on the present population becomes a very real question for analysis. This issue is one of 'option values' which is discussed in chapter 5.

5.2 Interaction and scale

The scale issue is crucial to the definition of land management because it focuses on the boundary problem of decision-making and of allocating costs and benefits. One person's degradation is another's accumulation, and this is equally true of uphill and downhill positions of a slope, regions, nations and even continents. For example, the 'hollow frontier' of Brazil in the early twentieth century, and that of the United States in the nineteenth, might be said to have contributed to the process of accumulation and the development of infrastructure on a national scale in the form of railways, roads and services. The fact of degradation on the settlement frontier had its effect on future options there, but the immediate effect of extracting short-term profits from the land was beneficial in the national context.

On a smaller scale, the physical transfer of fertility via riverborne silt and dissolved minerals, or by deliberate transportation of organic or mineral fertilizer from one place to another, makes it necessary to develop a more sophisticated set of criteria with which to analyse the impact of land degradation in one area upon the wider society. The exceptional case of Nauru has particular point here. The removal of rock phosphate from Nauru since 1900 has destroyed the agricultural capability of the island, which was never high, in the interests of overcoming phosphate deficiency in the soils of Australia and New Zealand. Latterly, the Nauruans have received good compensation for this loss, which they have invested mainly in the Australian economy, and on the proceeds of which they now largely live.

5.3 Contradictions between social and environmental change

The third aspect for debate concerns the possible contradictions between the criteria used for land degradation, and those for beneficial social change, or 'development', through time. An increase in cash incomes through commercial cropping and ranching can yield a temporary increase in rural incomes, maybe even over several generations, but can lead to degradation through lack of attention to management of the land, and hence to subsequent income reduction. Examples of this contradiction are legion. With the development of synthetic fertilizers, and their manufacture in larger

and larger quantities, it can be argued that those pioneers who put profit first and good land management second made the right decisions, since the deleterious consequences of their actions are now masked by inputs of industrial origin. Moreover, while it may be that the modern oil-based fertilizers will not always be available, and more certainly will not be available so cheaply as oil resources finally approach exhaustion, the optimists would maintain that substitutes will be invented as the need arises. It is impossible to refute this argument, other than by pointing to the lower long-term cost of adopting management strategies which rely more upon natural processes of regeneration and repair.

6 The approach adopted in this book

6.1 Demands made by the society/land degradation relationship upon the method of analysis

Three characteristics of the relationship between land degradation and society have been identified: the importance of interactive and feedback effects through time, the importance of scale considerations, and the contradictions between social and environmental changes through time. These have to be recognized as placing difficult demands upon the way in which land degradation and society is studied.

One of the chief demands is a great deal of data, and there immediately arise technical problems of definition, measurement and availability (these are discussed in chapter 3). The second set of data problems involves the relationship between physical changes in soil and vegetation and declines in the productivity of the land (e.g. crop yields, livestock production). Again, this is partly a technical exercise, and much of the biophysical modelling of these relationships is beset by enormous uncertainties and errors (Amos 1982), but it is also an exercise which must try to distinguish the impact of physical changes in soil and vegetation from the impact of other purely socioeconomic changes in the circumstances of the land manager. Thirdly, there are difficult problems in the quantification of flows between people and regions. These derive from several distinct sources: the problem of conversion of flows of qualitatively different types to a common measure where energy, nutrients, available calories for human consumption, and market or shadow prices are only sometimes interchangeable; more abstract theoretical problems of incorporating the 'value' of resources found in nature (see page 12); and lastly the 'unit of account' problem discussed on page 14.

Wide degrees of error can therefore be made in the assessment of the important causes and rate of degradation and the reduction in capability of land. The ambiguity is compounded by the scantiness of data on farming and pastoral practices. Over long periods particularly, the causes of degradation usually involve social and economic changes which are difficult to measure,

even if it is possible to reconstruct qualitative processes (see chapters 9B and 10B). If, for example, it is suggested that onerous rates of taxation and rents were responsible for heavy-handed and exploitative management of the soil, the challenge is to 'prove it'. A rigorous explanation linking the cause and effect would also have to predict that a reduction in rates of taxation and rents would reduce exploitation of the soil. This account of the problems should not be a charter for sloppy reasoning and inadequate empirical verification, but it does indicate that the extent of rigour in any analysis is as much a matter of circumstance as it is of necessity.

What then is our response to these demands for data which probably cannot be met? Presented with these problems it looks as if the task of explanation outruns the prospect of empirical verification. Part of the response is an adaptation and development of the ideas of Thompson and Warburton (1985a, b) who suggest ways of 'getting to grips with uncertainty'. The first element in our approach is to accept 'plural perceptions, plural problem definitions, plural expectations and plural rationalities' (Thompson and Warburton 1985a: 123). There *are* competing social definitions of land degradation, and therefore the challenge of moving away from a single 'scientific' definition and measurement must be taken up. This means we must put the land manager 'centre stage' in the explanation, and learn from the land managers' perceptions of their problems. Thus land becomes a 'resource-in-use', inextricably related to the people and society that uses it. It also means that we avoid single hypothesis explanations of degradation (and these are critically reviewed in the next chapter). Degradation at one place and time will be conjunctural and complex. There *are* patterns that repeat themselves in human–environment relations, but their modelling can only be partial at best. Case-study material therefore becomes crucial, and is a dominant feature in this book. But it is easy to lapse into a mere recording of unique events full of 'emic' data, which are difficult to relate to each other. Therefore an approach is suggested which allows for complexity, uncertainty and great variety, and one which takes as its point of entry those data which are beset with *least* uncertainty – the direct relationship between the land-user and manager and the land itself.

The other response to uncertainty leads us in a different direction, but one which is not contradictory. This is to try and improve our means of measuring and evaluating land degradation. If outside institutions are to make any contribution to the reduction of land degradation and of the incomes of people who rely on the land for their livelihoods, they will have to know *if* there is a problem and how great it is. Therefore, reliable methods of measurement of land degradation are crucial. Of course data are not reliable, they are *constructed*, and considerable attention in this book is devoted to their ideological nature, but this does not detract from the necessity to improve techniques of measurement. To this end chapter 3 explores the problems and prospects. Also, we need a methodology to evaluate the importance of land degradation in economic terms and a contribution to this is offered in chapter

5. First of all, the theoretical basis of the approach to land degradation and society is outlined in the next section.

6.2 *The approach of 'regional political ecology'*

The complexity of these relationships demands an approach which can encompass interactive effects, the contribution of different geographical scales and hierarchies of socioeconomic organizations (e.g. person, household, village, region, state, world) and the contradictions between social and environmental changes through time. Our approach can be described as *regional political ecology*. The adjective 'regional' is important because it is necessary to take account of environmental variability and the spatial variations in resilience and sensitivity of the land, as different demands are put on the land through time. The word 'regional' also implies the incorporation of environmental considerations into theories of regional growth and decline.

The circumstances in which land managers operate in their decision-making over land use and management can be considered in the context of core–periphery relations. Location-specific studies of the settlement frontiers of Brazil, the United States and Southeast Asia, as well as of agricultural decision-making in economically declining areas, provide considerable evidence for suggesting that declining regional economies provide an important context for lack of initiative and investment of labour and capital in managing land. Chapter 6 gives examples from hill and mountain areas of this link between the status of regional decline and the circumstances of decision-making in land management. Chapter 7 on the other hand provides evidence from eighteenth-century France to show that both the downswing and the upswing in a rural economy can almost equally press on the welfare and freedom of those who occupy the most vulnerable position in the social order.

The phrase 'political ecology' combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself.

We also derive from political economy a concern with the role of the state. The state commonly tends to lend its power to dominant groups and classes, and thus may reinforce the tendency for accumulation by these dominant groups and marginalization of the losers, through such actions as taxation, food policy, land tenure policy and the allocation of resources. The agrarian history of Europe provides abundant examples (Abel 1980; Kriedte 1983). Very recent work on the relationship between cumulative soil losses and crop and livestock yields has shown a negative exponential relationship (Stocking and Peake 1985; Hufschmidt *et al.* 1983: 146) which strongly encourages the state to allocate resources to protect productive and still capable land, rather than to repair already degraded land which has fallen to a low level of

productivity. Such a trend may be accentuated by the need of dominant groups to protect the source of major commercial crops. The allocation of state-controlled resources in rural development therefore usually disfavours the physical and social margin. This is shown for Latin America by Posner and MacPherson (1982) and for Nepal by Blaikie, Cameron and Seddon (1980). It may be added that the efforts of international agencies have hitherto tended to concentrate in the same direction, notwithstanding contrary statements of policy. These ideas are developed in an introductory fashion in section 7 of this chapter.

Extended examples of regional political ecology which consciously uses theoretical material from the core–periphery model, applied theories of the state, and the ecology of agricultural systems, are offered in chapter 2, section 4 and chapter 6, section 6. In the latter, it is hypothesized that many areas of the Third World suffer from a set of related symptoms which combine the results of land degradation, political and economic peripheralization, stagnant production, outmigration and poverty. However, there are clearly important variations in the politico-economic and physical histories of peripheral areas. Some areas, especially in hills and mountains, have avoided colonization and have preserved elements of ancient culture and social structure, such as segmented tribal organization and unformalized rules of land tenure. Other areas and their people have been intensively colonized and have attracted metropolitan capital into plantations, large farms and ranches, but are limited by sensitive and unresilient environments of a different type altogether. The distinction between these two is clearly drawn in chapter 6 and again in chapter 10.

However, there were and still are political economies which predate the world capitalist system, or remain only loosely articulated with it in modern times. Today, post-1945 Albania is an example and historically the Asian and tropical-American empires grew and differentiated on the basis mainly of internal division of labour and trade, with only peripheral dependence on external exchange. Such writers as Chevalier (1963) and Borah and Cook (1963) have shown how a class structure had evolved in central Mexico under the Aztec empire, how this was reflected in the management of land and the exaction of tribute, and how remoter groups brought under Aztec rule were incorporated into this system in a peripheral relationship. Degradation and erosion were substantial (Cook 1949). In this volume the more remarkable – because little stratified – case of the highlands of Papua New Guinea is analysed in chapter 8; here a political economy based on surplus production for competitive prestation evolved in the 300 or so years before there was any direct contact with the world political economic system, and a significant degree of land degradation was brought about under that isolated system.

