Rethinking Research on Land Degradation in Developing Countries
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Yvan Biot
Piers M. Blaikie
Cecile Jackson
Richard Palmer–Jones

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At the time this paper was written, Yvan Biot was a lecturer at the School of Development Studies, University of East Anglia, Norwich, United Kingdom. He is currently a research officer on the Bionte Project, sponsored jointly by INPA (Department of Ecology and Forestry), Manaus, Brazil, and the Overseas Development Agency. Piers M. Blaikie was a consultant to the Agricultural Policies Division of the World Bank's Agriculture and Natural Resources Department. He is a professor at the School of Development Studies, University of East Anglia. Cecile Jackson and Richard Palmer–Jones are lecturers at the School of Development Studies, University of East Anglia.

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Foreword

The topic of land degradation has received growing attention in recent years by many concerned agencies and individuals. The field is intrinsically complex involving as it does the consequences of decisions taken by literally billions of people relating to the management and custody of their land resource. It is not surprising then that analysis of what should be done about these matters vary greatly in their nature and conclusions.
The present paper grew out of a workshop held in Washington in 1989 with follow−up meetings in 1991. The intention at that time was to develop a research agenda for international agencies, particularly the World Bank. The issues proved to be sufficiently complex to make the implementation of such research agenda not immediately achievable, but it seems important to capture the essence of the deliberations arising from the consultation, and to make the conclusions available to a wider audience. These days there are many agencies, national and international, that are eager to sponsor interventions and to gather further cogent information to deal with what is perceived to be a growing global resource issue.

Busy readers are directed to Chapter 5, the concluding chapter, which serves very much the role of an Executive Summary. Readers desiring to grapple with the full range of complexity of the issues are, however, encouraged to delve into the foregoing chapters for a wide−ranging discussion of the complex of issues and the different philosophical points of departure relating to them, and as well to the country−specific appendices, which give rich context to the discussion.

Within the Bank, John English and Ernst Lutz from the Environment Department, and Jock Anderson and Peter Hazell from the Agriculture Department, provided the links and wherewithal for managing this initiative. The group at the University of East Anglia has labored long to synthesize the material that is here presented. In bringing this work to publication, the long hours spent by Corazon Solomon and Jock Anderson are gratefully acknowledged.

ANDREW STEER  
DIRECTOR  
ENVIRONMENT DEPARTMENT

ALEXANDER MCCALLA  
DIRECTOR  
AGRICULTURE AND NATURAL RESOURCES DEPARTMENT

Abstract

This paper critically reviews the three main approaches to land degradation and conservation—classic, populist and neo−liberal. The implications of these paradigm shifts are examined in terms of research needs. Next, the paper discusses the role of science and technology, and the origins and substance of differences in the perception, evaluation and diagnosis of degradation. Focus is then shifted to analyzing how farmers and pastoralists make decisions about resource use and management, and a research approach is suggested for analyzing decision−making. Two case studies illustrate the approach.

Acronyms

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<th>Description</th>
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<tr>
<td>AGRITEX</td>
<td>Agricultural Technology and Extension Department</td>
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<td>CGLAR</td>
<td>Consultative Group for International Agricultural Research</td>
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<td>EPIC</td>
<td>Erosion−Productivity Impact Calculator</td>
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<td>EPROM</td>
<td>Erosion Productivity Model</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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1—
Changing Paradigms in Land Degradation Research

Points of Departure

This section outlines the way in which approaches to land degradation in developing countries have been understood and the difficulties that can be expected with the attempt to deal with them on the basis of these current approaches. First, we identify a classic approach to conservation in developing countries and then a populist revolution that has been underway over the past two decades and shares some characteristics with neo-Marxist or world-systems diagnoses of land degradation problems; finally we characterize a neo-liberal counterrevolution that is embodied in the approach being proposed in such documents as the recent issues of the World Development Report (World Bank 1991, 1992). This counter-revolution draws mainly on the economic approach to the environment that has recently become dominant in policy discussions in developed countries (Pearce et al. 1989) and it adds to it a restricted interpretation of the neoclassical theory of institutions and the pure theory of technical and institutional innovations in giving an account of the roles of state, market, local and community institutions, and NGOs, in the evolution of policies with regard to the environment and mechanisms for establishing sustainable development. Such an approach fits well with the "market friendly" policies that have come into vogue in the late 1980s with major multilateral and many bilateral donors, and development practitioners. We argue that the ideas of this counter-revolution may not be as readily applicable in developing countries as the present consensus suggests. Many of the elements of this synthesis have already been tried in some developing countries and experience has indicated some of its limitations.

These three approaches (Table 1.1) are neither strictly sequential in their historical development, nor mutually exclusive. For example, the issue of population pressure on natural resources was a prominent theme in the classic approach to soil and water conservation, but has re-emerged strongly as part of the counter-revolution too. Also, the present emphasis on poverty as a major cause and effect of environmental degradation is shared by both populist and counter-revolutionary approaches. There is a dilemma, however, which is that, while a synthesis of these existing positions appears to have been reached and policies which should be successful identified, in practice there is widespread disillusion with the application of these approaches in developing countries.
The case of Zimbabwe is given in Appendix A2, where the classic approach has been adopted by a strong state for many decades and been implemented with a vigor that is possibly unsurpassed, yet land degradation continues to be perceived as a problem. In Nepal (in Appendix A1), where, by contrast, the policies that have been adopted in recent years by a "soft" state have been predominantly of the populist approach, yet here too land degradation

<table>
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<td>Institutional prescription</td>
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continues to be perceived as a problem. In both cases, there is considerable uncertainty not only as to the means to deal with land degradation issues, but even whether it is a central, or soluble issue at all. It is argued that, if in these two cases that have been intensively studied, there are still unresolved dilemmas as to how to proceed, then there is a serious issue that needs to be researched, which can be formulated in the following way. Land degradation is perceived to be a problem, there are perceived to be many technological and institutional innovations that can solve them, and these have been promoted by aid organizations—and yet these innovations seem not generally successful. Why?

This paper attempts to provide some answers to this question, and to indicate ways of resolving the dilemma through particular avenues of research. The rest of this of section describes the three approaches characterized above and goes on to suggest the foundations for work that will transcend the limitations identified. This involves more detailed thinking about both the scientific basis of the symptoms and diagnosis of land degradation, and of the economic and social models that have informed policy on degradation.

**Approaches to Land Degradation**

**The Classic Approach**

There are presently three sets of assumptions on which issues of land degradation in developing countries rest. The first set assumes that the extent of and solutions to the problems of land degradation are well known, but the problem is to get people to implement them. The second set assumes that the nature and extent of land degradation are imperfectly understood, that local peoples often reject conservation technologies for good reasons and, in fact, adopt their own individual and collective approaches that have in the past resulted in sustainable livelihood practices. Uphoff (1988) has characterized these contrasting positions (with respect to poverty alleviation policies and projects) as paternalist and populist, respectively. The former is characteristic of soil and water conservation (SWC) in the colonial and ex-colonial territories of East, Central and Southern Africa, and South Asia and of the American Soil and Water Conservation tradition, but it has regained favor, albeit in a new guise, as a part of the third set of assumptions, a new synthesis of previous views, called in this paper the neo-liberal approach.

The former position bears a strong resemblance to the "classic" approach identified in Blaikie (1985:53). The classic approach identified there comprises four major components:

1. the identification of an environmental problem with an environmental solution;
2. mismanagement of the environment by the users;
3. over-population;
4. subsistence fundamentalism

Such a diagnosis tends to be associated with a "three-step approach to the problem" (e.g., Stocking 1988:381):

identification of the problem as serious, indicating that soil conservation and land reclamation are urgently needed;

technical measures requiring the cooperation of the community are recommended; and

plans are implemented through a combination of encouragement, persuasion, and subtle threats sometimes backed by more coercive powers.
Key points are the lack of any account of the position of the participants (the natural resource users themselves), and the reliance on experts. The typical response to failures with this approach has been to find "escape hatches" (Clay and Schaffer 1984), blaming unfavorable weather, lack of cooperation by different government departments, lack of political will, or lazy and uncooperative farmers. However, the view from another paradigm instead sees classic soil conservation intervention failure in terms of five major problems:

1. technical failures through inadequate or misapplied research;
2. lack of fit between techniques and local farming systems and livelihood strategies;
3. inappropriate land tenure conditions—either poorly defined property rights or highly unequal landholdings;
4. lack of participation by land−users in designing and implementing conservation technologies;
5. inadequacies of state bureaucracies charged with soil conservation strategies.

These diagnoses lead to suggestions for further technical research and development, research on the decisions and practices of users (Blaikie 1985: 67 giving the example UNDC 1977), land and land tenure reform, "participation," and organizational reforms such as improved payment, training, organization and provision of resources rather than more fundamental structural reforms to enable real participation by users.

Further impetus to this critique has come from studies of indigenous practices, varying from indigenous cultivation and cropping strategies to "ethno−engineering." It was increasingly realized that, not only in many cases did traditional practices avoid conservation problems, but also effort had been invested in conservation practices by local farmers who had long practiced collective measures to create and maintain conservation structures (Richards 1985, IFAD 1992). It was argued that local communities could solve local collective action problems (Runge 1981, Wade 1987). Furthermore, in appropriate circumstances, suitably designed projects could induce the adoption of on−farm and collective SWC practices.

Thus local conservation practices, successful adoption in appropriate circumstances, and misdiagnosis of degradation issues, led to close attention being paid to the origins of and rationale for "classic" SWC approaches, and indeed to the development of a range of studies that constitute a "political economy of conservationisms" (see, for example, Blaikie and Brookfield 1987). Attention shifted from blaming backward farming practices for accelerating degradation, to identifying the constraints that were the primary cause of land use practices that lead to degradation. This line of investigation gave rise to a number of radical explanations ("chains or webs of causation") such as the incorporation of pre−capitalist societies into the world market creating new constraints upon decisions of local people, which lead them to take decisions which degraded their environment. The concept of "marginalization" was applied to understand the way in which an expanding population on a restricted resource base might be forced to degrade its environment in the absence of sustainable agricultural intensification, and/or redistribution of resources. Growing inequality and socioeconomic differentiation within peasant communities, and in their relationships with traders and state agencies, were seen to lead to impoverishment of smaller farmers. This, in turn, led the poor to have to over−exploit their environment (Blaikie and Brookfield 1987).

Populist Approaches

These critiques led to a re−appraisal of the classic approach during the late 1970s and the development of what we term the populist approach to SWC. As with other tendencies of the time, these people−centered and bottom−up approaches shared much with more politically radical Marxist ideas (e.g., the need for redistributive land reforms
and political changes to empower the people). However, a more populist and less radical approach has prevailed. Thus the Soil and Water Conservation Society summarizes the outcome of a workshop on the new approaches to erosion control (Diagnosis and Design, Farming Systems Research and Integrated Conservation Farming Systems) held in 1987, in the following words:

"There was a broad consensus of agreement among participants on how to achieve soil and water conservation on steep lands and why past efforts often failed. Perhaps the most recurring theme was that approaches of the past relied too heavily on structures that may have been expensive to build and maintain and that added little to productivity of the land.... It is much more effective to develop a plan or strategy for increased productivity and efficiency with the farmer, using structural measures, if necessary, to complement an effective system of land husbandry" (Shaxson et al. 1989:8).

As Will Critchley puts it:

"The conventional type of SWC project—with its emphasis on building structures and reducing soil erosion—has failed so often that there has been no option but to change strategy.... Peoples' participation, flexible work plans and conservation for production take center stage" (Critchley 1991:51).

Hudson after a review of 35 SWC projects undertaken by FAO concluded that:

"Design errors were mainly the result of incorrect assumptions made at the design stage ... overestimating the effect of new practices ... the rate of adoption of new practices ... the ability of host country to provide back-up facilities ... [over-optimism about] the time required to mobilize staff and materials for the project ... estimate of the economic benefits ... capacity to provide counterpart staff and ... the recurrent costs ... strength of national research base and its ability to contribute to the project ... underestimate the problems of coordination among different ministries or departments" (Hudson 1991:viiviii).

Hudson goes on to enumerate "good project design requirements," including flexibility "so that the project can grow and change and adapt during the course of the project," and technology that should:

"be appropriate and tested locally ...offer short term, on-site benefits, and large increments (50100 percent) ... require affordable inputs, especially labor ... not include foregone benefits, e.g. giving up land ... not include an increased risk ... be in tune with existing social factors, e.g., the separate roles of men and women in agriculture" (viiiix).

and further he argued "... participation is critical" (Hudson 1991:8).

The proposals that arise from these approaches require site-specific participatory study and design using a multidisciplinary approach by teams of specially trained and oriented natural and social scientists in combination with local farmers and organizations. However, it can be argued in orthodox government and aid agency circles that it is an approach that can only be effectively carried out on a small scale in pilot projects by highly motivated staff, with exceptional qualifies, and often in positions of considerable privilege compared to every-day street-level bureaucrats (Lipskey 1981). It is not an approach that can be applied on a widely expanded, let alone, universal basis. Successful examples are often subsidized and unsustainable, and unreplicable on a large scale. It is argued that it may be more appropriate to the activities of NGOs, not to the "aid business," which has to work within the state, and has a short time horizon with immediate imperatives to disburse, construct, show tangible results, and so on (Blaikie 1985: 61f).

In spite of these criticisms, the populist approach has become central to many development agencies, particularly NGOs, not only to SWC but also to sustainable agriculture and in health, welfare and education projects and...
policy. Farming systems research continues to develop new inter-disciplinary insights, has been attempting to include gender issues, encompasses not only the household but the region, and involves farmers at all stages of the development of technologies. Indigenous technical knowledge is being taken seriously and new forms of constructive dialogue between farmer and scientist, for example in Participatory Rural Appraisal (Mascarenhas et al. 1991), continue to be developed. In short, the populist approach to SWC and the broader context of sustainable agriculture in which it places the former remains a dominant one. It also shares an anti-state position with the neo-liberal approaches, which we go on to discuss next.

Neoliberal Approaches

Even as the populist approach is being integrated into establishment thinking, we can discern something of a counter-revolution against the populist approach. This neoliberal position holds that suitable technologies presently exist or can readily come into existence; the problem is to understand the present structure of incentives that prevents land users from adopting them, and to design incentives that will induce adoption. This approach derives partly from a reasoned response to the naivety of extreme populist ideas, partly from an understanding of the realistic constraints to change of real-world bureaucracies and state-citizen relationships, and partly from a reassertion of the classic position bolstered by the "pricist counter-revolution" in economic policy of the past decade. However, the various strands of this position are not all theoretically integrated, and derive from the previous approaches. The first is the central role of population growth in exacerbating pressure on natural resources, which, as is discussed below, is very prominent in contemporary policy statements. The second is the link between land degradation and poverty. This involves the careful construction of explanations of land degradation into land users' production strategies and the serious constraints under which they are formulated. Many of the poor degrade the environment in the longer term on account of the lack of resources, which forces outcomes of "desperate ecocide," and reproduces conditions unfavorable to the adoption of a norm of a small family and a reduction of population growth. The third strand from the classic approach re-establishes the certainty that technologies for SWC exist, problem definition is relatively unproblematic, and that it is a matter of getting farmers to adopt these technologies through extension and appropriate incentives.

This approach is typified by the World Bank's recognition of the need for a new, integrated approach to problems of environmental degradation, from its more general policy statements, institutional reorganizations, and from its recent country program documents. There has been widespread agreement on the importance of environmental degradation. An initial burst of concern was contemporary with the "Limits to Growth" arguments of the early 1970s and, when the Bank's internal operational instructions were revised in 1971, it was required that "projects should be appraised for their impact upon the environment" (OECD 1989:xiv). Many Bank projects have "attracted widespread criticism on ecological and equity grounds" and an internal review found that "there is room for concern that the environmental performance of projects viewed over 20 years may be less satisfactory than Bank documents might indicate. There is a disturbing tendency for the adverse consequences to emerge or become more pronounced with the passage of time" (OECD 1989:xivxv).

More recently pressure has mounted on the Bank from a variety of sources to become more environmentally aware. The basic thinking by the Bank about policies to deal with them has been summarized in the World Development Report 1991:

"The main priority world-wide is to establish incentives, regulations and safeguards that lead to proper allocation of resources for environmental maintenance and energy conservation" (World Bank 1991a:151)

Two further types of problem are discerned that correspond to the economists' concept of externalities. They are those that have local consequences, and those whose effects are world-wide (p.156), although both are extremes in a continuum. Included in the former are both strictly local and reciprocal externalities (e.g., village forests or
grazing) and unidirectional externalities such as those caused by land degradation on watersheds for downstream resource users (e.g., "extensive deforestation in Nepal is thought to have caused land erosion and floods in Bangladesh and India" (World Bank 1991a:59)). Examples of world-wide problems are the complex of problems involved in global warming, and loss of biodiversity caused by the loss of tropical rainforests.

The World Development Report 1992 focuses on "Development and the Environment." it also represents well the neo–liberal approach or the "economic approach" to the environment and public policy, but draws on both the classical and populist traditions. Its theoretical precursors are clearly represented in the way this report acknowledges the existence of interrelationships between economic growth, poverty and the environment. They bear a strong similarity with recent thinking about poverty among official aid agencies and the development profession. Others have drawn attention to the new consensus in thinking about policies for development and poverty reduction which is embodied in both the World Development Report 1990 and the recent UNDP–sponsored issues of the Human Development Report (e.g., Ravallion 1991, Lipton and Maxwell 1992). It advocates labor–intensive economic growth with targeted safety nets, promoted by "market friendly" state policies and limited roles for state bureaucracies, key roles for institutions of civil society, and recognition of the influence of international factors in achieving sustainable economic growth with poverty alleviation.

Three types of policy with benefits for the environment are identified:—

1. "win–win" policies that are based on the establishment of properly functioning markets (e.g., the removal of subsidies that lead to over–exploitation of environmental resources, the establishment of property rights to encourage, socially desirable stewardship, and the use of pricing to mitigate pollution);

2. policies that require some state intervention to mitigate market limitations, but which are justified by their economic benefits alone (education of women, investments in public health, and soil conservation);

3. interventions that are only justifiable when their environmental benefits are included(regulation and taxation of pollution and publicly owned natural resources).

We discuss next the contours of the emerging neo–liberal approach in more detail.

Environmental Economics

The recent resurgence in the "economic approach" to environmental management as exemplified, for example, in the work of Pearce et al. (1989), which has been taken up also by other major aid agencies, for example ODA (Winpenny 1991). The "economic" approach draws mainly on two streams of economics—the Meade–Pigou approach to externalities through bureaucratic regulation (standard setting, command and control) and/or administratively managed taxes and subsidies, and the Coasian tradition based on the internalization of externalities through the establishment of appropriate property rights. Practical policies incorporating elements of both have been developed, particularly in the USA, through the development of marketable permits. It is important to note that the state retains an important role in this system through determining the form and parameters of the system, and ensuring that no cheating takes place. It is noteworthy that most trades take place within rather than between firms.

The economic approach has arisen primarily in response to the perceived environmental problems of developed industrialized countries, where much of the impetus has come from the amenity value of the environment and much of the conflict is between commercial exploitation and aesthetic values. It is a conflict that arises out of the "success" of "development" which has generally secured the material well–being of the majority of the population. On the one hand, attention has come to focus on conservation of landscape and habitat, while on the
other, it has identified elements of unsustainability arising out of the production and consumption patterns of the affluent. In developing countries the conflict more often arises in the course of pursuing "development" itself, as "nature" is directly used as a source of livelihood and accumulation for the majority of the population. It also arises in the struggle for economic growth, basic needs, and survival strategies. In an affluent country it may be realistic to advocate a "polluter pays" doctrine (except in the case of landowners), but it is likely to be much harder to gain acceptance for this approach where the "polluters" are impoverished small farmers and landless people, or state agencies or private companies whose exploitation of the environment is a source of desperately needed growth, or foreign exchange.

Population

The main source of pressures generating these problems is thought to lie in rapid population growth, and "other pressures too: the widespread use of natural-resource-intensive-technologies; ineffective regulation of common-property resources; land tenure systems that do not secure long-term rights to land use; and policies that distort the prices of non-renewable resources" (World Bank 1991a:59). Population growth is both cause and effect of environmental problems:

"The effect of population growth on the natural environment is another source of divergence between private and social costs. The pressure of population can raise agricultural demand, leading in turn to the abuse of marginal land and other natural resources. (p.59) ... The pressure on land has been exacerbated by people's needs to gather fuelwood and graze their livestock ... as the situation worsens, farmers have to bum animal dung and crop residues instead of using them to enrich the soil ... Agricultural stagnation and environmental degradation also affect population growth. High infant and child mortality rates caused by food shortage and malnutrition induce men and women to have more children, partly to ensure that some survive to support them in old age. ... To break this vicious circle, policies are urgently needed to control population; increase agricultural productivity without damaging the environment; and reduce malnutrition, poverty, and infant and child mortality" (p. 61).

A key role is given to population growth that "increases the demand for goods and services, and, if practices remain unchanged, implies increased environmental damage. ... also increases the need for employment and livelihoods, which—especially in crowded rural areas—exerts additional direct pressure on natural resources. More people also produce more wastes ..." (p. 26). While agricultural intensification is a common adaptation to an increasing population, an illustrative example on sub-Saharan Africa identifies the problem as "sharply accelerated population growth." Population growth is itself driven by poverty, as noted above, and as the prescriptions make clear: "declining fertility rates ... will require solid progress on four fronts: incomes of poor households must rise, child mortality must decline, educational and employment opportunities (especially for women) must expand, and access to family planning services must increase". ... The primary task is to eliminate poverty"(p.29). Income growth takes pride of place in poverty alleviation ("Asia, with its rapid income growth, continues to be the most successful at alleviating poverty" (p.29)).

Furthermore, recognizing that many of the poor live in resource-poor areas the Bank argues for special policies:

"Increasing numbers of poor people live in areas that have little agroclimatic potential and are environmentally fragile. ... [P]opulation pressure in these areas has decreased the productivity of land and increased its vulnerability to flooding and soil erosion. This raises the question of the links between poverty and environmental degradation.
These regions need a special development strategy for three reasons. First, their potential for growth is limited. Second, they are increasingly occupied by poor people with the fewest skills and the least access to infrastructure and supplies. Third, environmental degradation in these regions adversely affects both the immediate area and regions downstream or downhill.

... Poor farmers are being marginalized and pushed to frontier areas. In addition, population growth and the commercialization of agriculture have forced farmers who once relied on environmentally sustainable forms of cultivation to use their land more intensively. ... but the intensification of traditional farming methods, such as slash and burn agriculture, has damaged the productivity of these marginal areas. Overgrazing and unmanaged irrigation, and an ever-widening search for fuelwood all accelerate decline.

... Insecure land tenure and encroachment on common and state lands encourage soil mining practices that diminish the long-term productivity of the land" (World Bank 1990:712).

Solutions are thought to lie in out-migration, "training poor farmers in better techniques for farming, diversification and off-farm employment, providing local user groups with rights to manage degraded communal lands. ... policies to make land tenure more secure in areas in which traditional tenure systems have broken down. ... adoption of low-cost, low-input technologies that would increase and stabilize yields, diversify production, and maintain the resource base. ... [e.g.,] contour cultivation ... vetiver grass ... improved technology for terraced lands and more appropriate land tenure policies ... government subsidies to develop and improve low-return farming activities may be the only way to reduce poverty in these regions" (World Bank 1990:73).

Thus the Bank shares one of the most important populist views that perhaps the major cause of these problems lies in poverty, which causes the poor to degrade their environment both directly, as the poor exploit their environment to survive, and indirectly through the effects of poverty on population growth. In the World Development Report 1990, it is acknowledged that "[N]o task should command a higher priority for the world's policy makers than that of reducing global poverty" (World Bank 1990:5);

"Often the problems of poverty, population and the environment are intertwined: earlier patterns of development and the pressure of rapidly expanding population mean that many of the poor live in areas of acute environmental degradation" (World Bank 1990:2)

One should perhaps add to these connections between poverty and degradation the way that, in the name of poverty alleviation, private and state enterprises are permitted to degrade the environment to repay debt. The World Development Report 1992 continues the focus on population. The connection of environmental problems with poverty is made thus—"attacking poverty is not only a moral imperative, but it is also essential for environmental stewardship" (p. 1). The poor are more likely to be victims of environmental degradation and less able to protect themselves from its effects. But they are also likely to be its agents, in particular through a linkage with population growth, as illustrated by the following quotation: "[t]here has been a] sharp acceleration of population growth in the past four decades. Low agricultural productivity, caused mainly by poor incentives and poor provision of services, has delayed the demographic transition and encouraged land degradation and deforestation, which in turn has lowered productivity" (p.8).