In chapter 7 we undertake a more specific historical inquiry into the conditions of degradation in the past. We seek to explain how and why erosion of a type generally associated with sub-humid areas of southern Europe came to prevail in quite large parts of central and western Europe in the past, reaching a peak, at least in France, in the eighteenth century. Finding the evidence to favour a preponderantly human causation, it is hypothesized that pressures on the peasantry came to be translated into inadequate management of the land. Landlords, the emergent bourgeoisie and the state all contributed to these pressures. This historical example, and other historical material in this book, are introduced for a very specific set of reasons. Not only was the early-modern condition of the peasant and working classes in the west comparable with, or worse than, that of their modern counterparts in the Third World, but the pressures on them assumed a severity rarely encountered today. The historical examples thus provide something of an 'extreme' case of our thesis that damage to the land and damage to certain classes in society are interrelated. Moreover, they also provide long-term depth of material that is not generally available to us in the Third World or in countries of recent European settlements, and hence provide both an illustration of political ecology in time depth, and also a corrective to facile conclusions that might otherwise be drawn from the examination only of contemporary problems.

7 The margin and marginality

The approach of regional political ecology makes considerable use of various models and ideas surrounding the concept of the margin and marginality, and in the last substantive section in this chapter we turn to defining them, and to relating them to land degradation. There are three rather different although related uses of the term in neo-classical economics, in ecology and in political economy. In the following sections each of the three uses are examined, and then in section 7.4 they are brought together, and the reader will recognize that we have returned once again to the ground of regional political ecology.

7.1 The economic concept of the margin

The concept of the marginal unit of a factor of production, that last unit which when brought into use yields exactly its own cost and no more, is implicit in the classical theory of rent. Ricardo (1951) developed the theory of rent in regard to qualities of land; when all land of the first, and by definition uniform, quality has been brought into production, and land of the second quality is then employed, the cost of production on the latter will be higher than on the first. For this to be possible the price must rise, and so all land of the first quality will receive an unearned income in consequence of the incorporation of the second; the unearned income of labour inputs on the land is rent. If land is more intensively cultivated, the law of diminishing returns will apply. Hence the schedule of production will form a parabola, so that at the optimum ratio land and labour will both be utilized fully, and beyond this point there is a shortage of the forces of natural growth relative to

the input of labour. Further increases in demand will therefore make it necessary to bring in new and inferior land, and the last land to be brought into use, or to be intensified, will just repay the cost of production and no more; this is the margin.

Von Thunen (Hall 1966) noted that beyond the optimum point of intensification it is a combination of constant land and increasing labour that becomes less productive, so that it is the additional units of labour that will in fact earn less. Gossen (as cited in Heimann 1945) noted that the value of any given unit of a quantity, wherever produced, is appraised like the marginal or last unit and thus has the same utility, and showed that the value of any individual unit produced must be equal to the marginal utility. The marginal unit is therefore that whose marginal cost is equal to the marginal utility, and if we are writing of land qualities, then this unit is the marginal land (Heimann 1945: 186–7). Add to this Von Thunen's arguments about the effects of intensification as the margin is approached on the distribution of returns to the factors of production, and we also have a link with the political-economy view of the margin which is developed below.

7.2 *The ecological concept of the margin*

In principle, at least, the ecological concept of the margin is comparable with the neo-classical one. For a given plant, or association of plants such as a forest, the marginal unit of land is that where natural conditions will just permit the plant to survive. However, an ecological view cannot avoid the question of environmental variability, so that we have to define the margin in terms of expected adverse conditions, recognizing that in some years plants can grow well beyond their 'secure' domain. This being so, a marginal environment for plants is better interpreted as the area or zone within which there is expected killing stress, but over which a plant or plant association can expand when that stress is absent. The same concept applies to marginal habitats for wildlife, and by extension also to crops and livestock.

Discussion of the 'ecological margin' does not always follow this logical approach. Perhaps it is better to be more restrictive and to define the term by extrapolation of the neo-classical definition to take account of environmental variability. The Sahel, for example, is thus defined as a marginal zone within which droughts of great severity and length can be expected. Discussion of the 'advance' of the desert margin into this zone (Stebbing 1935; Rapp 1976) means essentially that its marginality is becoming accentuated as human interference assists natural forces in the elimination or pauperization of plant communities, and makes their re-establishment in good years less likely.

Ecological marginality need not relate only to 'natural' conditions. Agro-ecosystems created by people immediately acquire a new set of relevant environmental variables. In all irrigated land, the availability and the quality of water become paramount. A clear example of ecological marginality in the context of created agro-ecosystems is provided by the annually reconstructed

fields made in the gravelled beds of rivers in parts of the Mountain Province of the Philippines, while another is the gardens fed with human manure that were until recently encountered on embanked portions of the sea beach around the inlets which penetrate the New Territories of Hong Kong. Both were economically better than marginal, otherwise they would not have been constructed, but both were ecologically marginal at grave risk from storm and flood. We illustrate the more complex example of the *sawah*-rice terrace later.

7.3 *The political-economic concept of marginality*

The political-economy approach concerns the effect on people as well as on their productive activities of on-going changes within society at local and global levels. Use of the term in this context has arisen in the Latin American literature, where it was used to describe the sort of process described by many writers from Mariategui (1971) onward, and pithily summed up by Stavenhagen:

> The channeling of capital, raw materials, abundant foods, and manual labour coming from the backward zones permits the rapid development of these poles or focal points of growth, and condemns the supplying areas to an increasing stagnation and underdevelopment. (1969: 108)

At about the same time, Casanova (1970: 123) wrote of the 'marginal masses' who are outside the political system of Mexico, and of the 'marginal population' which is disorganized, uninformed and which can make demands only 'in the traditional forms of supplication, petition and complaint'. The term was quickly adopted (Parra 1972) to refer to a whole class of people who are excluded from employment, services, participation in decision-making, opportunity and secure housing (Brett 1973). Gaining wider currency, 'marginalization' has been used in the feminist literature to describe the exclusion of women from productive employment (Hartmann 1976; Young and Moser 1981), and in being widened to this and other contexts has perhaps lost something of the force contained in the original Latin American formulation.

7.4 *The relation between three concepts of the margin*

Writing of Kenya, Wisner (1976) wrote of *marginals* created by colonialism and capitalism who, in the process of social allocation of space, were quite literally pushed into *marginal places*. However, socio-political and ecological or economic marginality are not necessarily correlated in this way. 'Marginalized' peasants can, and do, occupy smallholdings on highly fertile land, while ecologically marginal land that is also near marginal in the neo-classical sense can, if a holder has enough of it, offer the basis for a highly profitable commercial operation. Much of northern Australia is ecologically

marginal, but while most of it would be sub-marginal for commercial agriculture as has repeatedly been shown, it can support very profitable pastoral operations when coarsely divided into properties and chains of properties the size of small European countries. However, the Aboriginal people dispossessed of their land and now working on these estates share none of this affluence, and have been marginalized within the new relations of production.

If we control the comparison within a single mode or system of production, however, a relationship can more readily be established. An Asian rice-growing community has land sharply differentiated by fertility and hydrology, and its upland areas are sensitive under interference. When *sawah*-rice terraces are created, these new agro-ecosystems differ greatly in their ecological security. If they are on unstable slopes, the terrace walls may collapse. Some are difficult to supply with water in dry years, while others lose water readily by seepage. Under a high population density all the land capable of *sawah*-rice production has been taken up and converted; some of this is ecologically marginal even though economically secure in most years. Great differences in rent are yielded by the *sawah*-rice parcels. Some farmers without or with insufficient *sawah*, take up dry land for swidden cultivation on the ecologically marginal slopes, where they get good short-term returns of dry crops, but are at risk from erosion and loss of fertility. Those who are most marginalized in the socioeconomic sense have no land, and are forced to seek casual work from others. This is a hypothetical example, but is not unlike an upland West Java village (*kampung*) studied by members of the International Rice Research Institute (IRRI). They conclude

> As growth of population presses hard on limited land resources under constant technology, cultivation frontiers are expanded to more marginal land and greater amounts of labor applied per unit of cultivated land; the cost of food production increases and food prices rise; in the long end (*sic*), laborers' income will decrease to a subsistence minimum barely sufficient to maintain stationary population and all the surplus will be captured by landlords as increased land rent. This is exactly what has occurred in the *Kampung*. (Kikuchi *et al.* 1980: 15)

It will be useful to summarize some of the postulated and demonstrated relationships. To clarify, we identify the three concepts of marginality as economic (EN), ecological (EC) and politicoeconomic (PE) in what follows.

Land managers can become marginalized (PE) through the imposition of taxes, corvée labour and other relations of surplus extraction. The responses they make may be reflected in land use and in investment decisions over the preservation of productivity of their land. Adversity of this sort can produce innovations which raise productivity – to pay for the extraction of surpluses – as well as safeguard future productivity. However, more extreme marginalization (PE), often involving a whole number of readjustments particularly a loss of labour power (through war, conscription or emigration), has frequently led to changes in land use and the inability to keep up

longer-term investments in soil and water conservation (e.g. repair of terraces and cleaning of irrigation and drainage ditches). The land then becomes economically marginal (EN) and the result is a decline in capability and marginality (EC) of the agro-ecosystem.