The ways out of poverty are thought to lie in "labor intensive economic growth and efficient social spending" (World Bank 1991a:64) The social spending would focus on education and health for the masses, safety nets through transfers to protect the most vulnerable, food security through well targeted means, and public employment programs for the able bodied.
Like populist approaches to development, the neo–liberal perspective treats women as an undifferentiated group. Although poverty is seen as a cause of environmental degradation, gender relations are not. Women are given a key role, however, in the importance attributed to population control through women's education, which is believed to be the key to reduced fertility. Women are targeted merely as a means to achieving lower population pressure and thereby conserving the environment.

**Incentives and Institutions**

The *World Development Report 1992* draws from the populist approach the arguments that the people and their institutions are rational and reasonable in their behavior, once peoples' objectives and knowledge, and the structures within which they take their decisions are taken into account. Rather, failure to adopt is due to inappropriate government policies; "[S]ometimes government failures may be the cause [of failure to adopt beneficial and desirable environmentally friendly technologies]; artificially low farmgate prices ... fertilizers ... rationed because of subsidies or poor distribution channels" (p.20). The emphasis given to community management and participation in bringing about environmentally sound governance and practices also draws from populist ideas the possibilities for efficient and equitable collective action by communities.

From the economic theory of the evolution of property rights (Hayami and Ruttan 1985) comes the idea that degradation follows from the under−valuation of resources, which occurs because resources are shared. Resources are shared because either there is no mechanism for enforcing property rights or because property rights are impossible to enforce (p.36). Increasing resource scarcity, reflected at times in resource degradation, will be best managed by the evolution of property rights appropriate to the nature of the case, and will be promoted by "market friendly" policies of benevolent states; private property for divisible and definable resources, collective property for indivisible resources, and state regulation for those resources which cannot readily be privatized (air and water bodies). Thus, "[T]he principles of sound environmental policy ... are well understood" (p.42), and just as economic growth is not necessarily bad for the poor, so economic growth need not be bad for the environment; indeed environmental problems can be delinked from growth as the *World Development Report* claims it has, to a large extent, been in OECD countries (p.40).

As indicated above, the approach of the Bank is largely in terms of incentives and regulations; these responses coincide generally with the "economic approach" to environmental problems stemming from neoclassical economics, and in particular the economics of externalities, and of property rights. Externalities can be dealt with by a combination of taxes and subsidies, market−like pricing systems, establishment of private property rights, and the regulation of resource use where these fail. The determined application of this approach tends to focus on the inappropriate structure of incentives as the cause of environmental problems. The inappropriate elements in this structure can be discussed in terms of (a) distortions in prices brought about by government interventions, tax and subsidy structures (Repetto 1988, Binswanger 1991); (b) inappropriate or inadequate policies towards provision of public goods and resolution of externalities; (c) inappropriate patterns of property rights, particularly the persistence of open access and common property systems:

"Often a first step is to eliminate subsides for activities that harm the environment, including the colonization of forests that have poor soils and the excessive use of pesticides and fertilizer in agriculture. ... if pollution is taxed and regulated, concern for environmental and energy conservation can be incorporated into public decision making. It is also important to establish clear property rights: owners have a stake in preserving a resource. In some cases property rights can be vested in the state, with charges for use of environmental resources, as in extractive reserves in the Amazon" (World Bank 1991 a:151; see also Southgate, Sanders and Ehui 1990).

Broadly speaking, this type of approach identifies an interrelated set of environmental problems—deforestation; soil erosion and loss of soil fertility and agricultural productivity; contradictory effects of pesticide and fertilizer use, and genetic vulnerability; downstream flooding, siltation, sedimentation, and depleted low−season flows.

**Incentives and Institutions**
Great reliance is placed on getting the incentives right: "The way out of this vicious circle lies in reducing poverty by agricultural growth, and promoting agricultural growth by relying on farmers' response to incentives. Farmers need knowledge, about improved packages, learn about new technologies, to get access to markets, storage facilities, credit and inputs. ... Government can help by providing research and extension services, secure land tenure arrangements, better education, and physical infrastructure such as roads and irrigation." The main aim is to achieve "poverty-reducing growth" through

"first and foremost ... moderate taxation of agriculture and relatively undistorted product and factor markets. It also requires public provision of infrastructure and an environment that makes technical change accessible to small farmers and the urban poor.

Second, specific policies ... to improve the participation of the poor in growth by increasing their access to land, credit, and public infrastructure and services. ...increased and secure access to land.

Third, [in] resource-poor regions, ... additional investments, which are likely to require government subsidies" (World Bank 1990:73).

There is also a dynamic role for incentives:

"Appropriate pricing promotes institutional change and investment, both public and private. When pricing is right and agroclimatic conditions are appropriate, farmers demand additional infrastructure, extension, and credit services; research institutions intensify efforts to develop and adapt varieties highly beneficial to farmers; and private traders and moneylenders proliferate. Some of the demand for these services is met by farmer groups themselves and by other private enterprises, and some by policymakers approving public programs where supply response is expected to be particularly high" (World Bank 1991a:73).

Examples of institutional innovation that the Bank has in mind can be found elsewhere in World Development Report 1991.

This is a model of technical and institutional innovation (Hayami and Ruttan 1985). It argues that technologies and institutions evolve to fit their environments. In this "pure" theory of institutional innovation the state has a role:

"All these [institutional innovations] depended on state action. They molded the framework of enterprise in ways which increased entrepreneurial security and eased the flow of resources and people. In most developing countries development requires a state with well developed administrative structures and agencies responsive to markets' needs" (World Bank 1991a:135).

The priorities are, for Eastern Europe, "to establish the institutions necessary for a market economy to function efficiently: property rights, corporate and bankruptcy laws, commercial courts, banking legislation, and stock exchanges," and "for low-income Africa and Latin America, the priority is to improve the management of the public sector, a goal that often requires a simultaneous reduction in the size of the government and a strengthening of its capacity" (World Bank 1991 a:136).

However, there is another tradition in economics which needs to be drawn upon. One of the major problems with environmental policy in developing countries lies in the inability of regulatory organizations to perform the tasks they have been assigned, and the incompletely assigned, defined and enforced property rights to resources which contribute to their degradation. These problems can be understood in economic terms through the problem of transaction costs. As is well known, Coase's theorem about property rights depends on the absence of transaction costs and the presence of complete information allowing parties to transact allocations to simply take account of
all mutual effects. In the presence of transaction costs (and uncertainty) this comforting conclusion does not apply. One of the consequences is that firms and bureaucracies will exist to handle transactions among affected parties more effectively than can be accomplished through individual bargaining.

However the very reasons for the existence of these organizations lead to their "failure"—as captured in the ideas of "government failure," and of management science. In the case of firms it is generally accepted that there is some element of discipline where there is competition in the market that forces "efficient" behavior. The behavior of some firms is regulated by the state. But in the case of the state, or where competition is attenuated as in the case of monopoly, these disciplines are not effective. Control over the activities of the state is supposed to be effected by politicians accountable to voters.

Considered economic approaches to environmental issues accept that "governments—which must introduce and administer policies—have their own agendas. Government failure is conspicuous in the environment" (Helm 1991:xi). Furthermore, the environment is not the only "market failure" that may warrant state intervention; public goods, risk and imperfect information leading to inadequacies of insurance and futures markets, and hence problems of allocation over time, and monopoly are other examples, which may well occur in combination with environmental problems. In each of these areas there are probabilities of government failure—for example regulatory capture and "rent seeking." Also there may be complex interactions (of a second−best nature) among policies in these areas. For example, monopoly which lowers output in polluting industry may be preferable to competition when output and pollution are higher. But then regulatory capture may be more likely or extensive in the case of a monopoly.

It is not only liberal−democratic governments which have real problems in intervening in a rational manner above the competing interests in civil society, but also other institutions involved in soil and water conservation and regulation of the use of natural resources in general. These (e.g., bilateral and multilateral agencies, NGOs, and freelance consultants) have their own structurally conditioned agendas too, which inhibit them from conforming to market−efficient behavior in a developing country context. There are two major reasons for this. First, they have to work in an environment in which governments play a major role, and the policy that is actually implemented owes as much to the nature of the state through which it is filtered as to fine principle and thorough project preparation. Second, market−led competition leading to efficient outcomes cannot be brought to bear on these institutions, nor is regulation by the state easy for a number of reasons, including the interpenetration of state, business, and NGO elites and institutions.

A further point is that conservation policy offers very little that is attractive to its functionaries. As an activity of a "street−level bureaucracy," conservation offers little prospect for rent−seeking; it seldom provides political patronage for well−organized and powerful groups on which government may rely for support; and indeed it frequently involves unpopular prohibitive regulation rather than the provision of additional resources. Thus functionaries in developing countries often have to be coerced into accepting conservation and natural resource regulation.

There are well known difficulties with the idea that the state can be a neutral agent in the processes of economic development and management of natural resources; these have been addressed in different theories of democratic politics and the state (e.g., Dunleavey and O'Leary 1987). Even within the neoclassical paradigm, there are at least two models of the state that have been applied to developing countries. These are the theories of "rent−seeking" (Kreuger 1974, Tollison 1984) and of collective action (Olson, 1965). The theory of rent−seeking plays a large role in the neo−liberal model of the state and in the approach of the World Bank. It argues that state intervention creates opportunities for rent appropriation, which provides incentives for individuals and interest groups to compete for those resources, and to influence the activities of the state in their interest. This model leads to an "agenda for reform that ... calls for ... the state to let markets work where they can and to step in promptly and effectively where they cannot" (World Bank 1991a:128). There is something missing if not...
contradictory in this proposal; government intervention is bad because private individuals and firms will engage in unproductive rent-seeking, rent-creating, and rent-defending activities. They will support the state in creating these opportunities. But by giving more room to the private sector the state may well be creating more pressure even for rent-creating activities. After all, we should remember what Adam Smith strictures about businessmen's conspiracies against the public. Many rents are not created by the state alone but by capitalist enterprises, which are also responsible for much environmental destruction.

This line of thinking recognizes an appropriate role for the state but provides no politics that will induce the state to perform the, and only the, appropriate activities. This lacuna can be approached by drawing on Olson's theory of collective action, and more particularly its later development into the theory of coalitions. The earlier theory argued that many opportunities for collective action went unrealized because of the tendency of rational individuals to free-ride. Collective action to obtain collective benefits was only likely in rather limited circumstances: for example, only if selective inducements were offered, or if groups were constituted of or dominated by small numbers of members with similar and strong interests. One of the predictions of this line of argument is that collective interests shared by small groups were likely to be well organized and to get their way at the expense of groups composed of large numbers of people who were likely to be geographically dispersed and each of whose interest was individually relatively small. This accounts, according to Olson, for the exploitation in developed countries of tax payers and consumers to subsidize farmers, while in developing countries farmers are exploited to serve urban and industrial elites. Arguably it may also account for the emphasis given to the development of high potential areas through high input agriculture in developing countries relative to approaches which give appropriate weight to low-input, agriculture in less favored but still extensive areas. In any case the two theories can be linked together—deregulation to reduce opportunities for rent-seeking may enhance the role of the private sector, but individual components in the private sector may then be empowered to bring about state policies which serves its interests through the creation of new rents or the appropriation of existing ones in new forms. Political accountability to the social interest needs to come about. Deregulation, privatization and other means of creating more opportunities for the private sector are unlikely to achieve their objectives without political reform.

While recognizing the authoritarian nature of the states in NICs the World Bank draws attention to "evidence that links features of democratic systems positively with overall aspects of development and welfare... freedom and liberty" (World Bank 1991a:134), and highlights actions of the state that have enhanced the formation of institutions conducive to growth. But again the practical politics are excluded—it is not explained how the state can be induced to do those things it is appropriate for it to do, even though it is clear that the state in developed capitalist countries is conceived as broadly able to do them. Environmental lobbies might well dispute this claim.

The role of the state in the regulation of natural resource management in the developing countries is even more problematic because it is characteristic of developing nations that their bureaucracies and states do not function in the same, let alone appropriate, ways as those of developed countries; hence there are likely to be significant difficulties in applying the approach to environmental issues advocated for developed countries in developing country contexts. Not least of the difficulties lies in the need for enforcement mechanisms to police regulatory and market-like mechanisms for dealing with externalities. In modern liberal-democratic states, these mechanisms are arguably available, but the development of these institutions is a generally unachieved indicator of development rather than a readily available resource to promote it.

Consequently it is not at all clear that strategies that are appropriate for developed countries can be applied without much modification to developing countries. The experience of conservation and environmental aspects of projects and policies in the latter supports this contention. Hence there is a need for the Bank, which presently appears to be pursuing just such an approach, to undertake empirical research that both reveals its possible
weaknesses and provides understandings for the way ahead.

An example of the difficulties involved in this approach can be drawn from discussion of traditional land tenure systems and their evolution.

"Africa's traditional forms of land tenure seem to be evolving towards individual property rights. This is mainly because of population growth and the increasing commercialization of agriculture [although it is acknowledged that] land systems in Africa [which ensure that all members of the extended family have access to land] can avoid the extremes of poverty and landlessness that are common in Asia and Latin America: traditional systems have provided secure land tenure and encouraged farmers to invest in their land. [nevertheless] Where traditional systems have failed to provide clear land rights, land titles and registration are useful.

Common pasture and forest resources are important for poor rural households. fuelwood, fodder, and employment. ... When population is growing rapidly, or where there is open access to these lands and traditional community management has broken down, the commons are often overused and degraded. This hurts those who depend most on the common resources as a safety net. Policies to privatize these resources have often failed to protect the interests of those with existing rights or to create the basis for a viable and equitable system. Small farmers have sometimes been forced, as a result, to sell their individual holdings. Common−property resources should receive more attention. They need to be better protected and better managed. Investment in research on how to use these fragile resources would be money well spent" (World Bank 1990:65).

Common property is often seen as playing a role in cases of land degradation. Traditional forms of resource tenure were seen as primitive and backward, as epitomized in Hardin's "Tragedy of the Commons." More recently, it has been realized that traditional societies often had sophisticated institutions for the sustainable management of common property, and the problems of degradation lay in demographic, political, economic and social changes brought about as often as not during modernization (NAS 1986, Ostrom 1990). The history of the evolution of institutions to manage common property, and indeed the evolution of private property rights in Africa, does not obviously reflect a uniformly benevolent trend under the influence of private interests and state action in developing countries. Both commons and privatized lands have become degraded in many cases. Appropriate technical and institutional innovations have not necessarily evolved. What is required is a better understanding of the context that shapes change in each case separately, and in particular of the politics that informs the processes of change. This conclusion leads to a position that suggests that each case of land degradation should be evaluated in terms of the combinations of market and state failure that are involved, and pragmatic assessment of the courses of action that might be taken: "a priori general rules are likely to be inferior to case−by−case analysis" (Helm 1991:xi). For these reasons, carefully designed empirical research of past experience can be expected to provide useful insights.

Technological Optimism

The informal workshop on land degradation held in January 1991 (Towards a Research Agenda for the World Bank on Land Degradation) provides a good indication of the thinking of the Bank on these issues. The report on this workshop argues that "Land degradation is widespread ... [but that] ... [t]echnologies to ameliorate, or reverse or control land degradation are probably available for most of the types of degradation that are occurring." The problem for the Bank is put succinctly in the following way:

"Adoption of these land degradation technologies is low across all agricultural environments despite major support and investment in research and development on the problem. Instances where land degradation management have been successful are known but analyses of these instances have not yet provided clear guidance to policy makers, researchers or developers to enable more general adoption of these technologies."
A similar point is made by Crosson and Anderson:

"The failure to use them [technologies and management practices for protecting the productivity of land and water] more widely where they could protect or enhance soil and water productivity results, therefore, not from lack of knowledge but from lack of incentive" (Crosson and Anderson 1992:80).

The World Development Report 1992 draws from the classical approach the idea that technologies to manage resources sustainably exist—"[M]any options are available, including contour-based operations, inter-cropping, agroforestry, and changes in fertilizer application and animal husbandry. These improvements can sharply reduce erosion and raise yields and incomes. Why, then, are they not universally undertaken? The reasons include lack of access to credit markets and lack of knowledge of costs and benefits" (World Bank 1992, pp. 1920; see also p.57). In Chapter 7, when discussing Rural Environmental Policy, it is made clear that there are many appropriate technologies that will conserve resources, but their adoption is hindered by inadequate property rights and lack of farmer education and extension. New knowledge of appropriate agricultural techniques may well be required, but the processes for producing this (as represented, for example, by the CGIAR system) are in place. Problems in the past have arisen because sometimes only a single innovation was offered rather than a menu (p.138). Similar arguments are applied to soil conservation, fertilizer, afforestation and pesticides.

This approach leaves as many questions unanswered as it answers. It identifies the problem as essentially institutional. It implies that appropriate technologies exist, or will fairly rapidly come into existence provided appropriate incentives for farmers are in place to adopt appropriate practices, act collectively where necessary to provide local public goods, and provided state officials will come up with appropriate scientific and technological development, and regulative functions where necessary. This is an extraordinarily optimistic scenario, which only the most Panglossian rational choice theorist would believe. Furthermore, it stands in contrast to both earlier views about the role of the state in bringing about resource conservation, and more recent views about the ability of local peoples to solve their own problems. This paper examines the grounds for this technological optimism in Chapter 2.

Poverty

The link that is identified between poverty and environmental degradation can be broken in a similar fashion, involving the establishment of an appropriate institutional framework for the operation of market forces, together with safety nets, and limited public action to enable the efficient provision of public goods. The apparent contradiction between the role of economic growth in causing degradation of the environment but at the same time alleviating poverty is dissolved by arguing that "[T]he key is not to produce less, but to produce differently" (World Bank 1992: 25).

The frequently identified consensus about the new poverty agenda also draws from the technocratic and populist approaches to public policy and its administration. Poverty is represented in populist terms—the poor do not willfully degrade the environment, but "[P]oor families often lack the resources to avoid degrading their environment. The very poor, struggling at the edge of subsistence, are preoccupied with day-to-day survival. It is not that the poor have inherently short horizons; poor communities often have a strong ethic of stewardship in managing their traditional lands. But their fragile and limited resources, their often poorly defined property rights, and their limited access to credit and insurance markets prevent them from investing as much as they should in environmental protection. When they do make investments they need quick results" (World Bank 1992: 30). This may well be true in some cases, but such an analysis does not discriminate cases where poor communities (in the sense of low "standards of living") often live in a sustained "equilibrium" with their environment over long periods of time (i.e., sustainably), while many richer communities degrade theirs.
Furthermore, "Substantial synergies exist between alleviating poverty and protecting the environment ... the poor... will often benefit the most from environmental improvements... economic activities stimulated by environmental policies ... are often labor intensive and can thus provide employment. Targeted social safety nets make it less necessary for the poor to "mine" natural resources in times of crisis. Extension and credit programs and the allocation of land rights to squatters increase the ability of the poor to make environmental investments and manage risks" (p. 31).

This diagnosis shares much with other studies of poverty (e.g., UNDP 1990, 1991, 1992, Dreze and Sen 1989) and of the links between poverty and degradation (Blaikie 1985: 10737, Mearns and Leach 1991), as noted above. Poverty is understood in terms of lack of valuable assets and productive resources, vulnerability to both slow and gradual, and sudden and catastrophic entitlement declines, which often result in resource degradation. Relief and rehabilitation can enable the poor in poor societies to cope with disasters in the short run; in the longer term, disaster management depends on reductions in chronic poverty, which requires sustained economic growth. Since their resources are (increasingly) limited, and of poor quality (embody few capability-intensive entitlements), the main entitlement of the poor, which will enable them to participate in the benefits of economic growth, lies in their labor; hence the key to environmentally friendly poverty alleviation lies in labor intensive growth, improving the productive capabilities of the poor, or as others have put it "substituting employment for environment" (Mearns and Leach 1992), together with basic social security, mainly in the form of targeted safety-nets.

What is missing from these arguments, apart from confusion between labor and capability and intensity, is an account of the politics by which it is to come about. Much of the text has strong similarities with the self publicity and advocacy of "progressive" interest groups including official aid organizations and NGOs. The argument is conducted with examples that are claimed to demonstrate the points being made. New points are argued with new examples, rather than developing case studies more fully. This is an argument of the "pick and choose" persuasion. However, some of the examples more fully, or differently explained, can be used to come to conclusions very different from those advanced in the World Development Report 1992. One needs to ask—what of other similar cases that may have had different outcomes, and what of the context within which these examples arise? One of the tasks of a research agenda must be to throw more light on case studies, and to examine if the propositions made in World Development Report 1992 are indeed validated by experience.

Participation

How are today's nations (developing, OECD, and former Communist Bloc) actually going to bring all this about in the face of resource scarcities and vested interests? Why should institutional innovation be benign? Is the envisaged process of institutional change actually going to come about? Indeed, is there only one path that can, or should be followed, or might there be different routes with different outcomes for different groups in society, and the environment? Will participation and democratization be good for either poverty or the environment, and under what circumstances?

In addressing these questions (in Chapter 4), the World Development Report 1992 acknowledged that "Governments face many pressures in making environmental policy" (p.83). But these can be managed by "building constituencies." Democratization, the production of information—which requires resources, valuation of environmental resources and education—dissemination of the facts, and, above all, popular peoples' participation are among the means that may bring about institutional change. However, these means also lack politics. For example, as in other areas of public administration where participation is advocated by policy-makers, the aim is not only to enable local social welfare maximization. Participation in environmental management, it is argued, will help because it can reduce the costs of decision-making and conflict resolution, enforcement of regulations and operation and maintenance expenditure, and will improve decisions through
drawing on local knowledge. However, democratization and participation need not be environmentally benign. Pork−barrel politics, which has some claim to be a characteristic of some democratic polities, is responsible in part for many environmental disasters. Conservationism can also be promoted by authoritarian and inegalitarian societies. The example of commons in Rajasthan reported by Jodha (1986) seems to bear out both arguments. This example makes clear that democratization at the end of colonialism contributed to the decay of the management institutions and the degradation of their common pool resources.

Participation can mean anything from provision of information to "beneficiaries," through various levels of consultation, counselling, and therapy aimed at inducing acceptance of decisions made, or controlled, at higher levels, through to citizen empowerment. Much discourse about participation appears to entail the latter more radical definition, while in reality the mechanisms and resources required are not likely to develop. It is as well, while considering democracy as a policy prescription, to bear in mind the possibility that "in politics, democracy is the name of what we cannot have—yet cannot cease to want" (Dunn 1979:267).

For example, mechanisms for participation must be specified. As is well known, theories of democracy and collective action do not allow us to be certain that satisfactory outcomes can actually be defined, let alone be brought about. Participation and democratization advocacy begs the question of how and whether minority, or poorly articulated interests will be effective in public decision−making; nor are claims that "[S]econd−best policies ... if well implemented, ... are preferable to unenforced perfect policies" based on any better foundation, since in general there may be any number of less−than−perfect policies among which to choose and which cannot be unambiguously ranked against each other. Also, second−best may be best in the presence of imperfect information and incomplete markets, since first−best, in terms of efficient allocation by perfect markets, may simply not be possible.

Participation has become a key component in the advocacy of good governance by official aid institutions. Yet many of the theoretical issues remain unresolved and successful experiences are rare (or reified as in the official analysis of East Asian institutions (Wade 1990)).

While simplified versions of public choice theory may go some way to redress naive views about benevolent states and ideal bureaucrats, it is arguable that they should command such a central position in the analysis. This debate can be further promoted by research into actual experience of the functioning of central and street−level bureaucracies in their role of promoting sustainable environmental management. The implementation of these policies (privatization, or de− or re−regulation, decentralization, democratization) have now been realities in many countries. They should be researched, and the theoretical assumptions in the World Development Report 1991 and 1992 and those put forward by its critics put to empirical testing through theoretically informed case studies.

**Implications of Paradigm Shifts**

**Contested Views about Degradation**

The foregoing critique of the three approaches to environmental conservation has a number of implications for the design of a research strategy for degradation and conservation in developing countries. The first is that the assumption that degradation can be defined and measured unequivocally may not be as straightforward as previously thought.