Spatial marginalization (PE) may also accompany these changes. Dominant classes may gain control and use more fertile land and force others to use more marginal land (EN). The attempts of the latter to make a living with reduced resources have often led to land degradation. Marginal land (EC) which has a high sensitivity and low resilience to even skilful or light interference by land managers can attract land uses, for this reason, which permanently damage the capability of the land. Here the emphasis rests not only upon the socially imposed marginality (PE) of the land manager, but also upon the intrinsic marginality (EC) of the land itself. Commercial ranching in the Australian interior is a prime example. If land degradation comes about as a result of either commercial exploitation or socially induced marginalization (PE) of land managers, a vicious circle of increasing impoverishment and further marginalization (EC) of land and land managers (EN) can sometimes result. Hence land degradation is both a result of *and* a cause of social marginalization (PE). It can accentuate the physical marginality (EC) of land by reducing its present capability, and marginalize (EN) it for present alternative uses. Much of Ethiopia, the Sahel region as a whole, and other areas of low resilience find themselves in this position.

8 Degradation, hazards and the environmental paradigm

The approach of regional political ecology taken in this book is compatible with the new directions in hazards and disaster research. Both approaches share an historical and a dynamic approach to human–environment relations. Nature is seen to be in constant flux, and measurement must constantly be updated (see also chapter 3). Also, nature is not universally nor statically defined; resources 'become' resources when people define them as such (Blaikie 1985c). The multiple definitions of natural resources and degradation by three groups of land-users and three government departments in the Indonesian case study (chapter 9B, section 3.3) are a good illustration amongst others in this book. Both approaches emphasize underlying social order rather than capricious nature in the explanation of calamitous events:

> causes, internal features and consequences (of natural disaster) are *not* explained by conditions or behaviour peculiar to calamitous events. Rather they are seen to depend upon the ongoing social order, its everyday relations to the habitat and the larger historical circumstances that shape or frustrate these matters. (Hewitt 1983: 25)

The three concluding chapters in Hewitt's book provide the basis of this 'alternative approach', linking the ongoing social order to hazardous events. Susman, O'Keefe and Wisner (1983) build on the work of O'Keefe (1975)

and of Wisner (1976) who for a decade have linked disasters to processes of marginalization and proletarianization. The trigger events which start disasters or catastrophes have explanatory linkages with land degradation because both arise from the conjunction of physical and social processes. Sayer urged that we must start with the essential and necessary unity of society and nature, and that 'to start in the conventional manner with ... a separation followed by a listing of interactions would be to prejudice every other aspect of the exposition' (1980: 22). Approving this view, Watts goes on to argue that 'the subject matter of human ecology is accordingly *inter*-actions with nature' (1983: 234). This formulation is close to the idea of a 'resource-in-use' used earlier in this chapter. Also shared with the alternative approach in hazards research is an avoidance of relegating natural processes to a mere context or backdrop to hazards or degradation. Some radical literature has tended to do this and to imply that studies of climatic change in the Sahel, for example, are no more than a smokescreen and decoy to cover the tracks of the 'real' culprit – capitalism. It is vital to understand (as accurately as data, measurement and modelling will allow) the natural forces which create a variable management task to which decision-making, subject to political economic conditions of choice, has to respond.

9 The social scientist's contribution: the need for open minds

We set out initially to write this book from position papers which adopted respectively Marxist and behavioural approaches, in each case with qualifications. What happened instead was something unforeseen: large areas of agreement emerged between the two authors, and several of the contributors also. While a more abstract (and no doubt rigorous) analysis of the two positions would undoubtedly expose fundamental contradictions, there is a broad area within which the explanation of land degradation can draw upon similar themes. There is something to be said for declaring a truce on the more abstract structural differences in the interpretation of social change, however important these differences may be, if it allows cross-fertilization of approaches. There are certainly fundamental contradictions between the 'human adaptation', neo-classical and various Marxist approaches, to take these three only. However, they share the objectives of understanding and problem solving, and of bringing about change in the situation, albeit in different degrees and in different ways. While there are epistemological reasons why Marxists have not been too interested in 'decision-making' models, there is nothing inherently revisionist in building them. Likewise, there is no betrayal of the profession of neo-classical economics in trying to pursue the quantification of costs and benefits of degradation and conservation into the realms of politics and unquantifiable conjecture (as done in chapter 5). Nor is there any reason why the study of human behaviour should fail to take advantage of the insights of theory about economic rationality or disregard the contradictions inherent in all social change and social formation.

There is a need for open minds, too, in the use of quantification and model building. There is an extraordinary schism between two self-perceived epistomological camps, the one which measures, creates its own data and uses others' in model building, and the other which calls itself 'radical' and eschews analysis of this sort as positivist, and the data as ideologically tainted and reductionist. Whilst this book amply shows that data do not simply exist but rather are constructed, it also argues strongly for technically better *and* more ideologically aware measurement of process, costs and benefits. Quantitative modelling of resources-in-use and land managers themselves need not be mindless number crunching. Nor need a central concern for the social meaning of degradation and for conscious ideological choice in explanation be dismissed as biased and not 'real' science.

Open minds assist in clarifying and sharing objectives. There are many blocks to open minds: the criteria for excellence and promotion differ between various practitioners (academics of different disciplines, consultants, administrators, politicians); there can be interdisciplinary rivalry between different academic departments (particularly between natural and social science); and more specific epistomological differences, mainly about the domain and status of proof in discourse and research. Land degradation and society, because of its complex and multidisciplinary nature, and its theoretical and practical elements, encounters most of these blocks.

If these blocks are not removed, the issue of land degradation will remain shrouded in controversy, uncertainty and incomprehension. What people cannot understand, they tend to avoid; what is unclear, people cannot decide upon. So it is with policy-makers and land degradation. While solutions will be as multiple as the causes of land degradation, the general approach outlined here aims to unify but through an appreciation of plurality of purpose and flexibility in explanation. For the discipline of geography at least, Carl Sauer put the problem and challenge perfectly more than forty-five years ago:

> Surely nothing could be more geographic than critical studies of the wastage of surface and soil as expressions of abusive land occupation. On the one hand are the pathological physical processes; on the other, the cultural causes are to be studied. Next come the effects of continued wastage on survival of population and economy, with increasing tendency to degenerative alterations or replacement. Finally, there is the question of recovery or rehabilitation ... Geographers have given strangely little attention to man as a geomorphologic agent.... The theme was clearly indicated as a formal problem of geography three-quarters of a century ago by Marsh. Geographers have long given lecture courses on conservation of natural resources and considered the evils of soil erosion. But what have they done as investigators in the field, which may actually lie at the

doorsteps of their classrooms? Is the answer that soil students should study sheet wastage, geomorphologists gullies, agricultural economists failing agriculture, rural sociologists failing populations, and the geographer prepare lectures on what others investigate? (Sauer 18–19)

10 Summary and conclusion

All aspects of the relationship between land degradation and society are both social and physical – a commonplace statement that is self-evidently true, but not trivial. It means that degradation is perceptual and socially defined. There may well be competing perceptions and these can be put into the context of the political economy as a whole, in which different classes and groups perceive and use land and its resources in different ways. Our four central terms – land management, land degradation, resilience and sensitivity – are all defined in a social context, and with explicit reference to ongoing processes of social change. There are extremely severe problems of data availability and of verification and proof. The approach taken in this book must respond to this problem of uncertainty and does so by seeking a point of entry where uncertainty is least, at the point of the land manager. The land manager is then 'contented', and her or his actions explained within a set of dynamic human–environment relationships which we call regional political ecology. The various definitions of the margin and marginality are central to this approach.

It will be obvious that we avoid an ethical and fundamentalist approach to land degradation. The definition of degradation, and whether it is 'bad' or not are both related to the people who use land. The field of interest in this book does not include difficult environmental-ethical questions such as the extinction of endangered species, or conflicts between national parks and other human uses of the biome, where ethical judgements assume greater importance. The approach taken here is that land degradation is judged in terms of the altered benefits and costs that accrue to people at the time and in the future.

2 Approaches to the study of land degradation

Piers Blaikie and Harold Brookfield

1 Chains of explanation

We have described our approach to the explanation of land degradation in any specific area as regional political ecology, and essentially the approach follows a chain of explanation. It starts with the land managers and their direct relations with the land (crop rotations, fuelwood use, stocking densities, capital investments and so on). Then the next link concerns their relations with each other, other land users, and groups in the wider society who affect them in any way, which in turn determines land management. The state and the world economy consitute the last links in the chain. Clearly then, explanations will be highly conjunctural, although relying on theoretical bases drawn from natural and social science. In this context we examine the major 'single hypothesis' approaches to land degradation. After all, there *are* discernible patterns of social change and land degradation, and models which would claim a degree of universality. The first is the explanation of land degradation in terms of population pressure and is the main concern of a number of influential theories. The second is very much more limited and different in character and explains degradation in terms of maladaptions and ignorance of land managers themselves – the problem lies uniquely with them. This chapter examines each of these models in turn in sections 2 and 3, and finishes with a case study which illustrates their performances.

2 Population and land degradation

2.1 Attribution and generalization

Any attempt to find the cause of land degradation is somewhat akin to a 'whodunnit', except that no criminal will ultimately confess, and Hercule Poirot is unable to assemble the suspects on a Nile steamer or in the dining car of a snowbound Orient Express for the final confrontation. The analogy is an apt one. Murders are generally easier to identify than land degradation; but guilt is often shared in different degrees between different people (e.g. assassin, accessory, etc.), as in each case of land degradation. However, any

general statement about the causes of land degradation is of a very different order from the usual 'whodunnit', except perhaps in the case of the Orient Express, where *all* the suspects were found guilty! For the purpose of the analysis of land degradation such a statement may be true but is not very useful. At the other extreme, single general hypotheses of guilt do not get us very far either.

Perhaps the most common such hypothesis is that which attributes degradation to pressure of population on resources (which we shall henceforth call PPR), and therefore to growth in the numbers and density of population on the face of the earth. It does indeed seem self-evident that growth in numbers will cause land to be used more heavily; and that as the *per capita* area of arable and grazing land grows smaller, the sheer necessity of production will force farmers to use land in disregard of the long-term consequences. Yet, very severe degradation can occur in the total absence of PPR. Periods of population decline have often been periods of severe damage to the land.