Both the classic and neo−liberal approaches assume that land degradation is widespread, despite recognition that data on the physical processes of land degradation are often sparse and that a high degree of location specificity
makes for difficulties in generalization about the current status of the problem, the rates and extent of changes, and of degradation. This general diagnosis rests on the common sense hypothesis that there are unambiguous and undisputed criteria for the recognition and measurement of degradation. While it is essential that criteria for identifying degradation must be established, it is often not clear what these might be in any particular instance (Bie 1990). Different land users have different perceptions of what degradation is, and scientists and "official" agencies may have other (and sometimes mutually competing) criteria. Consequently, the perspective of the overall research design should include both official and indigenous views on what constitutes degradation. As will be discussed later in Chapter 2, official views may be based on a particular type of research (e.g., the research station and controlled experimentation), and on socioeconomic assumptions about the objectives of the land users themselves. Also, political factors often influence both the definition of degradation as well as the means of conservation. The conventional wisdom of the concept of carrying capacity is a case in point where herders and officials seem to have been "talking past" each other for generations. Herders tend to cast the problem in a totally different way from carrying capacity, and instead emphasize strategies of moving cattle to where the rain and grass are, and follow an opportunistic breeding policy in good years to see them through raised cattle mortality in bad years. It is not only a matter of the difficulty of judging who is "right," since the criteria used by herders and outside agencies may be different, but of the fact that they differ, and "non−adoption" is the outcome. Policy discourse consequently focuses on the conflicts in behavior and perception that these differences entail. Since they, clearly, are not always completely right, this implies that outside institutions are part of the problematic—and may be part of the problem too. Thus scientists and policy−making and implementing institutions should also be made the subject of study, in order to be able to reflect critically upon their so−called objective criteria for defining, measuring and costing degradation.

Degradation − Productivity Relations

Recognition that data on the physical processes of land degradation, as well as on its economic and social causes and consequences of land degradation are sparse, implies a thorough review of experimental and field data, and particularly on robust and cheap methods of measurement, in order to improve understanding of the physical processes involved. A particularly important research field is the relationship between degradation and yields of crops and livestock. Part of the reason for discrepancies between the perceptions of land users and scientists on the existence and importance of degradation is the degree of uncertainty attached to degradation−productivity issues. Modeling of these relationships, based upon affordable and replicable methods of measurement, provides the essential link between natural scientists and economists. Without it, certainly the costs of degradation and the benefits of interventions cannot be assessed but, even with it considerable uncertainty will necessarily remain. This issue is discussed in detail in Chapter 2.

Environmental Regeneration

Another implication of the existence of a plurality of views on "degradation" is that a properly designed research agenda should consider situations where land degradation does not appear to be a problem to at least one interested party (e.g., to land users or outside agencies). This means that the research strategy should concern itself with the causes and consequences of land degeneration and regeneration, rather than the causes of adoption or non−adoption of technologies, which outside agencies have judged to provide technical solutions to the problem of degradation.

It is assumed that technologies to ameliorate, reverse or control land degradation are probably available for most types of degradation but it is recognized, nevertheless, that adoption of these technologies is low despite major support and investment in research and development. This is a narrowly technical conception of technologies as equipment and procedures. It must also recognize that technologies are embedded in a more general way in the
land users' household and local community as well as in the wider agrarian society, and in the nature of the state. However, in this paper we use technology in the more usual and restricted sense. The casting of the problem as one of non-adoption of available technologies also implies a very specific model for the investigation of prevailing land-use management practices in the form of "why do they not accept the particular technology recommended by an outside agency?" Rather, the research question should be reformulated to ask "why do they do what they do?" It is observed that, as noted above, instances where land degradation management have been successful are known but the analyses of these instances have not yet provided clear guidance to policy makers, researchers or developers to enable more general adoption of these technologies. A detailed study of the circumstances under which specific technologies were introduced or developed indigenously in a particular locality by a particular category or group of people might provide a basis for understanding "adoption" or "non-adoption" in a necessarily broader context.

**Contextualization and Levels of Analysis**

It is also recognized that land degradation is diverse in form and impact on farming systems, suggesting that generalization is likely to be a problem. One of the implications for a research strategy is a need for detailed case studies and an emphasis on the particularities of the local history of land degradation and regeneration. This emphasis implies that both research and the design of interventions must invest intellectual resources into the contextualization of the problems of resource use. Although interventions cannot determine history, they become part of it, and their design must take into account ongoing processes of change in society and the resource base. Thus a research agenda on environmental degradation and management has to employ a structured and progressive contextualization that can account for the impacts and influence of the international economy and ideas, mediated through particular states, and the ways in which regional economy, society and culture develop and form environmental outcomes (section 3.10).

**Decision-Making**

The focus on farm-level decision making must obviously be most important in any attempt to understand why land users do as they do. We can identify decision making by individual farmers or by groups of farmers. This distinction is neat and attractive since it identifies different sets of decision-making models and identifies the existence of any externalities in the costs of degradation and its amelioration. However, it does not adequately recognize that decisions about land management are taken by an enormous variety of combinations of different people. Heads of farming households are seldom the only ones to be involved in making decisions of this kind (and both these entities—households and farmers groups—theirseves be constructs of western perception, in any case). Rather, decisions emerge from complex bargaining, confrontations, and complementarities between various individuals. The role of women in decision-making in domestic groups and the difficulties of identifying a single decision-making entity (e.g., household, production unit, or family) are two of a number of confounding factors in a simple individual–group division of decision-making models. What is more, different aspects of the same resource may lie within the decision-making purview of different individuals (e.g., tree conservation for fuelwood and fodder may be within the purview of women, but for domestic construction, or for sale, within that of their husbands). Also, certain land-use management practices require collaboration, not only between individuals and between households, but also between communities (both within and between farming systems); some require support from the local state structures (e.g., technical services), or through local public expenditure (e.g., on infrastructural development). In most instances, such collaboration is not external to the context within which individuals and groups adopt land-use practices, but intrinsic. If the research focus is confined to individuals and groups of farmers only, it will then become evident that factors other than those considered in this decision sequence may well impinge directly upon this class of decisions by individual farmers (and groups of farmers) and result in non-adoption. Further elaboration of the decision-making models suggested in this paper is
It is also common to cast decision-making in terms of adoption/non-adoption of improved technologies, which begs some very important questions about how decisions are made. The adoption/non-adoption paradigm concentrates on a predetermined direction of change (towards available technologies), without problematizing the processes by which those decisions might be arrived at. Land degradation may be perceived as a low-priority problem relative to satisfying basic needs in the short term by many resource-poor farmers, and actions following this perception may cause significant and increasing degradation-related problems. It also raises important questions about the different ways in which and levels at which environmental "problems" are identified and action taken. While the issue of different time–horizons (short-term versus long-term) or scope (small versus large) may be related to different "perceptions," it is often the case that the resource-poor, or at least some among them, are the most affected by land degradation and the most aware of it, but are simply obliged by their circumstances to act in ways that undermine both their capacity to fulfill their own basic needs and the longer term viability or sustainability of their physical environment. Thus, as we have argued, different behavior may be as much a function of different opportunities and constraints as of different perceptions. The question of how people actively and knowingly choose from a range of consciously assembled alternatives, or how far outcomes reflect absence of choice or pre-attentive processes (information processing outside the decision-maker's ordinary attention and awareness), must therefore be addressed in the research agenda on land users' decision making (see Chapter 3).

**Summary**

We have traced understandings of land degradation in developing countries from the classic formulations of the paternalist school represented in many mainstream soil and water conservation institutions. The problems with this approach, which has relied excessively on coercion of groups or privatization of land into the hands of the few, have given rise to a populist response that documents the rationality of peasants' and pastoralists' resistance to these interventions. This critique drew attention to the ways in which change could undermine or prohibit resource conservation; commercialization and technical change could impoverish people and lead them to degrade their environment. Persistent poverty and population growth exacerbate these problems. Solutions have to be sought in the peoples' own understandings and interests, and have to provide individually rational reasons for resource conservation. The populist approach typically finds this rationality in the norm of subsistence and in the viability of local collective action to provide public goods and common pool resource management. However, the populist policies and projects to which this critique has given rise have their own problems arising in particular out of resource and political constraints to their widespread implementation. Recent writing on these issues amounts to a counter-revolution, which also sees the problems as relating to inappropriate and excessive government intervention in markets, and incompetent, ineffective and corrupt state bureaucracies. This new approach does not, however, share the populists' suspicions of technical change and commercialization, provided they are brought about within an appropriate structure of incentives set by a state performing its proper functions. As far as land degradation is concerned, this role will involve some combination of the policies identified in the "economic approach" to the environment; that is, the evolution of property rights and contractual arrangements, as well as appropriate bureaucratic regulation, market support, and so on. In all this the state will have a role that varies and should be locally specific. In attaining this specificity, each case will have to be taken in its context. Yet this counter-revolution provides little insight into how the state can be induced to take on its proper form and function, except through processes of development in which the state itself will play an important role. These proper activities are likely to vary from case to case.

We argue, in subsequent more detailed theoretical examination of the issues as well as in the reported case studies, that it is essential to understand the activities of the state in relation
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to land degradation as not only part of the problem, but also determined in part by the particular conjuncture. Zimbabwe takes an excessively paternalist approach, while in Nepal the populist project is dominant, and these tendencies cannot readily be transcended. In Zimbabwe the problem lies in ignoring the reality of rural life, and imposing ill-conceived technical solutions without adequate participation, while in Nepal there is a lack of effective action by the state, bilateral aid agencies and NGOs to ensure proper implementation of more people-centered approaches. We hypothesize that states take an approach to land conservation that is part of the problem, for reasons that are deeply embedded in the local political economy, which imposes limits on the ability to implant new appropriate institutions. Thus research on land degradation must show how this occurs and establish what room for maneuver there is in each particular case.

In conclusion, the implications of this review for a research agenda are as follows:

the perceptions of outside agencies, particularly scientists, governments and implementing agencies should be within the remit of the research;

the problem of "non-adoption" should be broadened into an attempt to understand why land users do what they do so that cases of resource regeneration and of sustained use of resources can also come within the research remit;

the distinction between individual and group decisions, while sometimes useful, should be abandoned in favor of a more flexible and varied characterization of who and what is involved in the decision-making process;

the research question of how decisions on land management are made in any case must be complex and will involve analysis at a variety of different levels and linking them with the social relations of those who make them;

the political economy constraints on institutional innovation and function should be at the core of research on land degradation issues.

2— Rethinking Science and Technology in Land Degradation

In the previous chapter we have described current approaches to land degradation. It is clear that existing approaches are either largely discredited (the classic approach), impracticable or non-replicable (the populist agenda), or incompletely specified (the institutional and technical innovation approach). There is no clear consensus on the correct approach to take. Our central contention is that, while we borrow much from the "rational choice" framework, models of the individual and the interactions of individuals are as yet imperfectly specified for the purposes of understanding land degradation problems. This is because land degradation is (a) highly complex, involving locally specific phenomena that involve small changes over long periods of time and which are poorly understood; (b) is brought about both by individual and collective action; (c) involves both immediate and long term-interests of individuals. In this chapter we present recent developments in perceptions of the uncertainties inherent in the scientific understanding of land degradation issues and the bias involved in the development of technologies for dealing with the scientific perceptions of land degradation problems. In Chapter 3 we turn to the difficulties in specifying the role of individual, collective and state action in land management.

The Role and Limits of Science

Different people make distinctive demands of the same environment, and may regard resource degradation in ways that are irreconcilable. When the views of the state, as advised by scientists, contradict those of local farmers, conflicts arise that jeopardize the implementation of conservation strategies.
As we have indicated, conflicts between scientists' and local perceptions of land degradation problems abound. The following are a typical cross-section:

Problems of "over−stocking" have for a long time been the driving force in various stock−control measures in the rangelands of Botswana. Pastoralists, however, have seldom heeded government's admonitions, and stock densities have risen to levels that are now much higher than the ones that, for many years, were held to be excessive. Fortmann (1989) has traced the non−adoption of programs of stock control to a fundamental disagreement between local users and government as to the "carrying capacity" of rangelands, and indeed whether this concept has any relevance at all for pastoralists' circumstances.

In the far north of America, caribou are a main source of income. State managers, informed by biological science, have occasionally warned of declining herd numbers, and urged for government intervention in wildlife conservation. Freeman (1989), however, argues that the traditional users have a very different view of the evolution of migratory caribou herd numbers that does not warrant such interventions,

Arable and pastoral land in parts of Indonesia is constantly "threatened" by encroachment by *Imperata cylindrical* and *Eupatorium* spp. Government considers these as clear signs of land degradation caused by mismanagement of resources by indigenous land users. The latter however, view the dynamics of these two plant species very differently, to the extent that government plans for the management of such "infested" land are seldom adopted (Dove 1984).

These examples are typical of disagreements amongst the protagonists of development programs that often lead to incompatible approaches to resource management. Until quite recently, under the classic approach, the source of these conflicts was attributed to the "ignorance" of local land users. This explanation assumes that local knowledge is less capable of advising policy in matters of resource conservation than "science."

Local knowledge systems have been discussed by various commentators, including Chambers (1983). They are highly variable, and location specific, thus defying a unifying critique. The consensus appearing through the recent literature on this type of knowledge, (see, for instance: Ahlonsou et al. 1991, Dove 1984, Fortmann 1989, Freeman 1989, Fujisaka 1989) is that it is often well informed and must be considered seriously in the development of understandings of and technologies for efficient and sustained resource utilization. These insights seriously question the commonly held belief that local land users are ignorant, and that their knowledge should be replaced by a technical transfer from scientists.

The scientific procedures of resource degradation assessment across the world follow the general model illustrated in Figure 2.1 after Anderson and Thampapillai (1991). Details on each step in this procedure are given in standard conservation planning and engineering manuals (see, for instance, Hudson, 1971, El Swaifi et al. 1983, Morgan 1986).

Recent papers by policy analysts (Thompson and Warburton 1985, Anderson and Thampapillai 1991) and scientists (Bie 1991, Warren and Agnew 1988, Stocking 1987a and b, Biot et al. 1991) have suggested that there is underway a fundamental reappraisal of the role of science in resource management. They claim that the whole field of resource degradation is riddled with uncertainties, which throws doubt on the assumption that science is superior to local knowledge as a basis for action. Several authors have demonstrated how science has, in some cases, misunderstood the problem (see, for instance, Fujisaka 1989) and thus been responsible for the design of ineffective policy (Stocking 1985, Heusch 1981). The implication of these statements is that the very foundation of "official" degradation assessment and conservation planning has to be included in the analysis of "why farmers do not adopt." It is possible that the problem is not one of non−adoption by farmers, but of mistaken problem
identification and inappropriate technology development on the part of scientists themselves.

Figure 2.1.
"Official" land degradation assessment and conservation planning (after Anderson and Thampapillai 1991)

Institutional Decision−Making in Land Degradation Research

Taking in turn the perception of a problem of land degradation, its measurement and finally the evaluation of its importance, the uncertainties within this procedure are reviewed below. This review, which is not comprehensive and draws mainly on the case studies in the appendices, is necessary in order to identify priority areas for further research and to ascertain both the role and limits of science in the land degradation debate.

Perceiving Degradation

Decreasing crop yields are often mentioned as an important resource degradation problem (see Arntzen (1989) for an example in Botswana), but hard evidence for it is often deficient. Usually, there are no records of past production levels and very often production itself is expressed in terms that make little sense to the management objectives of local land users. De Ridder and Wagenaar (1984), Livingstone (1991) and Biot et al. (1991) discuss this with regard to pastoralists. Stocking and Peake (1985) have reviewed research on erosion−productivity relationships and have concluded that calibration is still at a rudimentary stage. Declines in crop yields can take place for a number of reasons besides declining soil fertility related to land degradation, for example, reduced inputs of fertilizer, or labor. There are also difficulties in dissociating short−term from long−term trends in yields, especially in environments characterized by large fluctuations in annual rainfall.
Instead, land degradation is not observed in terms of decreased production, but in the form of processes and morphological evidence of environmental change that are generally assumed to have a negative impact on the ability of land to produce. Direct observation of such processes is through field surveys of symptoms of degradation (see, for instance, FAO 1979) and remote sensing (see, for instance, Whitlow 1988). Rangeland scientists rely on the regular monitoring of vegetation at benchmark sites, aerial photography and the analysis of pictures taken from low-flying aircraft (see Abel et al. (1987) for an example of the latter).

Despite potentially being the most objective means of observing processes of change, field surveys face a number of important problems—first of all, they often rely on the observation of symptoms, and not the processes themselves. They thus rely on a priori understanding of the processes of degradation in terms of these symptoms, that is often deficient for the following reasons. The very high degree of spatial and temporal variability of processes and symptoms often mean that adequate sampling densities are unobtainable. Secondly, remote sensing over-emphasizes those features that are readily observed, such as gullies, landslides and bush encroachment. The relationship of these signs with active processes of land degradation, however, is not always clear. Lastly, the relationship between processes and symptoms often derives from research on other, generally temperate, soils that are often differently constituted from those in the tropics.

In many reports, information on land degradation is derived from measurements of other attributes of the land that are understood to affect it. For example, the technique of soil-erosion hazard mapping involves a systematic overlaying of maps of attributes of the land that have been selected for their potential contribution to the problem of land degradation: e.g., a soil map, a land-use map, a slope and rainfall distribution map. Another example is where land degradation problems are inferred from a comparison of "ideal" land utilization systems with existing patterns of land use. This is what is involved in the determination of rangeland degradation by a comparison of the "scientifically" determined "carrying capacity" of rangelands with actual local stocking densities.

Apart from the general problems already mentioned in the context of field surveys, the above methods are beset by additional sources of uncertainty. The use of "overlays" relies on models of the degradation processes considered. Modeling involves the correct identification of the different components of the system that affect environmental change and the relationships between these components. The former may be fairly well understood; however, the way in which the different components are integrated into an overall degradation assessment is often simplistic, and can lead to an exaggerated impact of any one of the causal agents.

Secondly, the approach that relies on a comparison of existing with "ideal" land use assumes that the latter are superior to farmers' own practice. This is not necessarily true: there is increasing evidence, for instance, that the scientific derivation of carrying capacity from information on land characteristics is inadequate in the case of extensive livestock production systems, a point discussed in more detail in the Zimbabwe case study (Appendix A2). The same applies to land evaluation, which is deficient when considering complex land-use systems, and where criteria for selection of land utilization types are biased towards temperate-region commercial farming.

**Diagnosing Degradation**

At first sight, problem diagnosis is fairly straightforward: reservoir sedimentation, for instance, is caused by soil erosion, salinization problems are easily traced to either soil, or irrigation water, or both, high rates of soil erosion can be ascribed to reduced ground cover. However, attributing weights to "triggers" and "conditions," as well as to the often interdependent factors involved in environmental processes, does not always lead to clear-cut conclusions about cause and effect.
Landslides and floods are typical examples of uncertainties as regards the relative importance of causative agents. The trigger can be of climatic or tectonic origin. However, the conditions which may cause the environment to react so violently following a trigger are not easily disaggregated. In the Nepal case study, for instance, it is not certain what the main cause of soil erosion is: is it forest (condition), slope (condition), lack of cohesion in the soil (condition), climate (trigger) or tectonics (trigger)? The dynamics of landslides and gully formation are poorly understood, and the conditions which favor them are multiple, and, again, difficult to disaggregate without substantial research efforts.

The same point applies to desertification. Is climate (trigger) or cattle (condition) the main factor? The present state of rangelands science is such that there is little agreement as to what exactly causes any given change in vegetation, and much of what has been said about rangeland degradation in the past (e.g., Lamprey, 1975 for Sudan, and Campbell and Child, 1971 for Botswana) needs to be re-assessed—see Bie (1991) for a summary of this debate.

Proper problem diagnosis leads to a complete map of the levels of analysis involved in resource degradation (discussed in Chapter 1). This exercise involves the analysis of the behavior of not only physical, but also human systems, and, especially, their interactions. Human systems are much more complex than physical ones, and notoriously difficult to penetrate, partly because of limited scope for experimentation. Mearns (1991), who discusses the limitations of such analysis in the context of the environmental impact of structural adjustment, calls it a "Wicked problem area."

The bulk of the work on land degradation is on soil erosion, and especially sheet and rill wash. Measurements of such processes are affected by three major sources of inaccuracies:

- measurement errors, partly caused by the necessity for the scientist to interfere with the process of erosion itself in order to measure it;
- large degrees of spatial and temporal variability, which are difficult to keep under control because of the costs involved in setting up erosion experiments;
- extrapolation from small plot experiments to large surfaces, and landscapes.

The measurement of sediment transport by rivers is also prone to measurement and sampling error. It is impossible to take a "representative" sample without disturbing river flow, and it is extremely difficult to collect sufficient samples to characterize the full extent of river discharge patterns.

Largely because of the costs and time involved in measuring rates of degradation, they are usually inferred from other attributes of the environment by the use of models. Some models are purely qualitative in nature. Whitlow (1988) in Zimbabwe, for instance, uses the frequency of occurrence of gullies on aerial photographs as a measure of the rate of soil erosion, and categorize these into classes from "no" to "severe" erosion without any quantification. Others are quantitative, such as the Universal Soil Loss Equation and Soil Loss Estimation Model for South Africa, but rely on statistical relationships that are dubious for extrapolation into situations not covered in the original calibration exercise.

Process–based models are potentially much more reliable; however, they are still in the design phase, and will need several years of further development before they can be used under developing country conditions—see, for instance the WEPP (Foster and Lane 1987) model, and the models developed by Morgan et al. (1986), Kirkby and Neale (1985), De Ploey (1990) and others. Once developed, their application will not be free of significant levels of uncertainty. These will probably arise because:
1. the field estimation of crucial soil–water characteristics such as the soil–moisture retention curve, the hydraulic conductivity, and infiltration capacity, necessitates sophisticated procedures which are time–consuming, costly and often unreliable;

2. the derivation of soil–water characteristics from related soil attributes through the use of "pedo–transfer functions" allows model parameters to be derived from readily available information, but introduces additional errors through the statistical relationship used to derive them;

3. very high spatial variability over small distances;

4. the complexity of the models makes sensitivity analysis extremely hazardous: the sheer number of parameters estimated, all with varying degrees of uncertainty, and their linkages in often nonlinear relationships makes it difficult to be conclusive about the confidence with which estimates of the rates of land degradation can be accepted to be a true representation of reality;

5. the costs involved in replicating experiments mean that, at best, only a small sample of the large number of soils, crops and cropping patterns can be simulated, and as yet there are no satisfactory methods of validating these simulation models.

**Evaluating Degradation**

The impact of erosion on "on–site" production has been measured on tracts of land which have reached progressively more severe levels of degradation. In some cases these different levels of degradation were identified through land surveys, followed by experiments or further surveys to assess production on each level. In other cases, levels of degradation were simulated, for instance, through de–surfacing. Stocking (1984) has reviewed this work extensively; see Vittal et al. (1990) for a recent example in India, and Biot et al. (1989) for an example from Botswana and Sierra Leone.

These experiments face similar problems as have been discussed above, as well as additional ones:

the simulation of levels of degradation through artificial de–surfacing leads to surface conditions not necessarily representative of what would be achieved naturally;

surveys may identify different levels of degradation; however, there is no guarantee that they are all representative of a degradation sequence;

very few experiments measure both rate of degradation and effect on production, and it is therefore quite rare for scientists to be able to establish the rate at which production can be expected to decline because of land degradation.

Here also modeling is a favored approach: see, for instance, EPIC (Williams et al. 1985), and PI (Pierce et al. 1983) models in the US, the Soil Life model (Elwell and Stocking 1984) and EPROM and THEPROM (Biot 1988, 1990 & 1991). Outputs from these models are in terms of future production from agricultural (or pastoral) land.

The sources of inaccuracies found in erosion sub–models have been discussed above. In principle, the same problems arise in production sub–models. These are compounded by the fact that the effects of varying fertility levels and pest/disease incidence are still not understood in terms that allow reliable simulations. Thus, application of the production model is restricted to simple cropping systems such as those found in the developed
world, namely systems where fertility and pest constraints are removed by capital-intensive management.

The results from experiments, and the model outputs are interpreted either in financial terms (see the EPIC and PI models) or in ways that reflect an "urgency for intervention": the soil life, residual soil suitability or production half-life measures of the soil life and THEPROM models. They represent what has, for a long time, been the "missing link" between the assessment of the processes of physical change and rigorous economic evaluation such as discussed by Wen and Easter (1987) and Anderson and Thainpapillai (1991). However, the final evaluation requires the proper identification of who the right user is, and whose management objectives are paramount: those of officials or the state, or of the peasant farmer, a choice that is far from unproblematic.

This type of research has concentrated mainly on the "on-site" impacts of degradation; the analysis of the "off-site" effects, despite being recommended now and again (see, for instance, Anderson and Thampapillai 1991), has not progressed far as yet.

**Design of Technical Interventions**

Once problems are perceived, diagnosed and their importance with regards to production assessed, possible solutions are identified, whose technical, financial and economic feasibility is analyzed. Recommendations for "adoption," or "non-adoption" are then decided upon. This Chapter deals with the technology design and assessment aspects of this decision path.

The previous Chapter has shown that the progression from problem identification to decisions about adoption of conservation techniques is not a simple one, and that the path taken by local land users may be different from the one followed by "officials." It was contended that, in view of the uncertainties that permeate the scientific assessment procedures, the "official" and scientific viewpoint must be critically analyzed. The same case will be made as regards technology development in general and in the particular case of natural resource conservation. The state is not the only actor in this: farmers themselves act against what they perceive as a threat from degradation and innovate using procedures similar to the biometricians' field trials. Chambers (1983), Richards (1985) and Chambers et al. (1989) discuss this issue at length. Examples of farmer innovation abound in the (dominantly francophone) literature on West Africa—e.g., Mietton (1986), Bonvallot (1986), Kassogué et al. (1990), Roose (1988), Ahlonsou et al. (1991). Farmers also experiment with and adopt partially and, or modify innovations brought by themselves or "officials" from outside.

The development and implementation of natural resource conservation techniques and plans follows the patterns found in most official programs of agricultural innovation very closely. These include:

Agricultural experimentation and extension. Agronomists and soil scientists carry out agricultural trials to identify the "best" technique or combination of techniques. Extension agents are then responsible for "technology transfer" to farmers. Unlike those agricultural research efforts which are aimed at productivity increases, much of the research on resource conservation is "low key," and restricted to the adaptation of recommendations to local conditions.

Land use planning. A concerted integrated rural development planning exercise based mainly on soil scientists' evaluation of the need for soil and water conservation.

The techniques of soil and water conservation tested by agricultural experimenters are listed in standard conservation engineering manuals (see, for instance, Hudson 1971, Morgan 1986, El Swaifi et al. 1983). They are traditionally grouped under the headings "biological" and "physical" methods; Figures 2.2 and 2.3 have been

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extracted from El Swaifi's manual to

Figure 2.2
Flowchart of selected soil erosion control practices (after El Swaifi et al. 1983)

Figure 2.3
Flowchart of selected mechanical methods of soil erosion control Source:
illustrate the range of possible interventions. In most cases recommendations for application of a conservation
technique are made strictly on the basis of these conservation manuals. This is explained by the fact that official
soil and water conservation activities have traditionally been controlled by agricultural engineers.

Mechanical ways of combating land degradation require investments which go beyond the confines of the
farmers' plots. For example, terraces have to be aligned across the entire slope, and excess water has to be
disposed off across other farmers' land. This necessitates some kind of concerted planning effort, which typically
involves the following activities:—resource assessment and degradation hazard mapping; land evaluation;
selecting the "right" type of land use; and selecting the appropriate conservation techniques.

FAO has published guidelines for resource assessment, degradation hazard mapping and land evaluation, which
are widely used in this type of work (FAO 1982, 1989). Land evaluation is based on the definition of land
utilization types, and a matching of their requirements with what the land has on offer. This allows a selection to
be made of the type of land use which is most suited to the environment considered. Production, management and
degradation criteria are used in the matching exercise.

Hurni's (1986) manual for soil and water conservation in Ethiopia is a typical example of this procedure applied
on a national scale. In this manual, land−use planners are guided in their selection of appropriate interventions
through a number of questions concerning the physical attributes of the environment. This leads to a selection and
description of several possible interventions.

Despite substantial investments in soil and water conservation, the literature abounds of examples of failures on
technical grounds. The exact reasons why they did not work depend on the situation, but can usually be cast into
one or more of the following categories:

1. The intervention was technically wrong: i.e., it did not stop further degradation. Part, of this has to do with the
problem−identification phase, in that the intervention has often been found to tackle the wrong problem;

2. The techniques are not suited to the specific conditions within which farmers operate, particularly because they
are too complex, need expert skill and heavy machinery, use villagers as unpaid labor and cost the farmers more
than if they let the land degrade in the first place;

3. There has been too much emphasis on mechanical ways of combating land degradation. This finds its roots in
the fact that soil and water conservation became a credible profession amongst agricultural engineers following
the 1930s Dust Bowl problem in the USA—see Stocking (1985) for a historical analysis;

4. Land degradation may be a symptom of a deeper set of socio−economic problems. The real problem may be
poverty and insufficient production or rapid population growth, as has already been discussed in Chapter 2. This
follows directly from Blaikie's (1985) discussion of the causes of land degradation in the developing world, and
explains why, when prompted for their views, farmers rarely identify land degradation as their

most pressing problem, but limited access to resources. Viewed in this light, the land's productivity does not need
protecting, so much as improving (Shaxson et al. 1989).

Biggs (1990), traces the origin of failures in agricultural innovation in developing countries to the hierarchy of
official technology development which puts the scientist in the design chair at the top of the pyramid, and the
farmers, who are supposed to adopt the scientist's designs, at its base. In this model, which Biggs (1990) calls the
"one−source model of agricultural innovation," the extension services are the link between design by scientists,
and adoption by farmers. The assumption hereby is that there exists "a neutral, apolitical scientific Research and
Development system which is steadily creating new innovations and pushing forward the frontiers of

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institutionalized academic knowledge" (Biggs 1990:1481). The validity of this assumption has already been discussed in the context of land degradation assessment (see previous chapter). Biggs (1990) makes the following points:

- purely political factors often influence the allocation of funds to research;
- education and research are "elitist": they consider what happens in the field of technology development by non–researchers as being of little value;
- research is guided by prestige and recognition by relevant academic and other institutions, whose assessment of the worth of a piece of research guides researchers into types of research which are irrelevant to clients;
- research is guided by the "value for money" principle by those who fund the research and who, in the case of agriculture in developing countries, are not the farmers themselves, but a wide spectrum of national and international interest groups;
- research is conducted within academic enclaves (and within them by non–communicating departments and disciplines);

Thus, "science and technology are continuously interwoven with economic and political events" (Biggs 1990:1481), and the existence of a neutral, apolitical system of R&D is a myth. This invalidates the one–source model of agricultural innovation as either a role model or as a description of reality.

The above critique is not new, and important changes in technology development by professionals have emerged recently: see, for instance, Norman (1980), Chambers and Ghildyal (1985), Farrington and Martin (1988) and Biggs (1980, 1990) for a select few. The alternative model now favored is the "multiple source model of agricultural innovation." Thus it has been recognized that many diverse private, public and institutional actors are involved in the research system, and that farmers, artisans and others in the rural economy conduct informal research (Biggs 1990:1485). The major difference from the one–source model is the involvement of farmers in the process of technology design.

Shaxson et al. (1989) and Douglas (1988) have tried to redefine soil and water conservation using this perspective. Their approach, as do those of numerous other authors emphasizes the following principles. The first is to concentrate on improving rather than conserving productivity. This moves the bias away from geomorphological processes, to socioeconomic considerations, and is aimed at what concerns today's farmers most, which is the improvement of their living standard. Conservation in this situation is hereby assumed to be achieved indirectly, either through the physical impact of improved production on land degradation processes (example: better production covers the ground better, hence rates of erosion decrease—see Biot et al. (1989) for an example of this), or through the increased "stewardship" effected by farmers because of increased returns from the land, and a better standard of living. This shift also means a move away from mechanical to biological means of conservation.

Secondly, the implications of the "multiple source innovation" model should be widely recognized—see Douglas (1988) for concepts and procedures; Piarom and Backhaus (1991) for a typical example in the Highlands of Thailand; Fujisaka (1989) for a list of possible approaches, including: Farming Systems Research (Norman 1980), Rapid Rural Appraisal, Agroecosystems Analysis (Conway 1986), Farmer Participatory Research (Farrington and Martin 1988), and many others. Finally, there should be an increased attention to Indigenous Technical Knowledge—see, for instance, the francophone literature mentioned earlier, and Millington (1987) and Reij (1989).
Uncertainty

The uncertainties listed in the previous sub-section can be summarized as follows:

1. the physical environment is much more variable, both in space and time, than can be represented in simple maps, statements and scenarios. Prediction in such variable environments is usually a highly inaccurate exercise;

2. the identity of the land user. Both the state, and the local users, as well as those who have to undergo the off-site impacts, have a legitimate interest in a given tract of land, and it is not clear who the client is or should be, when undertaking degradation research. The specific requirements with regards to land conservation differ across these "claimants," often in conflicting ways;

3. in many cases, the scientists' understanding of the process of land degradation is incomplete—see, for instance, the problem of land slides and gullies; in other cases, scientists understand the way in which the environment works, but cannot isolate cause/effect relations in observed phenomena: see the climate/stocking problem in the desertification debate;

4. charting out the anthropogenic causes of resource degradation is prone to huge margins of error.

Uncertainties are compounded by other constraints. Budgets for scientific research in developing countries are often limited. Scientists have to resort to fast and cheap methods of investigation, which rarely achieve the depth and replication needed to obtain an adequate understanding of the processes operating in any one environment, and often rely on the observation of "symptoms" of "processes" that are assumed to lead to reduced production. Science in developing countries to a large extent, still exhibits temperate and western ethnocentrism in the domination of concepts originating in the developed world.

The advances of modern science (such as process−based modeling, remote sensing and degradation/productivity research), while capable of resolving part of the problems of uncertainty, will not be able to resolve the fundamental limitations of the scientific method of inquiry itself. First of all, the environment itself is, to a certain extent, intrinsically unpredictable. Unlike scientists' models, systems are open and organic (i.e., their structure evolves), much more complex than can be observed (see also the next point), and can behave in unpredictable and "chaotic" ways, which may be characterized by multiple equilibria. Mearris (1990) discusses this most convincingly in the context of the environmental implications of Structural Adjustment.

Secondly, researchers are limited by what they can observe. This limits their perception of the reality to the empirical world, which is not necessarily the real one. This means that, notwithstanding further investments in environmental sciences, scientists' understanding of the dynamics of the environment will always be limited by uncertainties that may never be resolved—see, for instance, the global warming debate, the desertification problem, and the erosion problems in the Himalayas. This reinforces the point that the tradition of science, which claims that absolute knowledge of reality is possible, is probably not a useful one in the context of impact assessment. Rather, the model of scientific realism is much more adequate: there is perhaps a world "out there," which exists quite independently of our being able to perceive it, but our knowledge of it can never be absolute. Thus knowledge has to be revised continuously taking account of later scientific discoveries and interpretations (Meams 1991).

A third problem with the way in which science is conducted is the lack of experience of scientists in the inter-disciplinary approach to research required in the study of complex eco-social systems. Science is still compartmentalized, and there are serious problems of communication amongst physical scientists, let alone
between physical and social scientists.

However, there is a fourth, and perhaps much more serious problem with science, which invalidates the assumption that it is superior to local knowledge systems on the grounds of objectivity. Among the large number of uncertainties in the scientific procedures and findings on resource degradation issues, scientists often make deliberate choices that are not guided by scientific judgment, but by political and sometimes ethical considerations—see Biot et al. (1991) for a case study in Southern Africa. It is the case that much science in and about developing countries is heavily biased by the world−view, social and racial prejudices, financial, and wider economic objectives of scientists from or trained in developed countries. This means that the process of peer−review is often unsatisfactory and that science is conducted by a privileged few whose views are seldom challenged explicitly colleagues or anyone else.

Implications

This discussion supports the unease reflected in recent reports by policy analysts and scientists assessing problems of land degradation. Science does not have an unambiguous and objective message, and when it thinks it has, it often has more than one, depending on who does, and who commissions, the assessment. The existence of the problem itself cannot be taken for granted, let alone its importance with regards to farmers' management objectives, and there are strong reasons to suspect that scientists are biased by a number of social, economic and political factors that invalidate their claims of objectivity. The methods of science are no guarantee of its objectivity. It is not surprising, therefore, that there are major conflicts between scientists (the official viewpoint) and local land users (the indigenous viewpoint). To a large extent, these conflicts are not resolvable, which is not to say that are not manageable.

So, what are the implications for a research agenda? A first point to be made is that, in view of these uncertainties, science should be involved in a continuous process of assessment and evaluation. Given the strong social and political forces which guide scientists, science should be conducted and debated by all actors involved in the development process. This includes, especially, those who will ultimately have to carry out the proposed "conservation" techniques. Hence it is important not to confine the analysis to the farmer's decision process alone, but to include a critical review of the scientific assessment procedures that lead to the realization that there is a degradation problem to be addressed. Such a review should be a matter of routine for any development program that purports to affect the environment, and not be restricted to one−off exercises.

The growing literature on failures in agricultural innovation programs has a clear message: science often cannot provide the technology from the shelf. This reinforces the concluding remarks in the previous chapter on the uncertainties in the degradation assessment process, namely that science cannot be assumed to provide "the truth." There is a great need for the efficient implementation of a "multiple−source" model of technology design, which communicates with and empowers local land users to set the agenda for technical innovation. The emphasis in such programs should be on productivity increase, rather than conservation.

When researching farmers' decisions in the context of resource conservation, the following questions have to be asked:

1. Has the right crop been chosen for the right soil?
2. Does the (proposed or indigenous) technique work (i.e., combat the land degradation process that it is supposed to tackle)?
3. Is the technique appropriate to the social and political causes of land degradation?
4. How does the technique fit in the users’ world (e.g., how does it affect current agricultural practice, how urgent is the problem, who pays, what are the effects of the conservation program on other activities, how do farmers perceive land productivity and land degradation, what institutional support is there for soil and water conservation, what are the tradeoffs to be made in amongst all the above criteria?)?

Table 2.1 illustrates the idea of tradeoffs, and shows how the wide range criteria used in the evaluation of technologies may lead to a selection which is not necessarily the best as far as conservation itself is concerned.

In analyzing farmer participation in technology design, special emphasis should be given to the institutional context of this activity. The populist approach to development planning implied in these procedures has rightly been criticized for being expensive on resources and time. It is often restricted to well-funded programs involving substantial expatriate personnel, and does not fit into existing institutions of agricultural research and land-use planning in developing countries. Researchers also often lack the skills for this type of work, and it is no surprise that, despite more than a decade of efforts in farming systems research, there are few tangible success stories in agricultural development involving resource poor farmers. Thus, a crucial question in the World Bank's research into non-adoption relates to the possible re-organization of institutional agricultural research, and the institution of efficient and thorough training of research and project personnel in farmer participatory type work. This issue highlights the need to see the "official" institutions of soil and water conservation as part of the problem, and therefore as legitimate objects of research.

| Table 2.1 Hypothetical evaluation of three soil conservation measures |
|-------------------------|--------------------------|-----------------|-----------------|
| Criterion                | Bench terraces | Grass strips      | Intercropping   |
| Technical performance    | +++          | ++               | +               |
| Fits in existing practice| –            | +                | ++              |
| Cost with regard to       | –            | +                | ++              |
| importance of problem     |              |                  |                 |
| Cost with regard to       | –            | –                | +               |
| farmers' capabilities     |              |                  |                 |
| Short-term benefits       | –            | –                | +               |
| Fits in farmers'          | –            | +                | +++             |
| understanding             |              |                  |                 |
| Fits in local land tenure | +            | ++               | +++             |
| system                   |              |                  |                 |
| Fits in local             | +            | +                | ++              |
| institutional framework   |              |                  |                 |

3—
Rethinking Individual and Collective Decision-Making Behavior
Agents, Actors, Individuals

In the previous chapter we argued that, when land degradation and soil and water conservation problems are evaluated, science and technology (and the institutions that propagate them) are, to a large extent, part of the problem. This chapter moves on to the resource users themselves, and the institutions to which they relate. We have also argued that we need to extend the models of individual and group decision making in order to research more effectively questions of perception of resource degradation and the adoption of techniques to mitigate it. It has been common to contrast economists' understanding of human action as the result of decision making under constraints, with sociologists who see action as determined by structure. Economists see nothing but choice while sociologists see no possible role for choice. This contrast may be overdrawn but it highlights the interdisciplinary requirements for a methodological framework for a research agenda that is to focus on perceptions and decision making.

All we can observe in reality are human actions (observation itself being an action, of course). Economists have seen action as the result of choice, i.e., the action was intended as a result of rational calculation. What is required, according to this view, is to understand the goals, constraints and modes of calculation of individuals, and the resulting action will appear as reasonable. The role of other social scientists is to discover and clarify these components of decision making. But philosophers, sociologists and anthropologists have argued that matters are far more complex. Besides the practical reasoning involved in action, behavior can also be driven by unconscious motivations, actors may act against their will, and actions have unintended consequences. Furthermore, the time dimension profoundly changes the character of rationality, and this is particularly relevant to environmental management decisions.

The concept of the individual making decisions in the context of institutions forms the basis for a necessary extension to rational choice models. Individual action has intentional and unintentional outcomes and is formed by reflective monitoring of action and its rationalization, together with unconscious motivations that can be accounted for by social structure and socialization. The concept of agency attempts to capture those aspects of perception and behavior that are the conscious determinants of human actions—themselves patterned by structure and historical action. Human agents act as a result of conscious processes to obtain goals that are influenced by their socialization under constraints that are determined by the institutional and environmental context. They have knowledge and understandings of their situation which arise from the structures in which they live, and have experienced in the past.

The idea of agency differs from that of individual decision maker in that the actions of agents are socially structured (rather than determined). Individuals make decisions, such as those regarding land management, which are based on their perceptions of costs and benefits. But these perceptions and the calculations (decision making processes) that are applied, are socially constructed by ideological and cultural systems and institutional structures. An example can be found in Douglas's discussion of decision making under risk:

"Expectations about coping create the quality of hazardousness" (Douglas 1986:27) ... "ideas about the world come directly out of social experience. ... Ideas about ... the connection between probabilities and payoffs can be traced to commitments to kinds of social organization and the kinds of experiences and kinds of interpretations current in them" (p. 101)

The model of agency is more comprehensive than the linear sequence of perception, diagnosis, decision and action, which is elsewhere used for simplicity. Knowledge, understanding, valuation and the mental and social processes that lead to actions are all social phenomena rather than timeless characteristics of humans. Furthermore the actions of humans will, through time, alter the structures themselves, partly in intended ways, but mostly in unintended efforts. Thus, at the same time that individuals' understandings and goals are influenced by their actions within these structures, these understandings and goals are themselves transformed by individual and
collective action in both intended and unintended ways. There is a reflexive relationship between the individual and the institutions of society, where, in the short term, the individual is not only molded by but also maneuvers and challenges institutions, while, in the longer term, aggregate effects bring about changes in the institutions themselves. The term agency usefully describes this dialectic—for the agent is both a vessel through which social institutions pattern action as well as a generator of social change through the exercise of choice. It is suggested that this approach to resource-use decisions is a fruitful one and is used in our proposed research agenda.

The interaction between the individual and institutions is also a key element to understanding collective decision making. For economists the expected benefits of participation in collective action which produces a partly non-excludable and non-rival good (pure and impure public goods) will generally be exceeded by the costs because the probability of individual contributions making a significant impact on the amount available to them is very small. Hence people will free ride, and the good, with public good attributes, will be under-provided unless people are coerced by the state to contribute to its provision. According to this theory, in the absence of state coercion rational maximizes will overuse and degrade a common pool resource. It is in such a way, for example, that economists rationalize the role of the state in the provision of goods and the taxation of the population to finance it.

However, people often do cooperate in the absence of state intervention or initiation. Without the introduction of culture and norms it is very difficult for economists to explain the wide range of informal collective action that most people actually engage in, for example the widespread occurrence of traditional common-property resource-management institutions. Even the addition of culture and norms fails to explain all the variation found—hence the emphasis on agency, and one view of collective action as "interlocking projects." Full rationality needs to include the politics and strategies of decision making. Social science studies, however, have shown that there are indeed a wide number of cases where people have been able to devise institutions that manage these resources in a sustainable way. Within our framework, we see people as acting, partly under the influence of norms enable them to commit themselves to collective action, and reasonably to expect others to be committed in ways that lead to low levels of free riding.

One task of research, therefore, is to understand what factors influence this ability to act with an "extended" or full rationality so that "prisoner dilemma" problems can be avoided.

This has implications for the necessity of well-integrated, historically informed, interdisciplinary research. An example of the reflexive relation between agents and institutions and the significance of this for the environment can be seen in the following simplified account of the changing meaning of the communal grazing land in Zimbabwe.

Common-property institutions include a set of property rights, whereby use is restricted to residents of communal lands who are entitled to the free use of grazing land and whereby no individual may inherit, sell or "own" grazing land. These institutions serve to conserve the commons and constrain the actions of producers, at the same time a's allowing flexible responses to spatial and temporal variations in the availability of fodder. Yet there are also possibilities for individual agents to challenge this system of property rights both overtly and covertly, and through their behavior to changes in the meaning of the institution over time. Farmers may exercise choice in the following ways. They may:

- collectively request the extension organization to support a grazing scheme for the area, whereby the fencing off of grazing land into paddocks for rotational grazing allows a small group of farmers to convert communal ownership effectively to ownership by a small group. Since scheme members often continue to use the open range as well as the paddocks, grazing schemes can result in higher stocking densities outside the fenced area and exacerbate degradation there.
encroach onto land designated for grazing by opening up arable fields there illegally—these are inherited by individuals.

encroach semi-legally onto grazing land by the establishment of vegetable gardens, with tacit official support.

manipulate the designation of grazing land by incremental expansion of arable fields on the margin of grazing lands.

All these forms of encroachment onto grazing land are perceived by scientists and extension workers as having negative consequences for the environment. They occur because increasing space for the exercise of individual choice is opening up in circumstances in which common-property institutions, which have been imposed or upheld by the pre-independence state through fines and imprisonment, are no longer enforced in the same draconian way. Also the erosion of the authority of local leaders (as well as their participation in encroachment) has further weakened these common-property institutions. Population growth and political developments during the war of independence also contributed to pressures to act on more individualistic criteria. As the commons become degraded, they appear to be losing their secure meaning as common property, dividing up variously into categories that are better understood as either open access or private property. Thus over time, the meaning of communal grazing land changes through the actions of agents and these are partly structured by institutional constraints and partly (possibly increasingly) reflect choices between options. Encroachment on the commons was encouraged in the liberation struggles—peasants thereby resisted the colonial state and the traditional leaders it supported. Since Independence, the encroachment of the commons has been greatest where the weakening of the authority of traditional leaders has also been greatest, resulting in considerable variability in local practice.

This example has illustrated how the interaction of agents and structure must be treated as more than a simple determinism whereby the individual acts in accordance with institutional imperatives. There is a variable degree to which the individual can both directly contest and renegotiate compliance with social norms, as well as manipulate ambiguities and meaning.

**Institutions As Actors**

It is acknowledged that many of the techniques of resource conservation require collaboration among individuals, and it is thought that much resource degradation results from a lack of collaboration. The individualistic mode of analysis posits the problem as one of discovering the modes of calculation of individuals in regard to collaborative action, and the costs of negotiation and monitoring, which collaborative action entails. As pointed out above, this type of approach makes it easier to understand why collaborative action does not occur, rather than why it does:

"Rational actor models of interest groups or pressure groups ... [or collective action] ... explain why many groups should be underorganized, but not why large-scale collective actions occur" (Donleavy 1991:14).

Social scientists have suggested that collaborative action is easier to understand in the context of the role of institutions. We have seen that individuals and choice are both patterned by the structures of society that they create through their (inter-)action over time and space.

What are institutions? Institutions include the organizations in which we participate in everyday life, but they are better described as the way things are done in society, or standardized modes of behavior; they can be conceived of as the sets of rules that structure every-day action, including decision-making and habitual behavior. They strongly influence who can make what decisions, and how those decisions are constrained, prohibited, or required. They allow people to have expectations about the behavior of others, which radically reduces the uncertainty that
would otherwise characterize social interactions. They embody the processes of monitoring the behavior of others and of enforcement of normatively patterned behavior. In this context, institutions vary from such practices as telling the truth, and departing from the rules and roles of everyday life to organizations such as firms, households, agencies of the state, and so on. Contractual forms and terms can be considered institutions (for example, the prevalent (but not universal) norm of the 5050 share between landlord and tenant.