2.2 *Malthus rides again*

Only a minority, among whom we are not included, would continue in the 1980s to believe that the rapid increase in the earth's population, an increase now heavily concentrated in the less-developed countries, is no matter for serious concern. A steady decline in the amount of arable land per head of the world's population means that this land will be required to produce more in order to provide the food and industrial raw materials needed by a population anticipated to grow by at least half its 1975 number during the limited space of the last quarter of this century. In the less-developed countries it is projected that the *per capita* area of arable land will have declined from just under 0.5 ha in 1955 to under 0.2 ha by the year 2000 (Council on Environmental Quality 1982: 403).

In modelling the effects on the land of population growth, however, the assumptions are based on inadequately measured and understood current trends often stated with great conviction.

Eckholm, for example, writes:

> Whatever the root causes of suicidal land treatment and rapid population growth ... and the causes of both are numerous and complex ... in nearly every instance the rise in human numbers is the immediate catalyst of deteriorating food-production systems. (1976: 18)

Ehrlich and Ehrlich more baldly say that 'an area must be considered overpopulated ... if the activities of the population are leading to a steady deterioration of the environment' (1970: 201). Yet they go on to say that while Australia may be underpopulated 'the "frontier philosophy" is more rampant in Australia than in the United States in terms of environmental deterioration and agricultural overexploitation'.

The Ehrlichs' confusion is helpful, for it at once challenges their own

simplification. The terms 'underpopulation' and 'overpopulation', like PPR itself, imply that there must exist a critical population density at which none of these conditions obtain. This critical population is often described as the 'carrying capacity' of the land, a notion which applies to human populations a principle that is well-established among animal populations. Once animal numbers exceed the available food resources, they undergo a severe decline through mortality or other Malthusian checks. At least in so far as human populations depend on their land for their livelihood, similar conditions should apply. Or so the argument runs.

Efforts to employ the carrying-capacity concept continue to be made, notwithstanding criticisms. A notable effort is that made on a pan-tropical scale by the Food and Agriculture Organization of the United Nations (FAO) in association with the International Institute for Applied Systems Analysis (FAO 1982; Higgins *et al.* 1984). Here countries were subdivided on the basis of the major soil types and the length-of-growing season periods. Calculations of production of a range of crops were made under conditions of 'low input', 'intermediate input' and 'high input' – these being in all cases conditions of modern technology and fertilizers, not of labour. Assessment was made of country-level ability to supply the projected year-2000 population, with encouraging results except in the arid regions of Africa and Bangladesh, provided that 'high levels of farming technology' are adopted. This is an interesting exercise, but its assumptions carry a degree of unreality, and the assumption of access by the majority of the agrarian population to high levels of modern farming technology is perhaps the most unreal of all.

If carrying capacity changes with each turn in the course of socioeconomic evolution, each new technological input or new crop introduction, and can also vary markedly according to the bounty or otherwise of rainfall in a given year, of what use is the concept? Writing of Malthus' original essay, Peacock has argued that 'like any other theory, the theory of population must be regarded as a conditional hypothesis' (in Glass 1953: 66).

2.3 *Malthus unhorsed?: The Boserup hypothesis*

The objections to the PPR explanation of land degradation introduced above do not constitute a refutation. An alternative hypothesis was required, and was provided by Boserup (1965, 1981). Boserup proposed that the neo-Malthusian view of population capacity as dependent on resources and the state of technology was erroneous. She gathered evidence to show that output from a given area responds far more generously to additional inputs of labour than the neo-Malthusians suppose, even under pre-industrial conditions. She then proposed that 'the growth of population is a major determinant of technological change in agriculture' (Boserup 1965: 56). Population becomes the independent variable, and the dependent variables become agro-technology, the intensiveness of labour inputs and hence the capacity of the system to support people.

Boserup's conclusions were policy conclusions for development strategy,

made more explicit in a later summary (Boserup 1970). As such, however, they were largely disregarded. The prevailing view among development scientists of whatever background was that the modern biogenetic, chemical and organizational agricultural revolution, rather than labour intensification, would solve the problems if they were to be solved. A more gloomy view, closer to the neo-Malthusian approach, would be that of Cassen:

> While the Boserup theory may have some validity in the broad sweep of history ... there is no reason to believe the argument is of general validity in today's developing countries. Cases of the opposite effects are not hard to find: over-exploitation of land, overgrazing of pasture, man-made erosion and so forth (1976: 807).

There is an important ambiguity in Boserup's hypothesis which concerns the innovation process itself. Her model may be likened to a toothpaste tube – population growth applies pressure on the tube, and somehow, in an undefined way, squeezes out agricultural innovation at the other end. However, as Cassen points out above, there are many contrary examples. What appears at the other end of the tube is often not innovation but degradation. Why? One of a variety of explanations provided in this book is the lack of access to productive resources on the part of the cultivator, and this is intimately linked to the class nature of most land management (see also chapter 6).

That is not to deny that PPR *is* often an important and reinforcing link in reducing this access to sectors of an agrarian population. This argument has already been made by one of the authors (Blaikie 1985a: 18, 107), and will only briefly be recapitulated here. There is a wide variety of land management practices which can be adopted and there is a good deal of variation in the amount of resources required for each practice on the part of the individual cultivator or pastoralist. Agronomic methods of management are usually less demanding than soil conservation works, but even the former require some spare capacity of labour, nutrients, land or capital. Crop residue incorporation is one effective conservation technique but requires that the farmer can 'do without' residues which may be important for other purposes (e.g. fuel, roofing for houses or fodder for livestock). Cover crops require extra labour and seed, while a soil-conserving reorganization of crop planting times may demand a reallocation or increase in labour demand. These observations apply *a fortiori* to chemical fertilizers, tree planting or the construction of grassed waterways. Also, state-sponsored research and development in conservation requiring relatively plentiful and locally available resources tend to be neglected in favour of more paying concerns such as the development of commercial crops on large farms on uneroded lands (Beets 1982; Belshaw 1979; Richards 1985). Thus PPR may well produce degradation and fail to produce agricultural innovation. Nonetheless, a lack of access to productive resources must itself not be promoted as a rival single hypothesis.

By attempting to isolate population as a single causal variable Boserup comes close to the very neo-Malthusians whom she criticizes. For, while neo-Malthusians believe that there are ultimate limits to the capacity of the land to support population without famine, damage or both, Boserup merely converts these limits into launching pads without successfully demonstrating that this conversion can always be made in all environments, or can continue indefinitely. Indeed, the evidence of diminishing returns, stagnation in rural wages and increased hours of work in both of Boserup's books, and especially in the second, suggests that Malthus climbs slowly back into the saddle as the Boserup sequence advances. At least within the domain of pre-industrial and early industrial agriculture which is her preferred ground, Boserup emerges more as a corrector of Malthus than as his refutor.

Cassen (1976) has drawn attention to the impact of population growth in some countries (notably in South Asia) upon the composition of resource costs required to produce basic consumption goods. The argument runs as follows. As long as population growth creates a demand in basic consumption items which can be met by the application of labour alone to land, the impact of population growth is not deleterious and may well run the course which Boserup argues (the creation of landesque capital, clearing and cultivation of new land and so on). Mao Zedong's adage of 'with every mouth comes a pair of hands' may hold. However, when increased aggregate demand for consumption items has to be met by expensive purchased inputs using scarce foreign exchange, then in a sense these are 'wasted' in keeping alive a growing population without increasing surpluses and savings. In an important sense, the reassuring model of Boserup is also stood on its head, and PPR may again assert degrading tendencies upon the land. Whether the 'Green Revolution' restores Boserup rather than Malthus to a standing position, and if so for how long, is a matter of contemporary controversy.

2.4 *Innovation and intensification*

The question really comes back to land management in the course of achieving production. We must once again pause to clarify the meaning of terms. The term 'intensification' is much used in literature about the Boserup model to mean the adoption of production systems which gain more output, averaged over time, from a given unit of land. Thus, elimination of the fallow year from the European three-field system and its replacement by fodder crops would be intensification. So also, however, would be the addition of labour inputs to wet rice cultivation to squeeze more and more production from the same field, as described by Geertz (1963).

Properly speaking, however, intensification means the addition of inputs up to, or beyond, the economic margin where application of further inputs will not increase total productivity; in the case of agriculture these are measured against constant land, and in pre-industrial agriculture we mean mainly inputs of labour, plus livestock. When, however, there is a change in

the manner in which factors of production are used the inputs are applied in qualitatively new ways; a new curve of intensification is created. Such qualitative changes are innovations.

Brookfield (1984a) sought to distinguish between innovation and simple production intensification by means of the example of the West Indian sugar industry under slavery and subsequently. A production system which involved intensive land management with slave labour, and one effect of which may have been to save the production base from rapid degradation, was introduced for gain by seventeenth-century entrepreneurs. Requiring heavy inputs of labour, from 4000 to 8700 person-hours/year/ha, for both production and management, this system created a high density of population, the effect of which, even for a century after slavery was abolished, was to inhibit the innovation of new farming practices. Labour was cheap and abundant; furthermore, a large population required to be supported (Goveia 1969). Only the modern introduction of cane-breeding and fertilizers finally increased production per worker and so created a labour shortage. The old situation had endured some 200 years, with the effect that:

> Population-based theory is turned on its head in this case: given the social conditions of production, pressure of population on resources became a disincentive to innovate. Intensification and innovation became alternatives in a situation in which the means to innovate existed and were known, but conditions produced by intensification led the landholders to resist adoption. (Brookfield 1984a: 32)

In section 4 of this chapter we shall examine material from Nepal, where a high PPR is interpreted as both the cause of degradation, and also as the means by which degradation is managed and contained. Without anticipating this examination, it is clear that PPR can be seen both as creating a need to exploit resources in environmentally sensitive areas in such a way as to expose them to damage, and also as providing the means of a labour-intensive management system which seeks to contain the consequences. There is no reason, even on *prima facie* grounds, why both cannot be true.