Why place institutions so prominently in our research agenda? We have already indicated the importance of institutions in the sense of rules, norms and expectations, but in the second sense too, organizations, such as firms, state or local government bureaucracies, nongovernmental organizations, informal groups, and so on, pervasively structure and respond to individual action. Organizations such as these are centers of power that can have major effects on the livelihoods of individuals and they are consequently arenas of conflict over the allocation of resources and well−being. Recent developments in the economic approach to institutions have provided a number of fruitful hypotheses about these institutions. Individuals seek to advance their perceptions of their interests through such organizations, subject to the constraints they face. Models such as the budget maximizing bureaucrat, the market−share maximizing entrepreneur, or more generally the utility maximizing individual have resulted (Eggertsson 1990). In these theories, organizations exist to promote common interests, but there are generally incentives for members to free ride. Such opportunistic behavior is constrained by supervision, contracts, and norms.

Researching these organizations poses significant problems because of the potential conflict between the official purpose and role of an organization and the private agendas of its members. Furthermore researching organizations enters into the supervisory pattern of the organization and can upset existing arrangements. Thus researchers can be viewed with considerable suspicion, if not hostility. Such suspicion is highly likely in agencies charged with resource management (Lipskey 1981) because they frequently have relatively unsupervised discretionary power to impose costs or penalties on (would be) users, or to allocate rent−generating opportunities. Not surprisingly the relationship with outsiders is manipulated in attempts to preserve or advance private interests.

In much "evaluation" of development projects, whether carried out by the state or NGOs, a similar problem occurs. Critical reports can lead to loss of private utility (cuts in funding, extra work, loss of status or prestige, and so on). Policy science has always encountered such problems. These are typically "principal−agent" relationships where those being evaluated are charged with carrying out instructions of governments, donors, etc., and the evaluator is charged with gaining information on behalf of the principal. Conflicts between bureaucratic principals, or their evaluators, and their agents are often characterized as a gap between the reality of the organizations' life and the lack of experience or impracticality of academic researchers. Populist writers frequently refer to the need to re−orient bureaucrats or experts (e.g., Chambers 1983). Attempts to overcome this gap include Action Research and participatory research and development of various types, e.g., "process documentation" and the unit of study: but these too must be subject to critical examination. Researching the interface between local and community institutions, and official ones, is one of the highly policy−relevant central concerns of an environmental research agenda.

Self−Interest and Altruism

Our concern here is to examine objectives and motivations in decision making. We have pointed out that the model of the rational actor, with complete knowledge, maximizing individual utility, is seriously incomplete. A useful model must go beyond the individualism of elementary economic theory to include norms and the possibility of commitment, as well as imperfect information and uncertainty. The egotistical individualist would act opportunistically, maximizing individual benefit wherever possible. But in such a world, coordination with others would generally be very difficult, and life in it would be likely to be nasty, brutish, and short. In the real

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world, such an approach could only be characteristic of groups or times without social order.

The ways in which the reflexive (simultaneous and recursive) relationship between agent and structure occurs are bound to be varied and complex. The role of perceptions is crucial because they are necessarily the main objects of research and this issue has been discussed above. Here we take up the question of the unit of study.

Nowhere is the problem of reflexivity more apparent than in the need to identify the appropriate unit of decision-making and study. This has been approached in a preliminary manner in Chapter 1). Frequently field studies (as well as much modeling) have identified the household as the unit of study. In a developing country context the task has been to identify the appropriate definition of the household. This approach is now considered of limited use even in the regions where it originated (supposedly characterized by single wage earner domestic groupings). In recent years this model has been extended by the new household economics, transaction costs, and bargaining approaches. The new household economics drawing on the work of Lancaster, Becker, and Hymer and Resnick, expanded the economic understanding of activities of and constraints on the household but left the intra-household allocation of welfare and effort largely unexplained. Decision making is modeled by means of a joint utility function, a benevolent dictator, or perfect altruism.

All these approaches assume full information and costless "transactions." The application of transaction cost economics directs attention to the nature of the (implicit as well as explicit) contracts that govern the allocations of tasks and welfare within households, and the factors that determine them. Since these factors may be changing, the transaction costs approach provides insight into the way in which domestic units and their behavior may change under external (and internal) influences. These contracts may illuminate the delegation of decision making to household members in ways that identify the different interests household members may have in resources and responsibility for their use.

Among the criticisms of the transactions costs approach is the way it leaves open areas of dispute and negotiation within the on-going relationships that it describes. In this context another approach that has been fruitfully applied to the understanding of domestic units is that of bargaining. Intra-household relationships are understood in the context of the realization that coming to an agreement is better for both (or all) parties than the breakdown or threat point but there is a conflict over the allocation of benefits. Thus they are characterized as "cooperative−conflicts" (Sen 1987). This allocation is modeled in terms of the threat points or fall-back positions, which describe what happens if negotiations fail. The benefits accrue to those with the strongest fall-back position.

While in the mainstream literature the fallback position is largely modeled by income (women's subordination, for example, is traced to their lower income−earning potential), this is strongly influenced by the institutional structure of organizations, rights, norms and perceptions. As Sen (1987) has pointed out, the outcome of bargaining is also affected by more than alternative incomes—for example, by "perceptions" of contribution and welfare, and by physical threats of violence, which are culturally influenced. Thus the behavior of domestic units is affected by ideological constructs and cultural values as well as the well−being of respective fall−back positions measured in economic terms alone.

**Risk and Information**

Deciding and acting occur in a context of uncertain and incomplete information. The framework we suggest is of individuals whose decision making is determined by the evaluation of the perceived costs and benefits of actions (as influenced by the institutional structure) in interaction with relevant norms of variable strength. This new institutional economics draws not only on rational−choice models, but also the extensions to this model that are encompassed by transaction costs and imperfect information approaches to understanding institutions and
behavior.

A number of key concepts can be drawn from the approaches embodied in this framework and the assumptions they make. Individuals are assumed to want to improve their material well-being and to smooth its level over time in the face of external risks and varying endowments. They are risk averse and have imperfect and asymmetrically held information (and information is costly to acquire). People have different "endowments" not only because they differ as biological beings, but because they inhabit different environments and are socially endowed with different resources. (These different endowments are very significant in explaining the actions of individuals. Other Chapters are devoted to a more extended analysis of three important dimensions of endowment differentiation—identity, gender and access to resources.) Significantly, individuals are also assumed to want to improve the well-being of others to varying degrees, as discussed above.

From these assumptions we can deduce that individuals will seek to insure themselves against risks. There are two main ways in which they can do this—diversification (self insurance) and risk spreading (social or collective insurance). Diversification is undertaking a number of different actions whose outcomes are not perfectly positively correlated, even when this means lower expected (average) benefits. For example in some cases farming on scattered plots as a form of diversification can be accounted for not because it increases average net returns but because it reduces the variability in net returns. Risk spreading means participating in collective institutions, which provide mutual insurance with others whose well-beings are not perfectly positively correlated with one's own.

We can also deduce that individuals are likely to be (and expect each other to be) opportunistic whenever they can expect to get away with it. There will consequently be two types of behavior that strongly influence social institutions—moral hazard and adverse selection. Moral hazard occurs where information about the actions of individuals is imperfect and costly to acquire (e.g., laborers may not work hard unless monitored); adverse selection is when information about the type of individual is imperfect and imperfectly held (e.g., when it is difficult to discover whether the worker is energetic).

If it were not for these problems there would be no need for the form of plot diversification mentioned above because the same risk mitigation as can be achieved by plot scattering could be achieved by having the land cultivated in contiguous blocks with risk spreading agreements between the different cultivators. Moral hazard may be counteracted by devising appropriate incentive systems such as share payment systems and "bonding" (the giving of collateral or bonds to assure performance of the contract). Adverse selection may be mitigated by "signaling"; an example is where agents indicate their quality by getting qualifications, or, as taken up further below, by adopting identities that signal their adherence to known social roles and their associated patterns and norms of behavior.

In this framework the contrast between individual and collective action is dissolved. The ability and terms on which individuals can participate in collective insurance institutions depends on their "wealth" and "reputation." These are influenced by the "individual" actions they undertake, as well as the more explicitly "collective" ones. For example, an individual who is accepted into a risk-spreading institution on the basis of their current activities faces reduced risks and may consequently take on more risky individual actions. For example, once farmers are accepted into a crop insurance scheme they may adopt more risky cropping practices, and collective risks may therefore rise. Clearly this has major significance for attitudes towards common-pool resources that play important insurance functions.

Many institutions characteristic of poor developing-country agrarian economies can be conceived as playing this role. Thus the distribution of available material entitlements is such that
"every household in the community has a reliable guarantee of survival over the full weather cycle" (Platteau 1990:156).

For example, and perhaps most importantly, there are the systems of property rights that ensure access of members of the community to resources or employment, and maintenance of common properties. Reciprocity networks and gift exchange can be understood in these terms:

"[O]nce gift exchange is interpreted as an insurance arrangement ... transactors [are tied] together in such a way that they become mutually responsible for whatever misfortune may strike them" (Platteau 1990:156).

"Traditional" communities can be understood partly in terms of the need for security; the small–scale, closely–knit group among whom there are multiple and multi–stranded relationships, serves to overcome the informational problems of insurance provision. In such communities information about the activities of members is not so scarce (or asymmetrically held) that they are not prepared to insure each other.

Further, this framework dissolves the difference between organizations such as firms, households and markets, and hence challenges the traditional division of labor between economics, which largely studies the behavior of markets in which households and firms interact, and other social sciences, which largely study the internal working of those units. The approach we are following focuses on contracts as a more common economic phenomenon than markets, and sees firms and households as well as other social institutions as "nexuses of (often implicit) contracts."

**Actors' Identities**

The picture emerging from the theoretical approach outlined in the previous Chapter is one of an uncertain, complex and organic world, in which structure affects and is affected by the agents, and in which change occurs through short–and long–term processes We turn now to the concept of identity.

The differing endowments and motivations of individuals are aspects of differing identities. Economists are beginning to recognize the importance of identity to the functioning of markets and other institutions. Transaction cost economics recognizes that economic exchanges are not costless—it takes time and money to assemble information, to negotiate and to enforce agreements, and it is efficient to find ways of minimizing these. Identity is a key to reducing costs by reducing uncertainty and establishing trust (Pollack 1985, Ben–Porath 1980). In this perspective, the family is an efficient economic institution because members have identity—here meaning being known and being predictable. Family relationships can be seen as long–term implicit contracts that exploit the benefits of identity. It is possible to examine how the family loses some of its competitive edge as a way of organizing economic activity when social conditions change such that identity is no longer as significant, e.g., when states supply information, enforce quality control, and provide social security.

Economists have not, however, examined the plurality of identities that individuals carry—a single individual may be a woman, an elder, a wife, a mother, a weaver, a spirit medium. Some of these are achieved identities, others are ascribed and, of the latter, gender is an identity that is immutable and which carries with it role identities such as mother, daughter, sister. A man can be simultaneously a son, husband, father, farmer, cattle keeper, petty trader, migrant laborer and thief.

Identity is a major factor in determining the perceptions and actions of individuals, but the existence of multiple identities brings difficulties for the assessment of these variables. The integration of the roles assumed under different identities by an individual is always at best partial and, in situations of changing constraints and
circumstances, the pattern of achieved integration may be changing significantly. Bounded rationality will prevent a complete harmonization of conflicting impulses. For example, a man as father and farmer may have an identity embodying trusteeship of the land for his descendants; but as a husband and petty trader he may feel that it is appropriate to exploit the land in the processes of provision and accumulation. Clearly, then, it will make a difference whether the individual is acting under the identity of father or trader; and for different individuals at one time, and over time for the same individual, the dominant identity may also differ. Since individuals have multiple identity–based potential environmental contracts, which may be latent or active, this is one mechanism through which agency may be exercised. It would appear, for example, that there may be some room for choice, for some people, at some times, between whether to exploit the environment as a trader, or conserve it as a patriarch.

We can, for illustration, consider gender identity. Gender analysis helps to explain who causes degradation and why, and it also indicates how gender identity affects the likelihood and character of any ameliorating action taken in response to land degradation.

The following is a simplified account of how gender–differentiated rights to land provides an example of the how agents cause degradation. Kinship systems in areas of communal land tenure, such as Zimbabwe, serve to organize access to land unequally for men and women (only men can be allocated land in their own right). They invariably also regulate access to labor in the male–dominated household and, since this is the critical factor in the usefulness of land, this also results in differential effective access to land. Even where allocation rights are apparently gender–neutral, patrilocal residence after marriage also alienates women from access to land within their lineages. This would lead us to expect that women will relate to land differently from men, not only where they are by law deprived of land, and in this case their interests in the long–run productivity of land and local common–access resources is highly attenuated.

Further, patrilinearity serves not only as an inheritance system, with obvious implications for women where land is individually owned, but is also a system for ordering social placement, which has ideological implications of relevance in patterning how women and men relate differently to land. In Zimbabwe, women are not significant in the ancestor belief systems, which confer mystical status to land, so they are not spiritually identified with the land of their ancestors in the way that men are and thus clearly their sense of obligation to both ancestors and descendants (of importance in conservation incentives) is likely to be weaker.

Thus being a man or a woman conditions resource relations in a number of ways. At a general level it can be argued that women are not fully acting subjects in the same way as men (Whitehead 1984) and therefore their property relations are fundamentally different. That property should be seen as a set of relations between people, rather than between people and things, is a well established anthropological position, and these social relations limit the extent to which women, by comparison to men, are able to act as subjects in relation to objects of property. The implications of this type of gender difference for conservation will be fairly obvious, even if much further research will be required to explore them thoroughly.

To turn now to the question of how gender identity affects decision making regarding environmental problems, we can look at some of the stages in decision making that we refer to elsewhere in this paper:

perception by men and women of their environments is known to differ, as do their perceptions of what constitutes a problem. For example in Ethiopia different problems and management solutions were articulated by different groups, including women, on the problem of hillside closures. Another example is the variegated grasshoppers of Eastern Nigeria—seen as a pest by cassava growers but a valuable resource to be gathered and cooked for sale by poor women (Richards 1985).
**diagnosis** of what causes an identified problem is also likely to be gender differentiated for men and women, who are not socialized in the same way, and have different experiences of the environment through the gender division of labor, which assigns men and women differing roles in relation to it. The result is that men and women have differing knowledge systems from which they draw explanations. Women commonly have less formal education and access to extension information but they may have considerable knowledge of plant varieties and properties. Despite having knowledge, women may lack the authority to have an opinion that is listened to—the differentiation of problem diagnosis may not only be that men and women have different models, but also simply that women do not articulate diagnostic knowledge of the environment because it is considered inappropriate.

**prioritization** of environmental problems is very likely to reflect the intra‐household differences of interests of men and women. Models of intra‐household relations (Ellis 1988, Sen 1987, Ben‐Porath 1980, Pollack 1985) have moved conclusively away from the notion of joint household utility and accepted the reality of separate incomes and interests (often conflicting) within households. Power to impose individual self‐interest on other household members may be more commonly held by men but the degree of influence over decision making held by women will be dependent on a number of factors identified in these models—the general position of women in the society, the situation of widows and divorcees, the possibility of remarriage, the age gap of spouses etc. Whether a household uses its scarce resources to plant trees for future fuelwood supplies (a woman's priority) or to acquire more cattle (a man's priority) will depend on the bargaining power of sexes within households and gender relations within the society.

**solution feasibility** : The feasibility of a particular conservation technology will not be the same for male and female household heads because they are not equally resourced. In Zimbabwe, women household heads who are separated, divorced, or widowed lack both labor and cattle by comparison to their male counterparts, for them a recommendation of tied ridging to conserve soil and water is particularly unfeasible.

**costs, benefits and risk** : Clearly the gender division of labor, in addition to the differential access to resources and commitment to land described above, will differentiate the incentives for men and women to adopt particular technologies. Building soil conservation works may be onerous for women and offer little by way of short‐term gain.

Whilst we cannot usefully treat all women as an undifferentiated social category (given the differences of age, class etc. within this category) we need to recognize that gender is a primary ordering of society that profoundly affects resource‐use decision making and therefore has to be integrated into our analytical framework. We have raised questions of access to resources in a gender context but need to consider this more broadly.

**Actors’ Perceptions**

Why study perceptions as an element of decision making? A number of reasons suggest themselves; the need to manipulate outcomes, the value of an actor‐oriented analysis as discussed above, the role of perceptions in bargaining and legitimation of decisions, and in order to reveal the gaps between knowledge systems being just a few. We have noted above that there is a tendency to regard the role of social scientists as being to identify the actual goals and constraints of local people so that their decision making can be understood as the outcome of rational decision making. There is the implication that their actions can then be manipulated by changing either the constraints or goals with predictable outcomes determined by the universal process of rational choice. This entails the study of "perceptions." However, a typical response from social scientists to the problems of researching such a topic is the following:

"The reasons actors supply discursively for their conduct in the course of practical inquiries, in the context of their daily social life, stand in a relation of some tension to
the rationalization of action as actually embodied within the stream of conduct of the agent" (Giddens 1979:57).

The hermeneutic understanding of the presentation of self in everyday interactions is valid in so far as it directs us to take account of the sociology of the research encounter. We have seen that understanding the socially and culturally constructed, different and multiple identities that people embody should not be avoided. Thus the explanations that people are likely to give, whether privately or publicly, to a cold interviewer or to one who has established "rapport" (a concept honored far more in the breach), are problematic. Why did they give that account of their actions or views, and what relationship does their account have to their actions?

In practically researching perceptions of natural resources and their management several problems arise, namely: that of the choice of respondent, and having chosen the units of study, those of evasiveness (avoiding the question), dissembling (diverting the conversation away from the conscious motivation) and dissimulation (pretending some other motivation). The exact (spatial and temporal) context of interaction between researcher and object have significant influence here. Even more significant, however, are the problematic relationships between the knowledge of the actor, the rationalization of action, and the unconscious.

Much recent work, some of which is reported above, has raised questions about how scientists have perceived environmental problems, about the sociology of science, about how scientists beliefs arise and gain support. The same questions need to be raised about the practical consciousness of farmers and others in developing countries. The important points are that perceptions are socially constitute—perceptions are neither true or false, but are socially legitimated through the medium of cultural construction and social authority. Different social groups (class, gender, age) have different perceptions, are spatially differentiated, and are likely to be influenced by recent events.

These points are well illustrated in both case studies. A particularly illuminating instance of a type of problem that the framework we advocate seeks to overcome is what Ardener (1971) has termed the "mutedness" of certain groups, for example women, untouchables, or marginalized groups. The perceptions of such groups are subordinated to those of dominant groups so that they literally do not have the language with which to articulate models that differ from that of the dominant group. Recent attempts to overcome such dissonance between researcher and researched have been attempted by participatory rapid rural appraisal in which, for example, maps of environmental degradation have been drawn by farmers using their own spatial and categorical frames of reference (Chambers 1983, Mascarenhas et al. 1991). There is little in these procedures to guarantee more than a particular cultural representation, and neither the epistemological and heuristic robustness of these techniques, nor their larger scale usefulness for "everyday street−level" bureaucracies has been established. Like other research techniques they can be easily degraded, and even the most convincing practitioners are not immune to the constraints of society, resources, and uncertainty in their interpretations of reality. Participation (itself a deeply ideological concept) is rarely, if ever, adequately conceptualized.

We also need to note that problems such as resource degradation are not perceived just when they occur. Not only can they be mis−perceived and perceived differently by different groups, but also they can be perceived when they do not occur, and they can not be perceived when they do occur. We note a number of contexts in which perception tends to occur, including periods of rapid change (landslides, floods, droughts), periods of changing support systems (decline of the moral economy, failure of social security), and periods of resource scarcity, and in response to extension propaganda, or when it is a perceived advantage (politic).
Differential Access to Resources and Decision-Making

The pattern of access to resources of rural producers is probably the most pervasive set of explanatory variables in all stages of decision making about use and management of natural resources. Land management usually imposes additional production costs: especially in terms of labor to construct and maintain terraces; opportunity costs incurred in leaving land fallow for natural regeneration; cash to import industrially produced energy substitutes for fuel and nutrients and so on. A lack of resources restricts the range of technical solutions to degradation. Furthermore, a differentiated pattern of access to resources leads to a competitive disadvantage for producers with fewer resources in the utilization of common-pool resources. Such producers are sometimes literally pushed into marginal areas by a spatial patterning of the agrarian political economy. It is these areas that require greater costs (and skills) to manage in a sustainable manner. The understanding of the way in which differential access to resources affects production decisions and adoption of effective land management technologies must accept that access to resources is only one part of the determining socio-economic environment.

Differentiated access is also a crucial aspect of the structuring of individual choice through the constraints that people face and the identities that people have. We have already seen how gender identity will entail differential access to resources, and incentives to use and conserve them. Similar factors affect class-differentiated identities. The better and worse off make different uses of natural resources in their livelihood strategies, and calculate and represent themselves in interrelated but different socially and culturally constructed idioms. The breaking of taboos on entry into CPRs by the poor is tolerated in times of hardship in a way that the rich are not tolerated (McKean 1986). But the rich are able to corrupt the "street-level" bureaucracies of the state charged with the management of CPRs (see the case study of Nepal below). Folk culture has been analyzed in contrasting culturally constructed terms; of moral economy—guaranteed access to livelihood—and of political economy—individually rational free riding and adherence to collective action. These analyses have themselves been viewed as, respectively, the ideology of the traditional elites (Haggis et al. 1986), or populist romanticization of a golden past, and the ideological reductivism of an aspiring capitalist elite. However, this does not detract from the predicament that such strongly argued conflicting cases pose for those who wish to intervene in the form of projects and policies. These contrasting understandings provide an example of both the framework we are suggesting (in which the analysts themselves examine the origins of their own ideas), and of the task for research.

A more empirically informed understanding of the evolution over time of land degradation through the interaction of individual rationalities could be derived through a modeling approach as suggested by Blaikie (1985). Such a schema (a not dissimilar one is presented in Gregersen 1987) for analyzing the impact of access to resources upon land management would be a major research task for a particular project, and has only been partially realized where detailed farming system studies have been augmented by intensive household and farm management studies. Nonetheless, it may be used as a conceptual or heuristic device, in which unequal endowments, socially and spatially differentiated land degradation and feedback may be linked in a fully articulated regional political ecology.

Aggregating Decisions: Environmental Change and History

We have seen in the preceding chapters some of the ways in which agency and structure are mutually reflexive. When the natural environment is altered in some way, usually as the cumulative result of a myriad of different actions by individuals through time, the pattern of opportunities and constraints which the natural environment offers to agents as they pursue their livelihoods, is also altered. This is often a complex process in which feedback loops may take years to transmit their impacts. Some of these, such as a loss of productive capacity, may have contradictory effects to other longer term social changes. For example, environmental degradation of common-access land may reduce the costs of defining and policing that individuals are prepared to pay to
maintain them. At the same time, population growth may increase the need to encroach upon open-access resources, with a net result of simultaneously increased conflict and impoverishment. The case of waste land and revenue forests in India is a case in point (Agarwal 1989, Blaikie, Harriss and Pain 1989). In other cases, degradation and ensuing decline in securing a livelihood may bring about a marked change in land management. Nibbering (1991), for example, has traced the interaction of a regional economy in south east Java with environmental degradation of terra rossa type soils formed on limestone. A marked increase of economic opportunities due to road construction and the opening up of markets to cash cropping and to the availability of non-agricultural income, both enhanced the potential value of the land, and at the same time provided financial resources to invest in effective land management. Within fifteen years, much of the land had been terraced, particularly where eroded soil had accumulated down-slope, and this happened without any intervention by the state. The implication of these examples, and the idea of long-term and complex interaction between action and the state of the environment, is that a long time period has to be considered if the context of land management is to be properly understood.

There are also reasons concerning the natural processes of degradation itself which demand a long time span to be considered. Land degradation is, by definition, a process implying literally a reduction to a lower rank, however defined. In order to be able to measure and understand this process, it is essential that it be analyzed over a long period and in historical time (as suggested in Chapter 2). The physical processes are often slow and their impact may be reversible. Some erosion takes place at times of exceptional climatic conditions with a long return period. For these reasons a long time period should be included in the purview of research. Also these physical changes are linked with social changes, which together constitute the necessary study of what can be termed regional political ecology.

Any recommendation that the study of history becomes an essential part of planning interventions is bound to elicit a response that it is an unnecessary and academic exercise, and the past is a lost cause anyway. However, on the grounds of understanding both the natural processes of erosion as well as the unfolding of society–environment relationships, an a–historical "one–shot" picture of the physical processes of erosion simply will provide misleading conclusions. A process that, over a relatively short time period appears to be a process of degradation may, over a longer time period, be seen to be part of a longer process involving a sequence of degeneration and regeneration. Also, while changes in the resource base and social change may be closely interwoven over a long period of time, it is quite possible to draw false and over–determined cause and effect conclusions if only a short time perspective is considered, when in fact, outcomes are a result of historical conjunctures. To distinguish between "degradation" as an irreversible decline and a degenerative phase in a longer process of physical and social change requires that research takes a long time perspective. Even more important, however, is the way history as presently understood conditions institutions and agents. To paraphrase another well worn aphorism, present actors are generally the unthinking agents of dead historians. Understandings of the present always embody understandings of the past— that may provide an, albeit fickle, guide to the future.

Change can come about in any number of ways, whether by changes in the external environment (e.g., global environmental change), changes in resources (e.g., population growth or the discovery of resources), technology, social institutions, prices, class, perceptions and understandings and so on. At any point, systems are dynamic, contentious, and fluid with forces continuously operating and pushing in various directions. A vector of changes is always occurring and the speed of change in various directions alters both with changes in internal and external circumstances. This model contrasts strongly with that of "institutional innovation" which posits innovation as the result of changes in factor price ratios, rather than as the outcome of on–going adaptations to and conflicts over past changes. In the research methodology proposed here, there will always be a tension between actors who not only get the best for themselves out of situations but also change the rules and institutions under which action takes place. As we have said before, people will always be maneuvering and acting strategically to advance their
interests in conflictual conditions. In aggregate these bring about structural change.

**Categories in Action**

It is useful to identify a number of categories into which the outcomes of individual actions as people pursue their goals may be classified. These include the following, and are illustrated with reference to decisions regarding land management, although they refer to a limitless range of other types of action. **Confrontation** is one, and has been a familiar one to coercive soil and water conservation policies. Many of the freedom movements of east, central and southern Africa drew some of their force from the politicization of SWC policies of the colonial governments. The instant "over-population" of indigenous farmers and herders caused by the alienation of their land and the establishment of commercial enterprises was linked in peoples' minds to the onerous set of SWC measures that became perceived as necessary as a result and were forced upon them by government. The meaning of SWC changed and compliance with these measures meant compliance with the colonial regime. Political struggle also included deliberately ploughing up bunds and the settlement on land designated for grazing (Blaikie 1986). In more general terms it is important to give accounts of change that do not posit some homoeostatic stable equilibrium situation in which change is brought about by external factors (as is the characteristic limitation of functionalist and some structuralist models). It is important to be aware that conflict is an ever-present characteristic of societies, and likewise is not "introduced" solely by external interventions. Conflict and its more or less successful containment is characteristic of all societies, and has to be theorized from within the analysis of social change.

**Compliance** is another strategy, which is both evidence of and a reinforcing mechanism of social norms. Common-property management institutions are created and reproduced by the development and implementation of rules governing access to and use of the resource. Compliance with these rules may be enforced by effective policing or by their effective legitimation. Even decisions regarding land management on private land may be reached through a process of compliance, without the individual knowing it, since alternatives are literally unthinkable, and therefore unthought about. The decision to terrace an individual field within a flight of terraces owned by many other different owners must be reached in many instances without recourse to explicit rules. Crop rotations, planting densities, and the application of much indigenous knowledge may also be a matter of compliance, often following and complying with pre-attentive structures.

**Adaptation** occurs where agents comply with constraints by restructuring or recombining their objectives, resulting in a change of behavior. This strategy is usually defensive, but can also result in reflexive changes in the structures of which agents are a part. An example can be found in Zimbabwe where the strategy of defining commonly held grazing areas for the benefit of a smaller group of users was disguised by more powerful cattle owners, for example, as a productivity enhancing intervention. In this case the motives for the strategy were adapted to opportunities available from the state and NGOs in the name of range conservation. The costs of surveying the grazing scheme (as the strategy had now become), as well as the means of reducing definition and policing costs were born by others than the beneficiaries. Also this engrossment of grazing rights was lent the legitimacy of the state itself. Many other examples of technical adaptations in the face of growing scarcities of resource and income opportunities can be found in the case study of Nepal in Appendix A1.

Lastly, **evasion** is practiced where demands made by existing norms, customs, regulations and maybe force and coercion fail to elicit compliance, but also do not elicit struggle and confrontation. This strategy only can be identified in the case where positive action has been expected but is met with alternative actions which satisfy the formal or ritual aspect of the demand, without fulfilling its objective, or by no action at all. The distinction between the letter and spirit of the law captures the essence of this strategy. Attempts to evade maximum stocking densities by hiding cattle or falsifying returns is one example. Not complying with instructions to bund fields, or bunding to a standard that qualifies as compliance but not to one that fulfills the technical objectives of bunding...
(e.g., Nyasaland under colonial rule), is another.

Each of these strategies is followed by agents acting under constraints. They have implications for the structures themselves as well as for the environment.

Levels of Analysis

In considering individual action and social institutions it is useful to bear in mind three levels of analysis, with the lower levels nested within higher levels. At the lowest level there is the behavior of individuals as shaped by institutions; these are the operational rules of everyday action. Next, there are the institutions of local collective decision or rulemaking, which determine how operational rules are to be adjudicated and changed, and disputes resolved. Then there are the constitutional rules about how the institutions of local collective decision making can be changed.

Nesting does not entail determination or causation in that the lines of influence between levels run in each direction. Nevertheless individuals have more autonomy in their actions that are structured by the operational rules of everyday life than they do in collective and constitutional affairs. Change can be brought about more readily perhaps at the lowest levels, where evasion, adaptation, resistance and compliance are individually appropriate strategies; but significant degrees of aggregation are required for alteration to collective and constitutional institutions. Nevertheless individuals can be effective through action at these other levels.

Figure 3.1 illustrates in graphic form a possible trajectory of analysis (among many others) in which progressive contextualization of environmental management can be achieved. in this example environmental change is identified (Box A), although the problems of doing so in a unequivocal manner have already been discussed in Chapter 2. These changes may lead to economic consequences (Box B), although again, erosion–productivity relationships are notoriously difficult to measure and calibrate (Chapter 2). These changes are caused by specific land (mis)use by land users, and most of Chapter 3 to this point has examined approaches to decision making at the individual and "household" level. The nature of agrarian society (Box E) may be disaggregated into "community" (and CPR issues) and other cultural and socioeconomic issues (such as the "moral economy"). The state is important in both direct and indirect ways in land management, as the World Development Report (World Bank 1991 a, 1992) has recognized and which has been discussed extensively in Chapter 1. Finally, the international economy will have multifarious but pervasive impacts upon the state's ability to fulfill its role in land management and upon farmers directly, through world prices. Also the international scientific community (discussed in Chapter 2) is another important factor.

The implication of making contextualization explicit in this way is un researched blueprints, and proof by isolated example requires a much more pragmatic and flexible approach that leads to contested research.

Consider by way of further example the case of a CPR. Over time, rules have been established that have instituted collective organizations for regulating the commons, partly through the socialized behavior of individuals. But population growth, changing market conditions, environmental fluctuations or change, or the intrusion of outsiders can lead to increased use of the resource, which becomes less productive or degraded. Each of the levels we have identified are represented in these factors. At the local level increased contestation of the rules of CPR use under pressure say, of population growth or environmental stress, can lead to a breakdown of the institutions of collective management. Or increased social differentiation, perhaps associated with commercialization, can lead to domination of collective decision–making so that poorer people are led to reject the normative systems that regulate stinting (decline of the moral economy). Or changes in state policy towards CPRs—allowing commercial exploitation, removing control
local bodies to central agencies—can lead to changing management of the CPR.

This identification of the different levels at which agents can operate brings us back to the element that we considered missing in the model of induced technical and institutional innovation which is characteristic of the present counter-revolution against the populist critique of paternalist conservation strategies. It may well be true that a more efficient path of institutional innovation is promoted by restricting the state to its proper functions, but that process will only come about through the aggregate effects of individuals acting individually and collectively in a political mode. Understanding the problems of resource degradation and conservation requires an understanding of the politics of the case. In the two appendices of this report we present case studies that perceived as having unresolved resource degradation problems that should be addressed, and where the contrasting strategies that have been followed are apparently the result of political constraints. The approaches taken in each case are politically determined, as are the (more or less unsuccessful) ways in which they are implemented and their consequently unsatisfactory outcomes. Each state implements the conservation policy it must, and gets the land degradation it deserves, and changing this situation is inherently political. Thus we argue, somewhat in the same vein as argued by Heyer et al. (1981:13) for rural development, that there is a contradiction at the heart of any approach to environmental conservation, which is that the interests of those who are charged with the processes of resource conservation are in conflict with those who bring about resource degradation, and this conflict is inherent in these activities. Nevertheless it is important that the difficulty, if not impossibility, of reconciling this contradiction should be recognized.

Figure 3.1
Chain of explanation of land degradation (after Blaikie 1989)
4— A Matrix for Land Degradation Research

The previous chapters have set out issues that are recommended to be included in a research agenda on land degradation. They now have to be developed into a coherent research framework. The framework presented here has two objectives. First, it is used as an organizing device to review existing approaches and models in the study of land degradation further, and second, as a dynamic and critical tool to develop a multidisciplinary and holistic research method. The framework addresses the set of contemporary issues that has evolved from the sequence of broad approaches to conservation outlined above. Since the decision making process occurs at a number of different levels (from the individual up to the international), a cross-cutting framework is required, which is presented in the form of a matrix.

The matrix also invites a method that includes the necessity to adapt to pluralist interpretations of land degradation and multiple levels of analysis, which must be nested in each other, and it thus has much in common with Norman Long's recent book *Battlefields of Knowledge* (1992), which has come to our notice since writing. For Long, "the concept of the actor is a social construction rather than simply a synonym for the individual, and ... notions of agency are differently constituted culturally." Furthermore, the interlocking of actor strategies and of individual and collective "projects" generates social forms and commitments that shape future possibilities for action." (Long and Long 1992). The actor-oriented approach stresses the multiple (and competing) interpretations of actors; the fallacies of the insider/outsider, micro/macro and local/scientific knowledge dichotomies; and the need to include researchers in the analysis. It distinguishes itself from action-research (it is not concerned with the design of new intervention programs), from neo-liberal economics ("unpredictable, stochastic, fragmentary and partial" (1992:273)) and from populism, and participation rhetoric.

The first vector (rows) is a decision-making model based upon elements in decision making by resource users when problems of land degradation (as defined by any actor) occur. These elements are: perception, diagnosis, search for solutions, and action. The other vector (columns) identifies different levels of analysis. It directs attention to the individual alone and, successively, in relation to a small group (typically a family, household, residential or extended kinship group), the community, agrarian society, the state, scientific community, and international structures. These levels derive from the discussion of progressive contextualization in section 3.10. It should be noted that a number of alternative levels can be identified in particular circumstances. Nonetheless, is a useful device because it enables variables and parameters to be identified at different levels in the decision-making process, and also the ways that policies can have an impact at different levels (international, national, regional, community, household and groups of individuals within households such as women, female heads of households). This approach is a useful one, since it allows the identification of different causes of non-adoption of technologies that effectively conserve natural resources. These can be seen as non-perception of land degradation (in the way that the scientist has perceived and measured it); misdiagnosis of the problem of the results of degradation (for example, falling crop or livestock yields, increasing salinization of ground water); the lack of effective available technologies suitable for tackling the particular problem; or the lack of material or institutional resources to put suitable technologies into effect. The framework also invites an explanation of why there are a number of rational decision paths in the face of degradation, which do not end up with successful adoption. For example, it may be rational for a poor highland male farmer to decide to search for employment in the city, rather than to attempt to repair gulleys affecting the farm, given his perception of comparative returns to his and (his perception of) those of his wife's labor.

Both elements in the research agenda (represented by vectors) are required in the development of a research framework, and therefore they are combined to form a matrix (see Figure 4.1). Here, it can be seen that the
columns represent the levels at which decisions are made and the rows are stages in the decision-making process. However, examination of the matrix immediately suggests that, while the use of models and research approaches can apply to one cell at a time, it is much more useful to consider blocks of cells together.

In this way relationships between scales of study and/or different elements in the decision-making process can be examined. For example, the perceptions of the natural environment and symptoms of its degradation are formed by individuals in a variety of combinations and levels throughout their lives (cells 1.1...1.5).

Models of behavior involving contracts, their enforcement and moral hazard imply the combination of concerns that hitherto have been considered separately (within single cells in the matrix). Here they can be studied with a combination of cells (e.g., 1.1...8.1 and 1.2...8.2). Community and domestic perceptions may conflict with official ones, and these contradictions often have a long history (cells 1.1...8.1 and 1.2...8.2 with 1.4...8.4). Issues of property rights and land management involve official land law (cell 4.4), aspects of informal property rights situated in agrarian society (cells 4.3 and 5.3) as well as conflicts of private interest and common good (1.1...8.1 and 1.2...8.2).

There is a further vector which, for reasons of brevity, we cannot detail here, and this concerns the range of agro-economic zones, farming systems and broad socioeconomic situation, which should attract research effort. (See Leonard (1989) for applications of different environmental problems.)

<table>
<thead>
<tr>
<th>Levels of Analysis</th>
<th>Local/ domestic (1)</th>
<th>Community (2)</th>
<th>Agrarian society (3)</th>
<th>State/ scientific/ official (4)</th>
<th>International (5)</th>
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<td>1. Perception of symptoms</td>
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<td>2. Diagnosis of causes</td>
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<td>3. Prioritization of needs</td>
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<td>4. Identification of solutions</td>
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<td>5. Assess technical feasibility of solutions</td>
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<td>6. Cost–benefit and risk of solutions</td>
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<td>7. Assess need for collaboration</td>
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Rethinking Research on Land Degradation in Developing Countries
8. Decide about adoption

Figure 4.1
Levels and elements in decision-making

5— Conclusions

The perspectives and applications discussed in this section are points of entry into the analysis of the uncertain, organic, and complex world within which land degradation problems, and strategies to deal with them, occur. The discussion has been primarily abstract and theoretical. This is because we have found that we need a new, or at least a more complete, framework of analysis given the failure of past classic, neo-populist or neo-liberal, approaches to these problems, and particularly the incompleteness of the latter approach based on ideas of institutional and technical innovation.

This paper has described three policy paradigms for combating land degradation and promoting sustainable development. They have primarily been distinguished from each other by their conception of the role of the state. The current approach of the World Bank to promoting sustainable development (World Development Report 1990, 1991, 1992) is heterodox. It draws from the classical approach the claim that technical solutions to land degradation problems either exist, or can be readily produced by existing agricultural research and development institutions. From the neo-populist paradigm it draws notions of empowerment and participation of local people, and the link between poverty and environmental problems; but principally it derives its theoretical basis from what we call the "counter revolutionary" paradigm. This identifies the main problems that beset sustainable development as institutional failure (both at the level of the state and in civil society) and a lack of an appropriate structure of incentives to induce resource users to adopt appropriate conservation technologies. The assumed role of the state in environmental management is both smaller and less intrusive than under the coercive/paternalist paradigm, and must acknowledge the limited power of the state to intervene (and police) environmental policies. Instead, it should rely where possible on market-based instruments with limited roles for state institutions, community institutions, and state organizations only for those residual environmental problems that cannot be dealt with in other ways. The state should set realistic and enforceable standards, and maintain consistent policies.

This paper does not concern itself directly with questions of whether these propositions are true or false but rather the task of research in discovering some answers, although we have given much attention to apparent limitations of this approach. It has drawn attention to a number of unresolved research areas that seem particularly problematic and important to environmental strategy. These include the following:

Conservation technologies may, in certain instances, not be available because they are either technically incapable of reducing degradation, or (more commonly) are inapplicable within existing socioeconomic constraints faced by resource users.

The existence and causes of land degradation is increasingly recognized to be faced with scientific uncertainty. This derives both from technical problems of measurement as well as the realization that scientific information on land degradation reflects its institutional and ideological origins. The aphorism "the institutions are the facts" may be too pessimistic about the objective role of scientific information, but it does illustrate a growing acceptance of the problem that positivist natural science faces. Certainly, in many cases, natural science research has misunderstood the nature of the degradation problem.
The perception, diagnosis and explanation of land degradation is subject to pluralistic interpretations, which may differ as much between different resource users as between those based in indigenous and scientific technical knowledge.

Therefore, international institutions that undertake research and design policies and programs are part of this pluralism—they have views on the state of the environment and attempt to influence the ways in which it is managed—and therefore must be subject to critical research as much as the actions of states, and resource users themselves.

The characterization of the problem of land degradation as "non-adoption" may not be helpful in understanding the success or failure of resource users in practicing sustainable production. Instead it may be more useful to understand why resource users do what they do, and who and how they reach decisions on resource use and environmental management.

The ways in which resource users take decisions in an institutional context (household, village organization, credit or labor union, as well as official agencies such as the police, agricultural extension and land conservation officers) must be understood in a local and applied manner. It cannot be assumed that institutional innovation will take place at a rate that avoids or minimizes degradation; nor can it be assumed that institutions can be implanted and be sustained. Particularly intransigent problems cluster around common-pool resources, since many decisions about their management require collaboration (and thereby imply participation in the process of decision-making itself). The ways in which this may be achieved are far from simple and always involve cultural particularities, which therefore have to be understood through case study research.

A focus upon these research areas, this paper argues, will promote informed debate concerning the hypotheses put forward in recent volumes of the *World Development Report* and will contribute to a more effective monitoring and testing of their policies in a variety of local contexts in practice.

**Policy and the Research Agenda.** The audience for this paper consists of senior policy makers, project managers and researchers in international and national institutions (including research stations and universities). It is a central implication of our argument that the research should be conducted in decentralized locations with the involvement of a wide range of actors who are significant in the bringing about of both institutional and technical innovation. Hence the significance of this research agenda should be effectively marketed to senior personnel in organizations of state and civil society, as well as those involved in future and ongoing projects with conservation components. Therefore, research must be carried out within ongoing environmental programs, and be shown to be applicable to new ones. An additional advantage of not choosing a "green field" research site is access to existing information, and to longer term institutional experience of environmental management at all levels.

As the paper argues, the institutional structure for the production and communication of knowledge about land degradation must remain firmly within the purview of research. Therefore, the research institutions that carry out this research agenda must become both the subject and object of the research. For example, there will be implications of this research for how environmental policies and projects are designed. Fuller participation of resource users and their empowerment through their own input into the evolution of appropriate property rights, amongst other measures, as well as acknowledgment of scientific fallibility, uncertainty and legitimated plurality of perceptions, all should bring about critical reflection upon standard design procedures. Thus, it is important that induced institutional innovation must be allowed to flow from the research suggested here by including in the research effort senior officials, among others, in operational positions of projects and policymaking.
Since the research should be based within ongoing development research initiatives and have a strongly applied focus, it makes sense that a network of researchers be set up, drawn from a number of institutions who are involved in the particular environmental stress points identified in this paper. At the outset, a common agenda for a small number of coordinated case studies should be negotiated by the research teams themselves. It may be advantageous to call the teams together again for a mid–research review in order that the issues and methods can be tested and discussed critically. The input of operational managers in SWC and sustainable agricultural projects and program is important at this stage.

Some of the characteristics of the research field identified in this paper—uncertainty, pluralism, complexity, context, and the need for new institutional forms (that may include readers of this paper) are not attractive. Accuracy, certainty, credible quantification, bold, attractive theories and economic validation: all these are familiar and re–assuring parts of the policy making and of project design environment. Hence, it is understandable that equally familiar objections to this research framework can quickly be located. There is no time to delve into complexity and it is not necessary anyway—both the classic and neo–liberal approaches have answers to complexity that do not involve understanding it. However, it is equally as unattractive a fact that so much of policy, program and project initiatives in environmental management have been disappointing. Passive disillusion must face the growing realization of the global dimensions of land degradation. Therefore there are grounds for a comprehensive rethinking of land degradation and conservation that reaches to wider issues of the roles of the state, of science and technology, and of development agencies themselves.

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Appendix 1—
Land Degradation in Nepal
The Argument for a Case Study of Nepal

Nepal has attracted a great deal of research on sustainable agriculture and on environmental degradation. It is widely recognized that there are serious problems, both social and environmental. A nexus of different problems, which include poverty, population growth, land degradation and low agricultural productivity, is agreed upon, although the direction and strength of causality are disputed. The complex nature of these problems, the variety of interventions to solve them, and the generally unsuccessful outcomes have attracted attention to the conduct of development policy itself. Thus Nepal has become a paradigmatic case where the commitment of skills, technology, physical and social infrastructure, training programs, research of all kinds, and integrated rural development projects have occurred—but with, on the whole, disappointing impacts. Specifically, the roles of scientific research and development institutions in the context of the Himalayas have been called to task. This welter of development activity and constant reappraisal has added to rather than inhibited new interpretations and prescriptions. The World Bank and FAO have both produced sustained analyses of the nexus of problems and what should be done about it. Why then, should yet another research study be proposed? The answers to this question are as follows:

1. The paradox itself, that there has been so much research and development effort without appearing to significantly mitigate, let alone "solve" the main diagnosed problems, is a reason for research to explain it. This research will throw fight on the institutional framework for research and development and its relationship with policy formulation and implementation. The often—quoted but ill—understood "problems of implementation" will also receive overdue scrutiny in this proposed research.

2. There has been virtually no attempt to adapt policy and project formulation to the now well—known uncertainties surrounding land degradation. What constitute acceptable errors in information on which policy and projects are based? What are the risks of accepting estimates about certain facts that may be incorrect by a factor of 100 percent? When does this matter? Research on selected projects in the area of sustainable agriculture and SWC should be able to clarify when uncertainty over facts matters.

3. There is an enormous variety of different interventions into SWC and sustainable agriculture. There has been no all—Nepal review of experiences and of different interfaces between these institutions (NGOs, local and foreign; bilateral aid; charities, large, small, long—term, participatory, top—down, multisectoral, single sector, and so on). Most project reviews and evaluations make sad but informative reading. In terms of the methodology outlined in this paper, a review of the interface of local and community decisionmaking with that of outside institutions should be a priority.

Science and Technology

More Research, Less Certainty

Nepal has received a great deal of foreign aid over the past thirty years. At present over 90 percent of the country's development budget is provided from this source. There are literally hundreds of projects, ranging from IRDPs covering the whole country to NGOs assisting in a few panchayats. Along with Bangladesh and (until recently) the Sudan, Nepal receives one of the highest per caput allocations of aid in the world. There are a number of reasons for this, but the main one is the perceived size and acuteness of the problems faced by the country. It is one of the poorest countries in the world, and the problem of poverty has been identified as a key factor in continuing high growth of population and environmental degradation. However, there is another interesting paradox. In spite of the large and growing volume of scientific research into these problems, confidence that the problems can be clearly identified has ebbed over the past five years or so, not risen.
Two Problems Identified: Soil Erosion and Declining Soil Fertility

During the period from about 1960 to the early 1980s, the main problems identified scientific research were accelerated erosion in the Middle Hills caused by deforestation (with increased downstream flooding and siltation in the Gangetic plain), and poor and declining yields of the major staple crops. These two major concerns, as identified by a variety of outside agencies are discussed in turn.

The issue of accelerated erosion was developed from a number of studies and impressionistic writings, which claimed that Nepal would slide away into the Ganges by the year 2000 (Eckholm 1976), and that the Nepalese hill farmer was to blame for this situation. Rapid population growth with a declining resource base and a static technology were identified as the major socioeconomic causes of accelerated erosion in the hills. Specifically, deforestation, faulty design of terraces (especially dryland or pakho terraces) and overgrazing of pastures by large numbers of cattle were seen to be the main features of land (mis)management. Several policy implications flowed from this diagnosis. Attempts to control deforestation were made by the state through an ill−advised nationalization of forest land, and a variety of soil and water conservation and watershed management projects were established, which addressed themselves to the problems of forest management and agricultural practices on private land. (Even at the present time there are over sixty projects, that include reafforestation as part of their objectives, and over thirty that include soil and water conservation.) Needless to say, Nepalese farmers themselves seldom identified their main problem as soil erosion, and many project managers found themselves having to de−emphasize SWC objectives, or to trade the provision of other infrastructure (e.g., drinking water supplies, a suspension bridge or school building) in return for participation in SWC activities.