2.5 *Taking a position on population and degradation*

The growth of human numbers, and the growth of numbers among their livestock, can undoubtedly create stress. It requires the extension of interference into new areas, and the subjection of these areas to the high levels of damage that follow initial interference. It requires the occupation of sites of lower resilience and higher sensitivity, for which existing management practices may be inadequate. Since the expansion is likely to be carried out largely by those displaced from older areas by poverty, or by other pressures of social or political origin, the new land has to be managed by those with the fewest resources to devote or divert to its management. Here we see the three definitions of margin and marginalization (economic, ecological and political economic) combining in a downward spiral. An increase in damage to the land is an inevitable consequence, at least for a time, and PPR and lack of access to the means to innovate go hand in hand.

High PPR may also create stresses within existing systems with well-tried management practices. As the margin of subsistence grows narrower, so the pressure to maximize short-term production will grow stronger. The need to innovate will grow, but the means with which to innovate will be lacking. Wealthier landholders whose own resources are not gravely threatened by the 'downstream' effects of degradation on the land of their poorer neighbours, may welcome the growing abundance of cheap labour and see no need to embark on larger innovations which might be of benefit to all. While they may have the means to innovate, they may not see it as being to their advantage to do so. Grinding poverty is a poor environment for good management, and a favourable one for degradation. But grinding poverty is not only brought about by PPR, though it may well be exacerbated by it, as in the following case study of Nepal.

Except in the presence of a situation such as outlined above, however, a high PPR also provides abundant labour with which to undertake intensive management. Where known and tried innovations are available, but require a high labour input, they are more likely to be both undertaken and maintained under conditions of high population density. The long-enduring ecosystem stability in Roman and Byzantine Palestine, and after that in Lebanon, noted in chapter 7, existed under conditions of very high rural population density. Most of modern Java, despite the serious erosion that takes place in headwater areas and on land of high environmental sensitivity that is unsuited to irrigated terracing, exemplifies the high productivity obtainable under intensive management with extremely high densities of population. The peril is that such systems require abundance of labour not only for their establishment but also for their maintenance. If some of that labour is withdrawn, as by an increase in off-farm employment opportunities, or by emigration, or by the demands on male labour generated by the state for corvée work, or for war, the consequences can be disastrous. The created system itself is one of high sensitivity, although it is resilient as long as the necessary inputs for its maintenance are available.

Where land is abundant, the need to conserve it may not be apparent. It is only after major damage has occurred, as in North America in the 1930s, that the need to halt and reverse damage comes to be perceived. Shifting cultivators in the humid tropics are often regarded as a prime example of destructive land users because of their practices, made possible by low levels of PPR. This may be to malign them. None the less, some of the major modern examples of land degradation are in areas of low to medium population density, rather than in areas of high density.

For the present, then, we adopt an open approach to the relation of population pressure to land degradation. Degradation can occur under rising PPR, under declining PPR, and without PPR. We do not accept that population pressure leads inevitably to land degradation, even though it may almost inevitably lead to extreme poverty when it occurs in underdeveloped, mainly rural, countries. The question of why management fails, or breaks down, is not answered so simply. Population is certainly one factor in the situation, and the present rapid growth of rural populations in many parts of the world makes it, in association with other causes, a critical factor. But 'in association with other causes' is the essential part of that statement, for the other causes can themselves be sufficient. PPR is something that can operate on both sides, contributing to degradation, and aiding management and repair. In general and theoretical terms, then, Hercule Poirot remains with no proven case against his prime suspect. Unlike the situation in a 'whodunnit', however, this has become obvious at an early stage in the narrative.

3 Behavioural questions and their context

3.1 Them and us

For the natural or physical scientist who diagnoses the immediate causes of a specific problem of land degradation, the debate about PPR is of use only in so far as (s)he seeks general explanation; his or her more immediate concern is with the means of introducing or enforcing protective measures, and (s)he is often aware of considerable resistance on the part of farmers and rural communities in general. Indeed it has been claimed by Blaikie (1985a) that most conservation policies introduced by governments fail, although there are significant exceptions. Major schemes with substantial funding for compensation to cultivators, and/or with the political means of mass mobilization, have a better chance of achieving results. Models for this exist even in the nineteenth century, as, for example, in major efforts to introduce large-scale land management changes in the French Alps in the 1860s (Henin 1979). In modern China, the efforts of thousands of workers could be mobilized to plant shelter-belts against wind erosion, fix dunes and terrace hillsides in the loess regions, though apparently without significant success, as Smil argues in chapter 11. But the lesser task of obtaining the co-operation of farmers in works of protection and drainage, often involving restrictions on land use and the creation of some landesque capital at the farm level, is seldom achieved without a great deal of persuasion and example, and not infrequently fails.

For a long time it was the fashion to decry the 'stupidity' or the 'conservatism' or the 'uncaring idleness' of such farmers, or to stress their 'ignorance'. A minority of farmers, like a minority in any walk of life, are certainly stupid and many more are conservative, but conservatism does not necessarily arise only from an unwillingness to change. Where there is a known set of practices and behavioural responses, it is thus much easier for the farmer to adhere to an established pattern than to make changes, as Kirkby (1973) showed in Mexico. Changes may only be forced when a major 'discontinuity' becomes apparent; yields have fallen alarmingly; more land has been lost than can simply be rationalized away; the alternative to the risk of doing something new is the seeming certainty of losing everything.

However, where farmers are peasants, in contact with a larger economy, and are subjected to pressures to change from government, different conditions apply. Bailey (1966) wrote a classic interpretation of the 'peasant view of the bad life' which is particularly relevant to the assumption by 'outsiders' that peasants are traditional, conservative and stupid, when these outsiders are confronted by yet another failure to bring about effective land management. To the peasant the government is seen as the 'enemy' and its representatives have a completely different cognitive map from that of the peasant. Intervention by government to bring about 'better' land management is frequently met by suspicion and non-comprehension. In the multiplex and non-specialized relationships of a peasant society, specialized interventions such as forest protection or pastoral regulations seem incomprehensible and quite incompatible with the moral economy of peasant society. Often the peasant views the future as the 'round of time' rather than the 'arrow of time'. The farmer allocates resources on the assumption that next year will be, more or less, like this year and is seen against a round of time – so many years before an ox is replaced, two or three years before the house needs rethatching, and so on. Not so a conservation officer, who must persuade the target-group of tangible benefits through innovations, and try to set in motion a definite change within a specific time period.

An alternative explanation for conservatism of land managers is an economic one, and rests on the often-observed risk-aversion behaviour of peasant and other farmers. Living and working in an environment of risk and uncertainty in which it is not possible to predict with confidence that such-and-such a set of inputs will yield such-and-such a return, farmers are reluctant to embark on new practices which might increase risk. Poorer farmers, it is argued, adopt what Lipton (1968) termed a 'survival algorithm'. Lacking the resources to weather failure, they both suffer greater risk and are more inclined to behave in a risk-averting manner than wealthier farmers. Innovative behaviour involves risk and uncertainty. The rich farmers are better able to bear its risks, and so stand to gain more from its benefits.

'Ignorance', 'stupidity' and 'conservatism' imply that there *is* a choice, but people are too ignorant, stupid and conservative to make the right one: that provided by governments or international 'experts'. Economic constraints caused by uncertainty and risk, compounded by onerous relations of production, perhaps too by PPR, provide a more clearly defined economic map of what is possible and what is not. Unfeasible government plans can all too easily be laid at the door of unappreciative farmers and pastoralists. At

least economic explanations give some rationality to peasant behaviour and partially take the lid from the black box of ignorance and conservatism.

3.2 *Ignorance and perception*

Ignorance in a non-pejorative sense is another matter altogether. Ignorance of subtle changes in the quality of the soil is not only possible, but widespread. There is a number of degrading processes which show little immediate effect until a threshold of resilience is past, or until some untoward event exposes an increase in sensitivity. Leaching and pan-formation within the soil may operate in this way, as may changes in structure and chemical status. A striking example has recently emerged in eastern Australia where the planting of clover to upgrade pastures by nitrogen fixation has greatly improved capability since it began some fifty years ago. Surplus nitrogen gradually acidifies the soil in depth, releasing plant-toxic trace elements (aluminium and manganese); plants root to shallower depth to avoid them and become more sensitive to drought. The resilience of the system has a threshold beyond which acidification causes capability to suffer a sharp decline (Williams 1980; Bromfield *et al.* 1983; CSIRO 1985). Not only is none of this perceptible to the land manager until the limits of resilience are reached, but it has not even been perceived by soil scientists until lately.

It is equally possible for land managers to remain quite ignorant of the effects of low rates of erosion, where these exceed still lower rates of soil formation, until a critical level of accumulated loss is reached, and this can even take centuries (Hurni and Messerli 1981; Hurni 1983). The effect of loss of organic matter in restricting the ability of crops to respond to inorganic fertilizers is not likely to become apparent until the latter are applied. Both ignorance of degradation and its perception are functions of the rate and accumulated degree of degradation, as well as of the intelligence of the land manager.

A succession of good years can delay the perception of degradation to a critical extent, or at least facilitate an optimistic ignorance of the real consequences of observable changes. Without doubt, this has been an important factor in the 'degradation crises' that have struck many areas of new settlement during the past century. Newly settled farmers and graziers, who have used the natural 'capital' of long periods of 'rest' on land never before ploughed or grazed since the present soil–vegetation complexes were formed, had little means of knowing that the land they worked was of high sensitivity and low resilience until disaster – usually a drought – exposed the consequences of a period of heavy use. Writing just before the disasters of the 1930s, Webb (1931) showed how the perception of the Great Plains of the United States evolved rapidly during the nineteenth century, to the extent of a belief that occupation of the land increased rainfall and could ban the spectre of drought. In Australia, Meinig (1962), Heathcote (1965, 1969) and Williams (1974, 1979) have shown how the hazards of the semi-arid regions were first ignored, then harshly recognized and later only partly accepted.

Given the apparent success of remedies and adaptations a false sense of security could quickly become re-established. However, 'ignorance' shades from real to wilful, and may arise in part from other causes, such as a strong market imperative, a need to occupy new land for cash cropping or because of PPR elsewhere, or an ethos which believes that 'man' (and here we use 'man' rather than 'people') can and even must 'master nature'. This ethos, strikingly analysed by Passmore (1974), is at the root of much of the 'ignorance' so strongly complained of by those who work for a better management of the land. We present a stark illustration in chapter 11.

Still further removed from involuntary ignorance is the speculative abuse of land by commercial ranching and farming corporations and individuals, and by logging contractors. Here ignorance is not an accurate term since whether these land users know of the costs they inflict on future users of the land, and on present users elsewhere, through externalizing their costs, is beside the point. Wholesale disappearance of forests is the result (Plumwood and Routley 1982; Myers 1985), while the devastation of large tracts of agricultural land through now-abandoned commercial enterprises (Dinham and Hines 1983) is undoubtedly the result of calculated human agency and not of ignorance, nor stupidity.

4 The erosion problem in crowded Nepal – crisis of environment or crisis of explanation?

4.1 *The environmental situation*

Nepal is a classic area for the study of land degradation; we have already referred to it in chapter 1, and shall do so again at several points in this book. With an immensely varied environment, including the world's highest mountains, a strip of the Gangetic plain, and the high-altitude desert of the trans-Himalaya, Nepal is among the world's least 'developed' countries with a high and rising density of population on its limited areas of arable land (see figure 2.1). Rural population densities reach over 1500 per km^2 of cultivated land, or 15 to the ha, and there are districts in the middle hills with even higher densities. This is similar to densities in central Java and is 50 per cent higher than Bangladesh (Strout 1983).

In the main agricultural areas of the middle hills or *Pahad* almost all arable land is terraced. Irrigated land (*khet*), whether fed by rivers or from springs, grows rice and winter crops of wheat and potato wherever possible; dry land (*pakho*) is also terraced, but with a slope from almost level to as much as 25° or occasionally more. These dry lands grow mostly maize, often with finger millet as a relay crop which is transplanted from a seed bed under the growing maize. Unterraced land, used mainly for pasture (*charan*) but with a few cultivated patches, now occupies only the steepest slopes and ridgetops, but was in former times much more extensive and the site of shifting and semi-permanent cultivation among the mixed forests (*Quercus* spp., *Castanopsis* spp., *Pinus roxburghii*), and *Rhodedendron arboreum* that used to

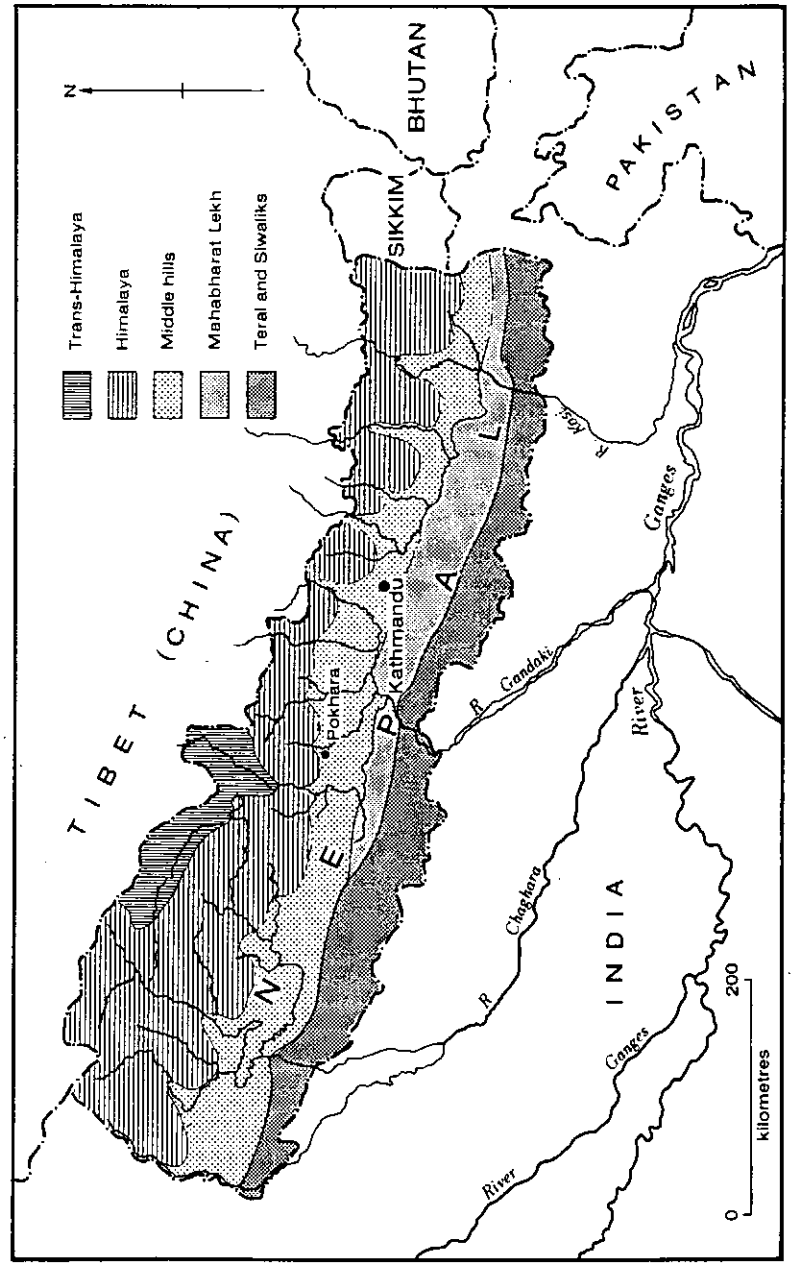

Figure 2.1 Nepal, showing main topographic belts

cover these hills (Burkill 1910; Mahat 1985). Cultivation and the collection of firewood were not the only reasons for clearance; charcoal-making for the metal industries of Nepal continued to be a major cause of depredation until early in the present century, though this has now diminished, and trees are also lopped to provide leaf-fodder for livestock (Bajracharya 1983). Livestock is a very important element in Nepalese farming systems (Axinn and Axinn 1983), and the numbers of livestock per human inhabitant are among the highest in the developing world.

The growth in population has eliminated the forest from large areas and has replaced it by cultivation. Commentators agree that virtually all land capable of being terraced has now been taken up in the middle hills (e.g. Caplan 1970: 6; Mahat 1985), so that forest boundaries are not now much in retreat. The degraded condition of the remaining forests is indeed now attributed to historical rather than to current practices (Mahat 1985; Nepal–Australia Forestry Project 1985). Yet this relative stability is only recent. In 1928 the government policy of replacing forest by human cultivation wherever possible was praised by one observer, who felt that

> this policy must be pursued for many years before there need be the slightest grounds for fearing that sufficient forest will not remain. For in the temperate zone [the middle hills] it is certain that cultivation can never occupy more than one-third of the total area.... Perhaps in the valley of Katmandu (*sic*) and its vicinity a condition has been reached in which it would be wise to call a halt.... But elsewhere the day on which restriction of cultivation need become a question for consideration is still far off. (Collier 1928/1976: 253)

From ancient times the State owned all land, and as it was the principal source of revenue to rulers no cultivable land should be allowed to lie idle (Stiller 1975; Regmi 1976). These principles were sustained and developed by the rulers of unified Nepal after 1768 so that the first king himself directed that all land convertible into fields should be reclaimed, and if homesteads were built on such land they should be moved (Regmi 1978). Peasants paid the state half the produce of the land in tax, or rent, and later this was paid to officials and others who received grants of land (and its income) in lieu of salary or as reward for service. Even so, only the irrigated ***khet*** land seems to have had firm definition until modern times, and in a village near Pokhara, Macfarlane (1976: 52, 87) noted that the ***pakho*** land was not shared out individually until about 1940; before that 'patches of jungle were slashed and burnt by those who had the labour'. By the late 1960s, however, only a few rocky and steep patches remained to be cleared; 'the limits of maize cultivation had been reached'. On the other hand, there have been no significant changes in areas of agricultural land and forest since at least 1900 in a densely peopled area at Thokarpa, east of Kathmandu, despite large population increases (Mahat 1985: 232).

Exposure of the slopes has serious consequences for runoff under the

torrential monsoon rain, especially at the beginning of the monsoon when there is little ground cover after the long dry season. Heavy erosion of the sloping dry terraces is a result, especially as the risers of these terraces are cut back each dry season to add new mineral phosphorus and soil to the terraces, which are thus widened and progressively flattened through time; each season a proportion of these terraces is rendered useless, and the land reverts to uncropped *pakho*; each season, however, new or reclaimed terraces are created on the *pakho* land.[1] Slope-wash, gullying and especially mass movement occur on all slopes, and mass movement also affects the lower-lying *khet* terraces, which become overcharged with water and saturated in depth. In occasional flash floods, the best valley bottom *khet* is sometimes washed out by heavily laden streams which widen their channels. As much as 50 per cent of the eroded material may be carried into the lowlands, causing wide channel braiding, choking rivers and adding up to a metre of soil per 20 years to adjacent fields; sediment loads as high as 25,000 ppm are regularly recorded in the major rivers.

The distribution and nature of erosion are, however, important. Dry terraces may lose only 0.4–1.6 mm/year, with corresponding losses of organic matter, nitrogen, phosphorus and potassium, and some of this is redeposited downslope, especially in irrigated terraces which can gain soil and nutrients. Much higher losses are experienced under degraded forest without surface protection from small shrubs, and on grazing land. In one small watershed gross estimated losses ranged from only 2 t/ha/year (tonnes per hectare per year) from the irrigated terraces to 20 t/ha/year from grazing land. However, while top-soil lost from this 63 ha catchment *and* carried beyond its bounds totalled only 220 t (3.86 t/ha from 57 ha of the area), the total loss was 1320 t/year, the balance being derived from mass wasting on the remaining 6 ha (Carson 1985). Caine and Mool (1982) calculated annual mass wasting losses to be as high as 13 t/ha from another catchment but derived from only 1 per cent of its area. Moreover, much of the landslip damage is repaired, and much land that appeared irreparably damaged when mapped in 1979–80 (Kienholz *et al.* 1983) was totally reclaimed under terraces, wet or dry, three or four years later (Ives 1984; 1985). Our own observations, using the 'geomorphic damage map' of the Ives and Messerli (1981) Mountain Hazards Mapping Project in the field, confirm that specific areas mapped as debris flow in 1979–80 were again wholly terraced in 1984 (Brookfield 1984b).