Recent Changes of View of Land Degradation

An abrupt volte face in the perception of the problem occurred as the result of three strands of research. The first claimed that the rate of geological erosion (i.e., natural, and not accelerated by human activities) was far more significant than previously thought, and that the very high sediment loads measured in some Himalayan rivers (Starkel 1972, Williams 1977) was due to active incision by rivers caused by rapid orogenic uplift. Thus, the contribution of accelerated erosion (caused by the land−use practices described above) to soil erosion and particularly sediment load had probably been over−estimated. Mass wasting at the sites of rapid down−cutting were now realized to be the major contributor to soil loss and export from the watershed (Carson 1985, Ramsay 1985). The accelerated soil loss from grazing land and highly degraded forest were, however, recognized, and Carson still concludes that:

"The decline in soil fertility through topsoil erosion is one of the major ecological crises facing Nepal today and it is in this area that soil conservation programs have an important role to play" (Carson 1985: 7).

A study by FAO (1980) was rather less emphatic on the seriousness of the rate of accelerated erosion, and classified only 3 percent of the land surface as in poor or very poor condition, although the map prepared by Panth et al. (1984) shows twelve districts in poor or very poor condition (out of a total of seventy−five). However, those landslips that had been recorded on arable land in the micro−catchments studied had mostly been repaired within three of four years (Caine and Mool 1982, Keinholz et al. 1983, Brookfield 1984).

This brings us to the second strand of research and concerns indigenous methods of SWC. Previous criticism of these methods (e.g., the Asian Development Bank 1982) gave way to a genuine inquiry into understanding why farmers do what they do, and whether they were, in fact, applying the most appropriate technology. For example, the outward sloping unbunded terraces used for dryland cultivation of maize and finger millet were criticized severely and inward sloping terraces urged. A project that managed to get farmers to convert the former to the latter design suffered the indignity of the whole flight of terraces collapsing under the weight of water a few weeks after the onset of the monsoon. Nonetheless, Magrath and Doolette (1990) also state that for Asia in
general, terrace technology, although well understood, is often poorly applied. Certainly, terrace improvement activities constitute an element in a number of projects at the present time, but in two cases at least only involve the levelling of existing khet paddy terraces in order to distribute water better, and not the radical redesign of terrace type. Detailed applied research from experimental stations and agricultural centers (e.g., Lumle and Pakhrribas Agricultural Centers) has produced ample evidence of how indigenous technology had incorporated SWC into complex production strategies. Terrace−back tree planting, varied terrace design, variation of planting densities of maize, and relay cropping are a few examples (see Whiteman 1982, 1988 for an agronomic perspective). Strategies of coping with soil slips (Johnson et al. 1982) are now seen to be sophisticated and reflect the farmer's resources of labor and land. A number of studies also identified the importance of access to resources in explaining production strategies and the degree to which they were sustainable (Blaikie, Cameron and Seddon 1979, 1980).

The last strand of research that brought a reappraisal of the causes and extent of land degradation concerned the historical analysis of land−use changes, particularly involving the conversion of forest to arable land. Most reviewers have assumed that forest clearance has been a recent phenomenon. For example, Claiborn (1983) cites a National Planning Commission estimate that from 1960 to 1980, forest cover decreased from 60 percent to 19 percent. Other commentators (e.g., Karan and Iijima 1985) have compiled similar statistics. However, detailed study of historical records, at least in central Nepal, has suggested that most of the forests in the hills were converted from forest to arable land before 1960, and this trend was encouraged by the feudal state at the time (Mahat 1985, Gilmour 1988, Metz 1991). Also, comparison of aerial photographs taken in 19645 and 19789 was undertaken by Nield (1985) showed conclusively that the forests of the high and middle mountains have retained both their areal extent and crown density, but that the forest in the terai and the outer (Siwalik) hills had been extensively cut during this period (quoted in Metz 1991). Of course, the term "deforestation" is ambiguous and the issues of crown density and removal of forest litter as major determinants of accelerated erosion are crucial here. The relationships between crown density and rates of erosion are still not well calibrated in the Nepalese context (O'Loughlin and Zeiner 1982). There has been a number of studies of the change in crown density of the forest, which have produced mixed results (e.g., Thapa et al. 1991 in the Pokhara Valley). However, it seems that, while the areal extent of forest may not have been substantially reduced in many areas (indeed it may have increased in some Sherpa areas over the past 30 years), litter collection and thinning has probably occurred. Gilmour (1988) estimates a 15 percent loss of crown cover in upland forests over the 14 year period. This may have increased erosion, while the role of removal of forest litter is still not well researched under Nepalese conditions. Gilmour et al. (1987) report that, although deforestation has increased compaction of the soil and decreased infiltration capacity, the intensity of the vast majority of rainfall events in the hills does not exceed the surface infiltration rate, with the result that very little overland flow is predicted for deforested sites. The authors conclude that the these data refute the contention that deforestation causes an increase in large−scale flooding and on−site erosion. It is probably true to say there are still unresolved controversies regarding the role of forests in modifying the impact of extreme rainfall events with a return period of fifteen years or more. Carson, (1985:11) discusses a number of such events, and cites one village, for example, where exceptional rainfall in 1934 and 1971 had been responsible for landslides, that were still visible, although no slides had occurred since the 1971 monsoon. The impact of deforestation on such events as these,, which are now acknowledged to be very significant, is still in doubt.

Low and Declining Yields

The second technical issue identified as a major problem in the Nepalese hills is the low and declining yields of staples. It is an important problem in the overall issue of sustainable agriculture, and the lessons to be learnt here are similar to those of land degradation. The issue of the decline in yields may, of course, be related to land degradation, although it has to be proved that average yields per unit area have not declined due to the extension of arable land onto more marginal and infertile land or lower input use, or other changes in crop husbandry. However, there are fairly reliable time−series data, that indicate the decline in yields (Table A1.1).
Most attempts to raise yields of the major staples (paddy, wheat and maize) were based on simple technology transfers from plant breeding stations outside Nepal (e.g., in the case of maize varieties from Mexico, via India to the Nepalese hills). For maize and paddy, it is true to say that these efforts have seldom been successful in the hills and mountains (Smith 1987) with a few exceptions in the case of maize (e.g., Arun and Janaki Seto). Improved wheat, however, has been adopted over most areas, with the exception of very harsh and infertile conditions. The main reason that many varieties were not successful was that many were developed in research and plant breeding stations in the terai, and have not been suitable for most planting situations in the hills. There remains the problems of extreme site specificity (altitude, orientation and declivity of slope, fertility and water availability), and differential access of farmers to resources, particularly imported inorganic and locally-derived nutrients. It is common for farmers to need to maintain varietal diversity in order to respond to site-specific constraints and opportunities. There is also evidence that outside agencies have recognized that farmers themselves experiment with different varieties and often exchange or purchase varieties (pokhareli masino paddy (Green 1987), or red winter wheat (Biggs and Rood 1986).

Some of the implications for science and technology applied to the enhancement of crop yields are similar to those for SWC. They are that it is necessary to understand the ecological and socioeconomic circumstances of the farmer and, that with site specificity being so marked in Nepal, generalized and universal blueprints will fail.

Remaining Debates

However, it would be incorrect to claim that one truth has been superseded by another. There still remains much uncertainty about "the problem" of the Himalayan region, and the recent publication of the output of The Mohonk Conference (1987) convened to discuss it, attests to the extreme complexity of the problems, their spatial variability, and the variety of problem definitions. Thompson and Warburton (1987) in a book aptly titled Uncertainty on a Himalayan Scale have questioned the entire scientific basis on which interventions have been planned, and draw similar conclusions to those in this report. Very briefly, they maintain that data, that are acceptable or accurate are so difficult to obtain that the conventional expectations of positivist science are almost bound to be disappointed.

The apocryphal example given is the situation in which the lowest and highest estimate for faelwood consumption in Nepal differs by a factor of 67. Further, the facts available are so obscure that it is perhaps better not to ask the question "what are the facts?" but "what do you want the facts to be?". They develop the argument that the institutions are the facts, a view that the authors of this report find much sympathy with, and is also reflected in the case study on Zimbabwe. They conclude that it is preferable to "context" every scientific fact, allow for a plurality of problem definitions, and to build into the development of solutions the possibility for the development of institutional structures, that are able to define the problem for themselves, and provide the opportunities for solving it.

Table A1.1. Nepal: Annual growth rate of cereal crop area, production and yield by region, 1970/71−1980/81

<table>
<thead>
<tr>
<th>Cereal Crop/ growth segment</th>
<th>Hills %</th>
<th>t−val</th>
<th>Terai %</th>
<th>t−val</th>
<th>Total Nepal %</th>
<th>t−val</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy Area</td>
<td>1.98</td>
<td>8.93</td>
<td>0.71</td>
<td>2.96</td>
<td>0.93</td>
<td>4.10</td>
</tr>
<tr>
<td></td>
<td>Production</td>
<td>Yield</td>
<td>Maize</td>
<td>Production</td>
<td>Yield</td>
<td>Wheat</td>
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<tr>
<td></td>
<td>0.72</td>
<td>-1.24</td>
<td>0.72</td>
<td>0.73</td>
<td>0.02</td>
<td>-1.14</td>
</tr>
<tr>
<td></td>
<td>1.45</td>
<td>-3.25</td>
<td>4.94</td>
<td>-0.86</td>
<td>-3.99</td>
<td>-2.30</td>
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<tr>
<td></td>
<td>0.73</td>
<td>0.02</td>
<td>-0.86</td>
<td>-1.11</td>
<td>-1.06</td>
<td>-1.14</td>
</tr>
<tr>
<td></td>
<td>0.87</td>
<td>-0.20</td>
<td>-3.99</td>
<td>-0.20</td>
<td>-1.19</td>
<td>-2.62</td>
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<tr>
<td></td>
<td>0.73</td>
<td>0.39</td>
<td>0.24</td>
<td>0.39</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>Maize</td>
<td></td>
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<tr>
<td>Wheat</td>
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<tr>
<td>Barley</td>
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<tr>
<td>Millet</td>
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<tr>
<td>Total Cereals</td>
<td></td>
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</tbody>
</table>

Source: Magrath and Doolette (19904).

A review of the detailed field notes and working papers of agricultural centers and field stations shows, as well as do such comprehensive studies as IN (Bergret & Petit 1986) that development practitioners are also wrestling with these problems of complexity, limited production opportunities and the futility of universal solutions. The institutional response by development agencies has been instructive. In a number of agricultural centers and projects, long field visits ("treks") have been initiated in which scientists have entered into long−term dialogue with farmers based on participatory data collection (Chambers et al. 1989, Mathema and Galt 1989). The data therefore grow out of the institutional and agroecological context and the "science" and technology it produces are the result of a partnership between scientist and (scientific) farmer. Quite often, the outside agency takes the role of adopting farmers' recommendations and passing them on to other farmers. Ongoing contacts between farmers and development agency too have developed beyond the "client−orientated" farming systems approach, which has now become the new conventional wisdom. In one project (Tinau Watershed management Project), the scientist becomes a type of consultant to an identified team of households, which includes all those who use natural resources (women and adolescents) and not just the (usually male) "head of household." The scientist then provides a technical service to solve the problems defined by the team itself. The extension approach adopted at
the Pakhribas and Lumle Agricultural Centers uses the *Samuhik Bhraman* ("travelling together") approach, in which interdisciplinary specialists initiate lengthy dialogue with farmers from the problem identification phase, through trials and problem solving. However, such initiatives are rare. A recent FAO report states bluntly:

"Scientists are often unwilling to share responsibility with farmers or even acknowledge that they can learn from current farmer practice. They are often unwilling to merge their discipline–based departmental mandates to implement team–based multidisciplinary programs." (FAO 1991: 24)

This report also discusses a perennial dilemma faced by such centers as Lumle and Pakhribas. They among others have pursued what might be termed a populist approach to agricultural development, based broadly upon farming systems research. The most successful in increasing local people's welfare have been the most independent of HMG, Nepal. They have been resourced at a much higher level than the regular programs of HMG, and it is just these programs that may not be sustainable after donor assistance is terminated. Furthermore, it is possible that these programs actually underdevelop the capability of HMG to train and retain personnel and to formulate coherent and long–term policies on their own. Whatever the truth is in this often–made assertion, two points need to be made. The first is that the ability and willingness of the Nepalese government to intervene in the development of agricultural technology (and in the regulation of the use of natural resources) unaided by donors must be open to doubt. The second is that such institutional adaptations to complexity such as participatory data collection and detailed site and farmer group–specific development work on the part of outside agencies are very skill–intensive, slow and expensive.

**Structure and Action**

**Historical Context**

In order to understand the contemporary relationship between the state of the environment and the actions of resource users, a brief account of the historical context from the beginning of the twentieth century is necessary. One of the main structural precursors of the agrarian society in contemporary Nepal was the "feudal" state, which pursued revenue extraction of characteristic style (land tax on cleared land, thereby encouraging forest clearance), mineral refining (causing further forest clearance in some areas), and labor tax to finance war and luxuries for the aristocracy (Stiller 1975, Regmi 1972, 1978). Slavery also existed until it was abolished in 1926, not for any discernible liberal sentiments, but because population growth rendered escape by slaves into the forest ineffective. The political struggle for an alternative form of government and a reduction in the onerous feudal exaction of labor and taxation has been muted, and mainly carried on by urban populations rather than rural. Recently multipart democracy has been instituted, but it is difficult to see any direct policy reform in the countryside (e.g., an effective land reform or reform of the tax structure), although the reasons are not relevant in this context.

**The Emergence of the Failure to Self–Provision**

Under these circumstances the Nepalese peasantry in the hills were part of a coercive political economy in which survival and the provision of labor and cash rents were the main economic objectives. Both were sought through agriculture and non– agricultural income opportunities, particularly military service as mercenaries, although the latter was only available to limited ethnic groups. The economic advantage of having a large family can only be inferred, although there are accounts of conscious means to reduce population growth through late marriage (Macfarlane 1976). At some time in the early–mid–twentieth century, the existing agricultural technology and patterns of land availability began to be unable to provide the circumstances in which certain people in the hills could secure their livelihoods (Hrabovsky and Miyan 1987). The timing and severity of the onset of this crisis varied greatly, of course, with location, farming system and socioeconomic group. The basic problem arose from an extension of agriculture onto increasingly marginal land for cereal cultivation to meet increased subsistence needs. The nutrients required for the cultivation of crops were (and predominantly still are) obtained from natural
sources—either from natural regeneration in shifting cultivation, or from the transfer of fertility from public lands (grazing lands and the forest) to private arable land. This was effected by the collection of forest litter, lopping trees and application to the fields, and/or the feeding of these products to livestock, the compost from which likewise was applied to cropped land. As long as the forest was accessible and productive enough this source of nutrients sufficed. Clearly there came a point where the degradation of the forest (even if not its complete removal) caused local shortfalls in this essential nutrient supply, and other strategies had to be sought. It is likely that drylands (pakho) suffered first, as irrigated land (khet), on which paddy was grown, reaches a stable equilibrium of low yields without the importation of outside nutrients. Certainly the yields of maize and finger millet are declining faster than those of paddy (Magrath and Doolette 1990). It is also likely that villages at lower elevations lost access to forests first and, certainly today, such villages only derive about 14 percent of their fodder and 36 percent of their fuelwood from the forest. Villages at higher elevations usually have better access to forests and obtain much higher proportions of these needs from the forest (Wiart and Dobremez 1986, Metz 1991). They also have not adapted to such severe shortages, which are usually more marked downslope, and so private tree planting, stall feeding of livestock, reduction in the number of livestock and other strategies are less commonly found here.

**Adaptation and Feedback in the Agrarian Economy**

The main methods employed by farmers to palliate this problem of an increasing failure to self-provision can be identified under four main headings (by Jodha 1989). They are:

1. diversification of sources of income, both from the farming/pastoral base, and from non-agricultural sources;

2. the application of folk agronomy to find and develop new agroecological niches by new cultivation practices and the introduction of new crops and new crop combinations;

3. the development of economic linkages between uplands and lowlands by the sale of goods (through petty commodity production), seasonal migration for agricultural employment the terai and India; and

4. the management of public lands by communal action so as to restrict extraction of resources from it in a sustainable manner.

These new activities form part of a livelihood strategy for different households and collectively represent longer term changes in the farming systems. They can be understood in relation to the socioeconomic characteristics of the rural population as a whole. Table A1.2 (Blaikie, Cameron and Seddon 1979) is a snapshot of the Nepalese peasantry as a whole, classified by means of (i) and (iii) above.

Thus it is argued from Table A1.2 that the great majority of rural households are those that engage in petty commodity production on a small scale and rely heavily on non-agricultural income. Note also that there is a negative correlation between the presence of non-agricultural income and the volume of sales of agricultural produce. These are the two main alternative ways of raising cash for essential items, that cannot be produced by the household itself.

**Non-Agricultural Income and Petty Commodity Production**

The major elements in household strategies for earning a livelihood can be identified in an analysis of household budgets of hill farmers (Seddon, Blaikie and Cameron 1979). It is quite clear from this analysis that the vast majority of households seek to balance their budget by means of either the securing of non-agricultural income (which is scarce, and demands quite stringent access qualifications) or by petty commodity production based on...
agricultural and artisanal production. Cash derived therefrom is used to purchase household items, that cannot be produced by the household itself (including making good shortfalls in grain production).

Table A1.2. Non–agricultural income and petty commodity production in rural households in Nepal

<table>
<thead>
<tr>
<th>Sales of Farm Produce</th>
<th>Wage Laboring + Domestic Producers</th>
<th>Wage Laboring</th>
<th>Domestic Producers</th>
<th>Small Employers</th>
<th>Large Employers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Witha Without</td>
<td>With Without</td>
<td>With</td>
<td>Without</td>
<td>With Without</td>
<td>With Without</td>
</tr>
<tr>
<td>&lt;250 Rs</td>
<td>44 68</td>
<td>24 39</td>
<td>103 12</td>
<td>9 1</td>
<td>4 0</td>
<td>304 0</td>
</tr>
<tr>
<td>250499 Rs</td>
<td>2 5</td>
<td>9 15</td>
<td>26 10</td>
<td>3 1</td>
<td>0 1</td>
<td>71 0</td>
</tr>
<tr>
<td>500749 Rs</td>
<td>0 7</td>
<td>2 8</td>
<td>14 12</td>
<td>3 1</td>
<td>1 0</td>
<td>48 0</td>
</tr>
<tr>
<td>750999 Rs</td>
<td>0 04</td>
<td>0 7</td>
<td>16 21</td>
<td>4 4</td>
<td>0 0</td>
<td>56 0</td>
</tr>
<tr>
<td>10001999 Rs</td>
<td>2 5</td>
<td>3 7</td>
<td>19 29</td>
<td>7 7</td>
<td>3 1</td>
<td>83 0</td>
</tr>
<tr>
<td>20005000 Rs</td>
<td>0 1</td>
<td>0 5</td>
<td>8 17</td>
<td>9 20</td>
<td>4 9</td>
<td>73 0</td>
</tr>
<tr>
<td>&gt;5000 Rs</td>
<td>0 0</td>
<td>0 0</td>
<td>0 2</td>
<td>4 4</td>
<td>4 11</td>
<td>25 0</td>
</tr>
<tr>
<td></td>
<td>48 90</td>
<td>38 81</td>
<td>186 103</td>
<td>39 38</td>
<td>18 21</td>
<td>660 0</td>
</tr>
</tbody>
</table>

/ With = with non–farm income

Source: Seddon, Blaikie and Cameron 1980.

did not have access to non–agricultural income and who had inadequate land holdings to self–provision). Likewise ginger, another regionally important export, requires imported nutrients, usually leaf mulch also gathered from the forest. Bamboo products (baskets, screens, etc) require increased use of the forest, and so on.

Also, there are severe constraints to finding a market for these products. Internal markets are limited since there is only a small non–agricultural population and the majority of rural households grow or manufacture most of their requirements. Exports to India have to compete with other producers there who are situated nearer to the point of sale and consumption, and often with lower production costs (e.g., Indian oranges competing with Nepalese tangerines). All of these developments in petty commodity production are rapidly confronted with the familiar constraints of hill economies—inaccessibility, ecological fragility and marginality.

Viewed in this light, Table A1.2 can also be used to trace probable future changes in the agrarian political economy of the hills. Given present population growth and the constraints discussed above, it is likely that there will be a drift of the numbers of households in the cells situated in the center and lower right of the matrix to the top left (creating a growing category of part–time and sub–marginal farmers). Thus in the future it will be the landless and those without access to off–farm income whose entitlements to adequate food will be jeopardized. Also there is an important gender aspect of inequality and poverty. Acharya and Bennett (1983) identified that women take a very large share in domestic as well as agricultural production. Their earnings are substantially below those of men, and they have a minor decisionmaking role in allocative decisions in agriculture, although they work almost twice as long as men in agricultural tasks (World Bank 1990b, Shrestha 1984). While there are
important differences in women's status between Hindu and Tibeto—Burman groups (in the latter status being less unequal), their security of income is almost always inferior to that of men, and particularly so in poor households. They work harder, probably have higher calorific requirements, suffer more illness as a result of frequent childbirth and have less access to medical care. Yet almost all the political power and allocative decisions from the Palace to the village will be made by men. Agricultural extension is carried out by men, who address the (usually male) head of household, and committees, that manage forest resources are made up of men, in spite of the fact that it is women who spend by far the longest time actually using them.

For the future of agrarian society in the Nepalese hills as a whole, the World Bank (1991b) Country Study of Nepal comes to broadly similar conclusions. Projections of population growth, which is currently running at an estimated 2.7 percent p.a., indicate that population may be set to double by 2020. Without significant scope for labor absorption in the formal sector, and only moderate scope in the service sector, the growing population faces an agricultural land base, that is rapidly approaching saturation. The somber conclusion is that "there is no easy poverty alleviation strategy for Nepal" (World Bank 1991b, p.xiii). The thrust of two of the major recommendations that follow this diagnosis are:— urgent investment in family welfare and planning and in those improvements in health, education and nutrition (particularly for women) that will reduce population growth quickest, and agricultural programs that concentrate on small farmers, non—purchased inputs and labor absorption into agriculture and food—for—work programs.

**Migration**

There is a final strategy to cope with the increasingly severe constraints faced by farmers in the hills, and this is out—migration. This can take the form of seasonal migration, often to the terai to seek agricultural laboring employment; absence from the hill household in mercenary armies for five, ten or more years; to the sale of land in the hills and repurchase of land in the terai . Usually this involves young males, but some groups (e.g., the Thakalis) involve members of both sexes, or even just women (Acharya and Bennett 1983). One of the implications of this strategy is a lack of labor at peak agricultural seasons, in emergencies to patch up landslips, and to invest in or maintain soil and water conservation works. It is reported that, near Pokhara, out—migration of Gurungs to the army and urban occupations has led to a neglect of terraces on their land and to local but serious accelerated erosion (Thapa, pers. comm.). How far this is generalizable is difficult to gauge, and the issue of labor shortages to maintain terraces should be included in the research agenda. Migration as a coping strategy is recognized by the World Bank (1990:44), and it implicit elsewhere in this report and in World Bank (1991b) that greater involvement in the Indian economy will be an inevitable safety valve for many hill households in the future, albeit a strategy that staves off desperate poverty, rather than contributing to structural conditions that will alleviate it.

**Some Examples of Agronomic Adaptation**

The patterning of agronomic adaptations by farmers in the Nepalese hills is extraordinarily varied across micro—locations and households, each with different access to resources. A few illustrative examples of each type of variation are given below.

**Example 1:** The introduction of wheat onto khet land, where moisture conditions in winter allow. Sometimes at altitudes of up to 1000m and in fields with an all—year water supply, wheat is sown without tillage into the ripened but unharvested paddy crop, allowing a third crop of quick maturing paddy to be added to the crop rotation. This intensification creates acute problems for nutrient supply, which can only be met by purchase of inorganic fertilizer. There has been widespread discontinuation of wheat on khet land for this reason. Nonetheless, cropping intensity in Nepal as a whole has increased from 108 percent in 1965/66 to 166 percent in 1985/6 (Hrabovsky and Miyan 1987).
Example 2: The planting of fodder and fuelwood trees on terrace backs. The difficulties of obtaining fodder and fuel from public lands have encouraged farmers to plant seedlings on their private lands. The problem of the resulting competition for moisture, sunlight and soil nutrients between trees and cereal crops, in a situation of growing land shortage has been mitigated by planting the trees on land between ploughed strips of land and by lopping and pruning. Planting is concentrated in those area most affected by deforestation, particularly in areas near the larger towns, where cutting and sale of wood has been concentrated and in other localities where complete clearance of the forest had resulted from small-scale copper mining and smelting earlier on this century, as described by Mahat et al. (1986) for central Nepal, and Blaikie, Cameron and Seddon (1980) for west–central Nepal.