The importance of accelerated erosion in Nepal has been the subject of a great deal of uncertainty (Thompson and Warburton 1985a, b). A variety of

[1] Most of the modern literature cited in this chapter refers to dry terraces as *bari*, thus distinguished from the irrigated *khet* and the unterraced *pakho*. The Nepalese geographer Dr Harka Gurung (personal communication) advises that this is incorrect, being based on the writings of Kathmandu scholars who are unfamiliar with the languages of most of the farmers. *Bari* are infield dry terraces, heavily manured and mulched and often fenced; *pakho* is outfield, whether terraced or not. Gurung's advice is followed in this chapter. The same usage also seems to be followed by Regmi (1971).

commentators have been convinced that Nepal is an ecological catastrophe. A single doom-laden quotation from a wide choice will suffice:

> Population growth in the context of a traditional agrarian technology is forcing farmers onto even steeper slopes, slopes unfit for sustained farming even with the astonishingly elaborate terracing practised there. Meanwhile, villagers must roam farther and farther from their homes to gather fodder and firewood, thus surrounding villages with a widening circle of denuded hillsides. (Eckholm 1976: 77)

However, a detailed and quantified analysis of the extent of degradation has produced a more qualified interpretation. A recent FAO study stated that the results of their analysis suggest that past descriptions of conditions in Nepal have exaggerated the erosion problems, and go on to say that the 3 per cent figure of the total land surface classified under poor and very poor watershed conditions is not a serious erosion problem (FAO 1980: 5). Interestingly, they attribute part of this possible misconception to the effects of road-biased rural tourism, according with Chambers' (1984) apposite diagnosis of misconceptions of foreign and urban-based observers. There is an often-visited panorama which almost all visitors see as they travel west from Kathmandu by road towards Pokhara, at the point of leaving the Kathmandu Valley. From the lip of the valley westward and northward lies a rather desolate scene of considerable erosion, deforestation and degraded pastures. The higher parts of this same area were clad in heavily lopped *Quercus semecarpifolia* scrub when Kirkpatrick traversed it in 1793 (Burkill 1910). This scene finds its way into numerous articles and publications on the ecological crisis of Nepal, but is not representative of the country as a whole. Indeed, much of the agricultural land is in surprisingly good condition (FAO 1980: 7). The worst land erosion is on shifting cultivation land in the Mahabharat Lekh, and in the arid trans-Himalaya, where mass wasting and wind erosion carry away all soil from steep, unprotected slopes. In general, it seems that *charan* land including abandoned cultivation patches and pastures suffer from most serious erosion, particularly sheet erosion and loss of topsoil. *Pakho* land is the next most seriously affected followed by *khet* (Carson 1985: 7). However, mass wasting and catastrophic events such as large-scale slope failures are probably *not* due to human interference (Carson 1985; Ramsay 1985). Hence the most noticeable and dramatic forms of erosion, remarked on by rural tourists, are probably not caused by Nepalese farmers at all.

4.2 How Nepalese farmers cope

At a superficial level, the Nepalese problem has appeared to many observers, local as well as foreign, to be a classic example of the effect of PPR, specifically through deforestation and the dry terracing of steeply sloping land in a sensitive environment. Eckholm (1976) suggests that Nepal will

slide away into the Ganges by the year 2000, and has no doubt that PPR is the principal culprit. A secondary culprit, however, is the Nepalese farmer of whom the Asian Development Bank (1982 II: 34) was highly critical. The practice of building unbunded, outward-sloping dry terraces was attacked with particular severity, and inward-sloping bench terraces were urged as a means of checking runoff. Water management was also regarded as primitive, a view shared by two local agricultural scientists (Nepali and Regmi 1981) who wrote that 'the technology of water management is scanty if not absent'. Under pressure of declining resources *per capita* cattle holdings are declining, and moreover the technology of composting manure is primitive, so that up to 52 per cent of the nitrogen and up to 80 per cent of the phosphorus are oxidized. Over 90 per cent of the fodder consumed by the animals does no more than keep them alive, leaving only 10 per cent for yield of 'economic products' (Asian Development Bank 1982). All this is regarded as very inefficient.

Others differ, at least to parts of this deluge of complaint. Axinn and Axinn (1983) analyse the flows of energy within the farm system, and stress the vital significance of 'keeping the animals alive' to plough the land and manure it; both 'economic products' of their existence. Ives (1985) notes that dry terraces slope outward to avoid waterlogging of dry crops, and to prevent accumulation and penetration of water which would cause landslipping; the absence of a bund is a deliberate measure to *ensure* runoff. Like ourselves, he is impressed by the skill of Nepalese levelling, terrace construction and water management, which includes extensive systems designed to enlarge the command area of irrigation flows. Gurung (personal communication) argues that it is the capital needed to build irrigation systems that is 'scanty', not the technology. Against the view of the critics is the glowing tribute paid by Cool:

> Personal observation suggests that it may require up to twenty years to fully transform an afforested hillside into a relatively stable irrigated terrace. The enterprise is marked with difficulty, setbacks and occasional failure. Yet what stands out is the skill and energy that goes into their design and execution and how successful the hill farmer is in maintaining and improving his terraced fields year after year, generation after generation. Flooding, landslips, goats and cattle, and occasional earthquakes are taken in stride. With only hand tools and simple bullock-drawn ploughs, but with enormous fortitude, the mountain farmer rebuilds, reploughs, reseeds and survives. (1983: 7)

Much greater detail concerning the manner in which farmers of the Kolpu Khola area manage the specific hazards of their environment is provided by Johnson, Olson and Manandhar (1982) in a paper written within the 'natural-hazards school' paradigm, but illuminated by use of ethnoscientific method (Conklin 1954) and by a degree of social awareness not common among this school of research. Methods of maintenance, repair and damage reduction are described, both those used by individual farmers and those

known to them but beyond their means. The problems are well understood, although the supernatural forms part of the folk explanation of sudden and unpredictable terrace collapse. Maintenance is a regular and time-consuming task. When damage actually occurs the problem becomes one of resources. Thus:

> Farmers evaluate the options and, often, must choose the less effective one which is, however, the one within their means. Timing is a crucial factor in this decision. Constraints and limited resources may lead the farmer to postpone taking preventive measures in the face of warning signs. This may result in rapid deterioration or destruction of the endangered field, or it may allow time for the accumulation of resources for complete repair. (Johnson, Olson and Manandhar 1982: 84)

All farmers, however, are willing to experience temporary loss, even of long duration, in order to reduce the risk of greater loss. Thus farmers may cut irrigation off from endangered *khet* land and use it as lower yielding dry terrace, or even let it lie waste until consolidation is achieved. Even more drastic is the deliberate diversion of erosive flows of water on to land threatened with slumping to wash it away before new terraces are built to entrap new soil and rebuild irrigated fields, which then take some years to recover full capability. On the other hand, loose temporary terraces are sometimes made on the *pakho* land in order to obtain a little extra production at extreme risk. Differences in resources between farmers may lead to differences in net damage suffered by the poor and the wealthy, so that 'the overall effect of "random" landslides and floods may result in increased disparities between rich and poor' (Johnson, Olson and Manandhar 1982: 188).

The larger socioeconomic problems which underlie both differences in the quality of land management, and in the impact of damage, thus emerge. Some of these are discussed in a wider context in chapter 6, and a detailed study is offered by Blaikie, Cameron and Seddon (1980). Bajracharaya (1983) also places deforestation in such a context. Gurung (1982) argues forcefully that 'the basic problem of the Himalayan region ... is not ecological but the low level of development'. However, development of some types is not necessarily beneficial to the land. Khanal (1981) offers convincing demonstration of the effects of labour migration on land management in another part of the middle hills. While 90 per cent of the population of Nepal still depends on the land for its major sustenance, by one source only some 64 per cent of rural income is farm income (National Planning Commission, Nepal 1978), though by another the proportion is 85 per cent, 60 per cent from crops and 25 per cent from livestock (Nepal Rastra Bank, cited in Nepal–Australia Forestry Project 1985). Already some two-thirds of the agricultural production of Nepal comes from the lowlands (or *terai*) along the Indian border, where only one-third of the people live; a major shift in population is taking place (Goldstein, Ross and Schuler 1983), and the effect of a substantial reduction in labour inputs into the intensive farming and

land-management systems of the middle hills could be more devastating than the increase in PPR that has taken place in historical and recent times. Some shortage of labourers and livestock hands is already felt in some areas (Gurung personal communication).

There is a further question of significance to be derived from the Nepalese case. It has been widely assumed that severe land degradation is a recent problem, but this is mainly because the problem has only been recognized since foreigners began to enter freely and move around the country after 1950. Logically, one would suppose that earlier shifting cultivation and wood cutting for charcoal-making on a large scale would have done more damage than the intensive terracing that has covered the same hills under rising PPR in modern times. Maize and potatoes were introduced into Nepal in the eighteenth century (Regmi 1978), and the effect of these crops, which offer poor ground cover in the early stages of growth, must surely have been to increase erosion before terracing was widely established.

Certainly, the massive transportation of material from the Himalayas and the middle hills into the Ganges plain is not new. The Kosi river, which drains eastern Nepal, has shifted its course 120 km to the west (i.e. up-Ganges) since 1736, and flooding has been experienced since ancient times (Carson 1985). The contribution of deforestation is disputed in the light of this evidence, and in any case forest destruction in Nepal has been in progress for several centuries (Mahat 1985). There is some slender evidence that the Ganges itself may have become more shoal-ridden during the first half of the nineteenth century, necessitating the replacement of early steamboats by shallower draught vessels (Headrick 1981: 22) but catastrophic events (such as glacial or debris dam-bursts) have been bringing vast quantities of sediment down into the lowlands for millennia.

In these circumstances, the effect of rising PPR in Nepal appears double-edged. Terracing has probably diminished erosion; deforestation and the creation of larger areas of grazing land have probably increased it. It is by no means clear that the balance has been towards greater degradation. Nor is it clear that the pessimist's vision, caricatured by Ives as desertification of the Himalayas, 'the devastation of the Ganges and Brahmaputra plains and a major opportunity for Dutch polder engineers in the Bay of Bengal' (1985: 428) will come about under present practices. 'Development' of a type which would involve major reduction of available rural labour in the middle hills, or the introduction of machinery and of large but untried works conceived by engineers without understanding of the dynamic montane environment, might however be more conducive to this result.

4.3 *The 'chain of explanation' in the middle hills*

The precise role of PPR still needs to be explored further: in terms of the interpretation of whether accelerated erosion *is* a major and widespread phenomenon; whether it has recently become worse; and also in terms of

the causal relationship between population growth and erosion. A more comprehensive frame of analysis must be provided or, to use the metaphor with which this chapter started, the chain of explanation must be followed back to broader socioeconomic links.

One of the most fundamental relationships in evaluating the impact of PPR is that between population growth, extension of cultivation and the productivity of land and labour. Between 1970–1 and 1980–1 the increase in population was greater than the increase in cropped area in both highlands and lowlands (Gurung forthcoming), and in the highlands most of the increase was due to extension of double-cropping particularly involving wheat cultivation on *khet* (Mahat 1985). However, inadequate data indicate that food-crop production declined by 0.5 per cent between 1970–2 and 1980–2 in the middle hills but increased by 9.6 per cent in the lowlands, against area increases of 11.6 and 15.1 per cent respectively (Gurung forthcoming). Forest clearance in the *terai* has now reached the limits of good land, and a weakening situation of irrigated rice production probably reflects the extension of cultivation on to less fertile land.

Mahat (1985) describes the double-cropping, inter-cropping and relay-cropping systems in use in a part of the middle hills east of Kathmandu. Livestock manure is the basis of production, and in the hills there is one 'livestock unit' per head of population, mainly cattle and buffalo (41 and 22 per cent at weightings of 1.0 and 1.5) plus goats and pigs for meat. However, in Nepal as a whole, the annual increase in cattle population between 1966–7 and 1979–80 was only 0.12 per cent while the buffalo population declined by 1.3 per cent (Rajbhandari and Shah 1981). The consequences for production are probably better illustrated by a representative interview with a farmer than by unreliable statistics:

> Some thirty years ago we still produced enough grain to allow us to exchange surplus for necessary daily goods, which we could not get from our farming. Of the grains harvested, one third was exchanged.... While the good farmers who have enough cattle and do very intensive cultivation can still increase their yields, this is not the general trend. In a *khet* (irrigated) field where we sowed 4 *mana* of seed we used to get 1 *muri* of paddy; now we need an area with 8 *mana* of seed to get 1 *muri*. Our wheat used to have big ears and long halms and we filled six baskets a day, nowadays it is sometimes only one or two. In many houses there is no longer enough food. For some, the harvest grains are sufficient for only three to four months a year. (Banister and Thapa 1980: 90)

The small size of corn-cobs on stacks outside houses in the middle hills is a matter of observation, though whether or not any trend is present is impossible to determine except by farmers' recall.

Intensive questionnaire work in west-central Nepal undertaken by Blaikie, Cameron and Seddon in 1973–4 and 1980 (Blaikie, Cameron and Seddon 1979, 1980) indicated that farmers were in fact well aware of decline in yields

on old-established fields, particularly dry fields which supported maize and millet. The main problem is one of a reduced availability of plant nutrients, which come predominantly from composting of forest products and involve a 'transference of fertility' from the forest to arable land (Blaikie 1985b). Cattle are stall-fed much of the time and are fed forest-litter, tree loppings and hand-cut grass, all of which are gathered daily. The manure, together with leaf material from animal bedding, is then applied to fields. As the population rises, the increased demand for food crops is met by heavier lopping, which thins and destroys the forest. Mahat's (1985) informants at Thokarpa, east of Kathmandu, held that the greatest forest degradation occurred between 1951 and 1962 when there was a partial breakdown in central government administration, but that controls have been restored under the local government system established in the latter year.

Fuel needs also reduce forest cover. Indeed, wood fuel demands exceed supply by 2.3:1 in the middle hills and by 4:1 in the drier far west. One source estimates that all accessible forests will be eliminated within twenty years (Asian Development Bank 1982: 12), but other information cited here sheds doubt on this estimate and indeed all estimates are fraught with uncertainty (Thompson and Warburton 1985a). Crop yields decline when the forest-to-arable ratio is upset, and whatever the direct effect of deforestation on erosion it certainly has an effect on the capability of the arable lands. The inability of most Nepalese households to make good this 'energy crisis' by importing chemical fertilizers, and kerosene or other alternative fuel for cooking is an essential part of the explanation.

So we must pursue the question of PPR and degradation to the next link in the chain of explanation. The problem, as Harka Gurung argues, could be conceived as a lack of development. Simply, incomes are so low that few can *afford* chemical fertilizer, or any capital investment other than that generated entirely by their own labour. Half the households of a rural household survey undertaken in 1973–4 (Blaikie, Cameron and Seddon 1980) sold less than Rs. 250 (*c.* £10) of agricultural, pastoral and handicraft produce per year. Most budgets were balanced to within a few rupees, or were in deficit (Blaikie in Seddon, Blaikie and Cameron 1979: 69). Also chemical fertilizers do not produce a satisfactory return on unirrigated crops and, therefore, are not usually applied to summer maize and millet, but are largely limited to winter wheat, and winter maize at low altitudes, to industrial crops and sugar cane in the *terai*, and to vegetable growing by larger farmers in the Kathmandu Valley. Thus, as traditional forms of energy use start to fail because of population growth and degradation, the peasantry is, and becomes more, unable to transform itself and substitute new and imported forms of energy for agriculture, livestock rearing and fuel. It also becomes less and less able to harness water for more irrigation, especially as the replacement of local smelting of iron and copper by imported metal has reduced the population of miners whose winter off-season work used to be the building of irrigation systems for villagers (H. Gurung personal communication).

However, rural households *have* responded to PPR in other ways. They

have migrated out of the hills altogether (so that the *terai* now holds over 40 per cent of the population of Nepal, according to the 1981 Census). They continue to extend cultivation and upgrade land (from dry *pakho* to terraced *pakho* and to *khet*). As the Land Resources Mapping Project has shown, a number of new crop rotations have been introduced, particularly on south-facing slopes and lower elevations, involving relay-cropping, inter-cropping, the selective introduction of quick maturing varieties, zero-tillage cultivation allowing broadcast wheat to be sown before the harvesting of *padi*-rice in *khet* fields, and so on. However, the endeavours and ingenuity of Nepalese farmers can in many areas of the middle hills and mountains barely cope with the increasing challenges being heaped upon them. However, lest the erroneous impression arises that PPR *is* the ultimate culprit, the question must then to be asked, *why* is the majority of the Nepalese rural population so poor?

The last link in the chain of explanation is vital, but it is only explored in outline here to avoid anticipating the argument of chapter 6. Nepal has had a long history of political independence, but also of quite important economic relations with British and later independent India. The independent state, however, taxed the farmers heavily and placed heavy demands on their labour for corvée work; in some areas landlordism developed as state officials were allocated areas of land and people to exploit in lieu of salary (Regmi 1971, 1978). Until very recent times the state remained unchanged in its antique and quasi-feudal form and kept out modernizing reforms in education, forms of representative government as well as productive capitalism in industry and agriculture (Blaikie, Cameron and Seddon 1980). Nepal remains landlocked and dependent upon India, both politically and economically. Such surpluses as there are in Nepal tend to be used in merchanting, smuggling, real estate and speculative purchase of land. Attempts at manufacture are undermined by cheaper products from India, and the 'leaky' frontier allows grain from the surplus-producing *terai* to flow south to India rather than to the food-deficient hills. The state itself has had great difficulty in outgrowing its quasi-feudal and extractive nature to meet the daunting challenges of development at the present time (Shaha 1975; Blaikie and Seddon 1978).

4.4 *Crisis in explanation?*

The explanation starts with changes in the intrinsic properties of the Nepalese landscape and ends with the problems of the Nepalese state and its relations with India. Each link of the explanation is firmly closed around the next, but initially the direction is away from the environment and towards more general 'development problems' of the agrarian economy and the Nepalese state. It leads back to land degradation because a vicious circle of links has been created, leading from degradation to underdevelopment and back again to degradation.

The palliation or gradual reversal of the problem of poverty requires a

series of 'techno-political' decisions. However, there is a considerable degree of indeterminacy between the 'levers of policy' and intended results. For example, we cannot state with certainty that more commercial economic opportunities for Nepalese farmers (e.g. growing fruit and other crops for which they have a comparative advantage) would *necessarily* improve land management and reduce degradation. As the discussion of the land-management decision-making process in chapter 4 will suggest, there are many *other* exits from the vicious circle just described, aside from more effective land management. The more the explanation is linked to the social and political economic context, the more unpredictable and less direct the impact of environmental policy becomes. On the other hand the more directly environmental and technical the explanation, the less it is able to account for human agency in the management of land. The knack in explanation must lie in the ability to grasp a few strategic variables that both relate closely together in a causal manner, and which are relatively sensitive to change. In that way the most promising policy variables and paths of social change can be identified.

In the Nepalese case, the need to distinguish between the natural processes of a high-energy environment and the effects of human interference – and further to distinguish between the harmful and the positive elements of that interference – is of paramount importance. As we shall see again and again in this book, not enough is known of the modern history of the land surface to establish this distinction, although there is certainly enough evidence to discard the generalizations of even a decade ago. What is certain is that the management efforts of the farmers of the middle hills are under stress of such an order as to threaten the basis of their livelihood. More specifically, the stresses are felt most keenly on the overgrazed forest-fringe areas and on the upland dry-terraced fields. Here, poverty is the basic cause of poor management, and the consequence of poor management is deepening poverty.