Example 3: Strong covariance between caste (jat), wealth and access to more productive land in the hills (White 1987). The Bahun and Chhetri castes have historically settled the lower lands and were instrumental in introducing paddy culture to Nepal. Today these castes still tend to occupy the valley floors and own more irrigated land than the occupational castes or the hill tribes (Rai, Limbu, Tamang, Magar and Gurung), and have also developed favored access to and investment in education. The result is a familiar pattern in which it is the farmer better endowed with capital, cash to employ hired labor, and with more irrigable land, who responds to extension advice, and can afford to risk new varieties and purchase the necessary fertilizer. It is acknowledged that incomes earned by households living in valley floors is both presently and potentially far greater than those earned by households on hill slopes (Blaikie et al. 1980, World Bank 1991b: 59.). Detailed household budgets of the categories of rural households (both for valley floor and hill slope) shown in Table A1.2 (in Seddon, Blaikie and Cameron 1980) demonstrate clearly the very small amounts of cash expended on the purchase of improved seed, pesticide and fertilizer in virtually all sub–groups in the laboring, domestic/laboring and domestic categories. There have been a number of calls for acknowledging and planning for such differential access to resources in all sustainable agriculture programs (Ives et al. 1986, Jodha 1989).

Institutional Change

The above examples illustrate the technical adaptations farmers have been making in response to population growth without the development of a market–orientated agriculture, and they have reflected their differential access to resources at the household level and at the level of the farming system. However, there have also been institutional adaptations to cope with the growing scarcity of public resources. Although there are few detailed data on the history of common–property resource–management institutions, we do know that these existed in many localities by the 1950s, and had probably been in existence long before then (Gilmour et al. 1984, Arnold and Campbell 1986, Messerschmidt 1986). Increasing scarcity of forest products had prompted many villages to evolve such institutions, which in some cases (e.g., in Sherpa communities) developed sophisticated rules for forest management. However, the nationalization of forests in 1957 created enormous uncertainty for these institutions and undermined the mutual assurance required to implement communal management. Local people felt that government officials would give felling rights to contractors, and thereby destroy an essential community resource. Nor were they wrong in some instances. Nationalization also made virtually all farmers law breakers and trespassers and subject to arrest. In turn this led to the appearance of the "green apple syndrome," and a drastic foreshortening of users' time preferences for resource use and management. Compliance with community rules was withdrawn, and the forests became de facto an open–access resource. They were reported to have been used in a non–sustainable manner as a direct result. (A curious contradiction occurs between accounts of the outcomes of the nationalization of the forests (rapid deforestation) and historical accounts of deforestation (quoted above), which have recently stressed that there has not been marked reduction in the forest area since the 1960s). However, the state found itself unable to regulate the forests and a high degree of local discretion by forest officers gave rise to rent–seeking behavior and a further loss of a sense of mutual assurance (Bajracharya 1983, Messerschmidt 1986). During the 1970s the government opened up the possibility of private encroachment of forests by registering all private land. Many more powerful members of the...
community were able to register large tracts of forest in their names through various means. It was not until mid–
1970s that the government finally recognized that its abrogation of communal rights in the name of the state and
later of private property had greatly contributed to the degradation of the forest. It reformed its previous
legislation over a period of years, and guaranteed panchayats and lessees control over the produce of certain
forest lands. Not surprisingly, the common–property–resource management institutions had fallen into disuse, and
the technical and political resource that they represented had decayed. Nonetheless, various social forestry
projects have been able to resuscitate these resources by the formation of panchayat forest committees or similar
institutions. The Nepal–Australia Forestry Project and other projects financed by the World Bank, for example,
appear to have enjoyed a certain degree of success.

Institutional adaptations by government and other development agencies have been framed by a complex set of
contradictions, mostly framed by conflicting objectives both between HMG and outside agencies and between
different interest groups within either set. As Section 1 claimed, SWC policy (and any other policy) is not a matter
merely of announcing a new set of ideas, that promotes current international thinking, but has to be negotiated or
(more realistically, filtered) through the contradictory and multifarious interests of national governments. Perhaps
nowhere in the world with the possible exception of the Sudan and Bangladesh are those confusions so clearly
identifiable as in the contemporary history of Nepal. The Nepalese state itself has struggled to modernize itself
and leave behind its feudal origins, which historically served a landowning aristocracy through the extraction and
realization of labor rents, minerals and forest products. As training programs and universal primary education
have developed, a cadre of technically trained and modernizing bureaucrats and policy makers have emerged.
Other momentous political events over the past few years have further challenged the old order, although it is still
not clear to what extent multi–party democracy can develop popularly based institutions, that can start to tackle
the issues of poverty, the emancipation of extremely poor and oppressed sections of the population (lower castes,
women, and the landless/near landless). Nor is clear that it has the trained (and adequately paid) personnel nor the
local legitimacy to regulate the use of natural resources in the manner repeatedly recommended in policy and
project documents.

Set against this are a myriad of development agencies, often mutually competing for political patronage from
HMG in order to secure agreement, and separated from others in their own conception of Nepal's development
problems, their development theories and immediate objectives. HMG struggles to channel prospective donors to
provide inputs and assistance within their five–year development plans, while representatives from donor projects
attempt to secure approval by the Planning Commission at any cost—and to a tight schedule. The National
Development Plans themselves are part mobilization exercises, part the construction of a planning rhetoric to
attract foreign donors, and part the rational effort of the new Nepalese technocracy to come to grips with the
development problems that face their country. However, the Plans must rely on foreign expertise and funding
(over 90 percent of Nepal's development budget is financed from sources outside the country), and their agenda
differs from those of donors. This is in contrast with the state of affairs in Zimbabwe, where only 8 percent of its
development budget is financed from external sources. This gives Zimbabwe a very much greater opportunity to
frame its own development plans in general and natural resource policy in particular. In the case of Nepal, the
more powerful agencies can afford to publish reasoned
critiques of the shortcomings of government (e.g., FAO (1991) commits an entire annex to the problems faced in
project implementation), but other smaller agencies negotiate as best they can. The implementation of successive
Plans has therefore fallen far short of targets and there is widespread agreement that most foreign–financed
projects have failed in reaching their stated objectives.

Has there been any institutional innovation at the level of government or outside agency over the past 20 years,
which has responded to political or economic signals from the clients of such policies and projects? Some
long–term projects with a history of at least 15 years have adapted to the provision of the needs of the rural
population. Short–term consultancies have been abandoned in favor of longer contracts and a fluency in Nepali
or other ethnic languages. Longer term flexible planning with rolling targets has been substituted for blueprints, and attempts have been made to "institutionalize" these interventions by training programs for Nepalese counterparts, when these have been forthcoming. These, it probably true to say, are still in the minority, although hard evidence is difficult to come by, and remains a pressing research question. In terms of Nepalese institutions, which will survive the withdrawal of foreign expertise, and must await adequate salaries and infrastructural support, the question is still more difficult to answer. Almost every policy document calls for these (e.g., The National Conservation Strategy for Nepal 1988, World Bank 1979, 1990 (pp. 104f), FAO 1991, the Master Plan for the Forestry Sector, Nepal (1988, pp. 123f), to name a few). There are some encouraging early signs, for example the First Local Workshop on Environmental Planning, Lamjung 1990, and isolated examples provided by Thompson and Warburton (1987). Formal attempts to decentralize planning to regional and district level have taken place, but without participative and democratic local institutions and real powers to allocate resources at the district level and below, this initiative has still to make an impact. Local management committees for forestry, small irrigation projects and integrated resource management have been revived in isolated, though not insignificant examples. However, the problems of local vested interests (focused overwhelmingly on land ownership and other correlated variables such as gender and caste) have remained in place (Local Environmental Planning in Nepal 1990:4), and are connived with by the center.

Conclusion

Adaptation, Compliance and Struggle

The above account of land degradation and conservation in Nepal has illustrated the extent and impact of scientific uncertainties upon official interventions, and how an increasing volume of research has led to increasing controversy about the future direction policy should pursue. It also shows the complex responses Nepalese farmers themselves have made, and how these through time, have helped to shape their present social and natural environment. Specifically, it shows that the major action set of Nepalese farmers in the hills was and is adaptation rather than compliance and confrontation as in the other case study of Zimbabwe. This is so because the question of access to land in Nepal is politicized differently and is not such an overt issue and high on the national agenda; because there is not a coercive and scientifically sophisticated settler state, that which imposed restrictions on pastoral and agricultural practices on the population; and there exists a myriad of different agronomic adaptations in the Nepalese hills, which is much more varied than that possible in the Communal Lands of Zimbabwe. Also, in Zimbabwe there is a relatively successful industrial sector offering employment to rural populations, and thus an alternative to continuing agronomic adaptations. Thus, in the Nepalese case, compliance and struggle were inhibited, and adaptation encouraged. Exceptions exist in the evasion of state attempts to control natural resources (by "poaching" forest products) and to gain resources from foreign aid projects through adroit political maneuvering. Avoidance and evasion are therefore significant strategies, which fall somewhere in between adaptation, confrontation and compliance.

With regard to institutional innovation in Nepal, the dominant outcome has been compliance with state power and its support of landed interests in the countryside. While formal institutions within government have burgeoned until recent retrenchment under structural adjustment, it cannot be said that the ability of these institutions to intervene in rural development has been demonstrated.

Evolving Environment–Society Relationships in Nepal

The argument has been made that adaptation rather than transformation has been the form of action by the rural population of the hills in Nepal. Many and varied adaptations have been made by farmers in a highly differentiated ecosystem according to various configurations of their access to labor, land of different qualities,
spatial access to markets, caste, etc. Most of these actions have been made on an individual household basis, with the exception of the management of common-property resources. These countless actions by households over the past century have essentially been mutually competitive, and represent a struggle for fewer physical resources per capita. **The emerging result in the hills is a small peasantry increasingly squeezed and slowly proletarianized, but one without a marked increase in economic and social differentiation. However, these processes have modified the natural environment itself and altered the flow and quality of natural resources available to the rural population.** These changes, in turn, have constrained and channelled further adaptations. These can be grouped into five categories.

1. Adaptations to environmental degradation, that disguise the impact to outside observers and serve to palliate or respond to the loss of productivity, e.g., reduction of livestock, increase of small stock, reversion to shallow-rooted crops on eroded soils, and cutting back on cropping intensity where nutrients are not available.

2. The substitution of purchased household requirements for those that used to be manufactured from forest products directly (roofing materials, dyes, natural fibers for clothing), or indirectly (through livestock products, that were supported from the forest indirectly (e.g., powdered milk, cloth, roofing materials, faelwood). This, in turn, has stimulated cash requirements to be met by petty commodity production, out-migration to secure paid employment and non-agricultural wages.

3. The extension of agriculture onto very steep land often with shallow and infertile soils. This activity is often speculative, not labor-intensive and not accompanied by investment in good land management (terracing or fertility maintenance). The activity merges into what could be classified as shifting cultivation, but without a commitment to return to the same area at a later date. It is, of course, illegal, which further adds to the uncertainty of secure economic gains from the enterprise. Usually it is practiced by those households, that have poor access to private land and non-agricultural income.

4. Abandonment of agricultural land, that has lost much of its natural fertility. This, in effect, is the end-point of disintensification as a result of a long-term failure to transfer fertility from the forest or via inorganic fertilizer, and amounts to change in land-use from arable to rough grazing. It is usually accompanied by a disinclination to invest in the maintenance of conservation works or to repair soil slips. It seldom reverts to forest because of intensive grazing. A higher density of soil slips occurs on grazing land than elsewhere and confirms the abandonment of the land to a less productive use.

5. The opposition of many households to panchayat forests whenever this implies the exclusion of livestock and the collection of fuelwood, even for a short period. For many poorer households there is simply no alternative to keeping livestock on common land. The Phewa Watershed Management Project found, paradoxically, that those villages with better access to forests were more willing to extend or improve forest land than those with poor access. It is hypothesized that the lack of productive alternatives is the main reason.

**Appendix 2— Rangeland Degradation in Zimbabwe**

Zimbabwe, like Nepal, is a paradigmatic case in environment and development discourse. There is a high level of awareness of the Zimbabwean experience as representing the case of a strong and interventionist state, a powerful environmental lobby backed by an impressive and deep-rooted scientific tradition, and a politically effective resistance to state conservationism by the peasantry. The justification for Zimbabwe as a case study goes beyond this, however.
Zimbabwe, as Southern Rhodesia, has had, historically, a high consciousness, amongst state and settler society, of the "reality" of environmental degradation. This perspective derived not only from the sociology of colonial science but also from the politics of segregation and the intellectual history of the region—environmental concern can be traced from the small state (clearly finite resources) mentalities of eighteenth century colonists through to continental southern Africa and the belief that climatic change was caused by environmental degradation. Given the need to research changing perceptions, including those of state policy and official science, of environmental degradation, the excellent existing historiography of Zimbabwe and the strength of state intervention in the name of conservation are good arguments for the location of this case study. Furthermore, we have for Zimbabwe the beginnings of an anthropological literature on peasant environmental consciousness.

Zimbabwe has a constellation of features common to a number of other regions—dry, fragile and drought−prone ecosystems, a high (but falling) rate of population growth, localized and relatively dense populations, a migrant labor economy with temporary male out−migration. Given these features, the communal areas of Zimbabwe are both overpopulated and face labor scarcity. This central issue is an important backdrop against which the widely differing perceptions of actors need to be seen. The state, as do some NGOs, sees the communal areas as overpopulated and therefore requiring conservation and development interventions that are essentially based on intensification. For many peasants, however, their most scarce resource is labor and therefore they rationally pursue a strategy of extensification. Whilst the Zimbabwean case has its own specificities (e.g., formal−sector employment is more widely available than in many countries, although unemployment is a growing problem), the investigation of environmental management, decision making and policy in this context is likely to be broadly useful.

Environmental concerns drive other development policies, yet the nature of the environmental problem remains unclear, despite considerable research. The important linkage with other policies justifies continuing to research environmental degradation, and the uncertainty is a powerful argument for new and more sociological analyses of the problem and how it is understood by different actors.

A fourth justification for researching environmental degradation in Zimbabwe is that clearly several problems do exist, which the crisis in science should not obscure. Current uncertainty cannot be read as negating the problem in its entirety. Whilst basic research needs to be reevaluated, long−term trials initiated, new techniques and models applied to measurement and indigenous knowledge tapped for alternative understandings of environmental processes, we cannot assume that there is no problem and that there will not be one in the future, and we must proceed on the assumption that, if degradation is not an acute curative issue, it is certainly a chronic preventative one.

The main purposes of this appendix are:

to illustrate the use of the proposed framework in researching environmental behavior

to raise some important, but not exhaustive, research questions.

**The Evidence**

**Official Perceptions and Diagnosis – The Colonial Government**

The physical aspects of the problem of farming system degeneration have, traditionally, been analyzed in three, fairly distinct, categories:

degradation of the vegetation,
soil erosion

the degeneration of *dambos or vleis*.

Both the degradation of the vegetative cover and soil erosion are considered to be the result of "overstocking", i.e., the imposition of stock densities above "acceptable" levels, and excessive wood harvesting—see Scoones (1989b) for some typical quotes from official statements by the colonial authorities. Abel and Blaikie (1989) add that the reason for over−stocking and poor pasture management is because communally held rangeland is grazed by privately owned livestock. Thus, a "tragedy of the commons" ensues (Hardin 1968), in which individual herders increase their herds because the individual gains all the marginal benefits, while sharing the marginal costs.

These views, while mainly based on "expert opinion" of colonial civil servants, find support in scientific publications—see, for instance, Pole Evans (1932), Hayle (1932), Kennan (1969), Kelly (1973) and Denny and Barnes (1977) for the case of vegetation studies, and the work by Hudson (1957, 1965), Elwell and Stocking (1975, 1976), Stocking (1971) and Stocking and Elwell (1973) for the case of soil erosion. Techniques to assess rates of soil erosion (Elwell and Stocking 1982) and the "carrying capacity" or maximum "allowable" stock density of rangeland (Ivy 1969) were based on this research and used as the basis for agricultural policy and planning.

*Vleis, or Dambos* are "shallow, seasonally waterlogged valleys at or near the head of a drainage network" (Roberts and Lambert 1990:538), which were originally used for rice cultivation (Mharapara 1987), and are important regulators of the hydrology of large catchments. *Dambos* have, throughout the colonial era, been considered to be especially at risk from degradation. This is partly grounded in the work by Rattray et al. (1953) and Elwell and Davey (1972), who claim that cropping lowers the water table, reduces dry−season stream−flow, increases soil erosion and "burns up" the organic matter (Roberts and Lambert 1990).

Gaidzanwa et al. (1987) and Scoones (1989b) have reviewed the colonial authorities' responses to rangeland degradation. Scoones (1989b) mentions breed improvement programs in the 1920s and 1930s, and policies of de−stocking that were eventually enshrined in the country's Natural Resources Act 1942, and the Native Land Husbandry Act 1951. When drastic programs of de−stocking met with too much opposition, they were replaced with programs of stock control within enclosed pastures, with enforcement of the Savory (1976) method of rangeland management, which includes strict guidelines on stock rotation.

As we said in the previous Chapter, these interventions were derived logically from the official analysis of the problem. Rangeland degradation was thought to be a result of the "Tragedy of the Commons," Rangelands, therefore, had to be enclosed and livestock owners made directly responsible of the state of their land (Abel and Blaikie 1989). The "safe" stock densities were adjusted to the "carrying capacity" whose estimation relied on stocking density trials in government research ranches (e.g., Kennan 1969, Denny and Barnes 1977).

Problems of soil erosion met with an equally vigorous government intervention. Acts were passed early on this century, such as the Water Ordinance, and Herbage Protection Ordinance and a Department of Conservation and Extension was set up within the Ministry of Agriculture. *Dambos* were protected from degradation through the Water Act, and the Natural Resources Act, which effectively prevented their cultivation, and reserved them for grazing (Mharapara 1987, Bell and Hotchkiss 1989, Roberts and Lambert 1990).
Contemporary Continuities

Evidence from recent legislation (see, for instance, the National Conservation Strategy 1987) and the advice given by AGRITEX to farmers and project officials involved in rangeland regeneration projects in the dry Communal Areas (see, for instance, Reynolds and Tsanga 1987, Freyer et al. 1987, Gaidzanwa et al.) indicates that the present government's attitude to problems of rangeland degeneration has not altered. Alarming messages are still sent out by soil scientists such as Stocking (1985), Whitlow (1988) and Whitlow and Campbell (1989) on both the extent and main causes of the financial losses incurred from soil erosion in the Communal Areas. This evidence is used extensively in the debate on resettlement of Communal Area farmers onto the Commercial Areas: Whitlow and Campbell (1989), for instance, conclude from their study of the causes of soil erosion in Zimbabwe, that the main culprit is the "Communal farmer" who doesn't manage the land in a way that is environmentally acceptable, and who should not, therefore, be allowed onto the better soils, which are needed for the production of the nation's food.

The government's response to land degradation is very similar to the one that prevailed during colonial times. The first Five-Year Plan (19861990), for instance, mentions that stock control, better land management and de−stocking are a necessary tool in the preservation of the nation's livestock production (Scoones 1989b). This policy is enshrined in the country's National Conservation Strategy (1987), which specifically supports stock regulation and is implemented through a demarcation of grazing territories with rights of exclusion (Abel and Blaikie 1989). Only in the case of the degradation of vlei land is there a definite attempt at reviewing the problem through a special program of research.

Uncertainties

Notwithstanding the very substantial research efforts afforded by government, some crucial questions have recently been raised, which may invalidate the basis of many apparently rational conservation policies. The uncertainties raised are reviewed here, by subject area.

Equilibrium Versus Non−Equilibrium Dynamics of Rangelands

Traditional rangeland science is derived from the concept of a stable climax vegetation, which is reached through a succession of vegetation types, each having varying potential for producing livestock. The role of the manager in such systems is to "engineer" through the judicious use of fire and stock densities, the stage in the "succession" THAT is most productive in terms of livestock. "Mismanagement" sends the system into less productive, (i.e., degraded) successional stages such as are found in most savannas in which African pastoralists operate today.

Ellis and Swift's (1988) and Scoones (1990b) analyses of the behavior of vegetation in Southern Ethiopia, Northern Kenya and Zimbabwe challenge the notion of a vegetation that can be kept in a stable equilibrium somewhere along its succession towards a climax. They argue that savannas never reach equilibrium, and that they are constantly in transition between a number of equilibria defined by extreme climatic conditions, with high biomass production (both vegetative and animal) during the "good" years, followed by massive deaths during periods of prolonged droughts. Given the multispecies nature of such environment, and the unpredictable nature of rainfall, it is impossible to accurately predict what tomorrow's vegetation will look like, let alone if it will be able to support livestock. The concept of carrying capacity is of little value in such an environment.

Looked at in this light, the traditional pastoralist's management cannot be characterized as irrational, as has often been claimed: large numbers of animals maximize output during the "good years" in order to "store" wealth for the "bad" years, movement from one area to the other ensures that, when rains are bad in one locality, livestock do not exert undue pressure on a fragile system, and fully utilize the better endowed areas. The imposition of strict "conservative" stock densities within restricted grazing territories entails a drastic reduction in overall output from

Feed Supply

The productive potential of rangelands from which Zimbabwe's farmers in the dry Communal Areas derive a living is not only variable in time, but also in space. Some areas (e.g., low-lying basins) are better endowed than others with those attributes of the environment that determine productivity (such as water, for instance). Scoones (1989a) talks about "key resources" such as Dambos, which provide dry season grazing, areas of better rainfall situated at a great distance from the farmers' usual grazing territory and wood during periods of drought, and "browse" material (from bushes and trees).

The concept of "key-resources" becomes crucial when linked to the analysis of the variability of the productive capacity of the range in time (see above), and emphasizes again the need for movement of livestock, and the inadequacy of any attempt at restricting livestock in narrowly defined grazing territories, unless other forms of income security can be provided to farmers—see, especially, Scoones (1989a) and Abel and Blaikie (1989), as well as Behnke and Scoones (1991).

Livestock production in the dry Communal Areas of Zimbabwe is not a simple operation, and has to be viewed within the context of a mixed farming system. In such systems, livestock receive an important additional supplement of feed through crop residues. The availability of this supplement is usually not assessed in the calculations of "carrying capacity" of rangeland, neither is the availability of "browse." De Ridder and Breman (1990) have developed a method that does permit such studies based on the work by Penning de Vries and Djiteye (1982) in the Sahel, and which indicates that carrying capacity estimates using the traditional rangeland scientist's concepts may under-estimate the real capacity of the range to support animals by a factor of 2; we are not aware of similar work being carried out in the dry communal areas of Zimbabwe.

Rangeland Degradation

The traditional scientific view is that, under increased levels of stock, savannas lose perennial grass species in favor of annual ones, palatable grass species are replaced by less palatable ones and bush encroachment occurs, all of which lead to the eventual decline of the capacity of the range to produce livestock.

This knowledge is derived from short-term studies of vegetation changes in restricted grazing areas. Abel and Blaikie (1989), Scoones (1989a) and Biot et al. (1991), however, contend that much of what has been derived from enclosed rangelands does not necessarily apply to open communally held rangelands and that, even if these changes do occur on communal rangelands, they do not necessarily mean an irreversible reduction in the land's capacity to produce livestock.

The lack of evidence for decreased livestock production, despite more than 50 years of warnings concerning rangeland degradation (Scoones 1990b), tends to support the idea that vegetation changes are not necessarily to be seen in terms of land degradation, unless the original vegetation itself can be ascribed a value higher than that of the livestock derived from it during that time.

Recent evidence from Botswana (Veenendaal 1990) on vegetation recovery after drought would indicate that trends of rangeland degradation observed during periods of drought are readily reversed once the rains have returned. This finds support in Kelly's (1973) work on rangeland productivity for different types of management: in this study, the "slightly grazed" tract of rangeland used to illustrate the advantages of having low stocking
densities was established on land that, until ten years previously, had been affected by the heavy stocking densities of the Communal Rangelands.

It is in order to address this issue of "reversibility" that the concept of "resilience" of the savanna vegetation has been introduced (Walker and Noy–Meir 1982), which is a measure of the capacity of rangeland to recover from severe stress. Most research in this area would tend to indicate that the "resilience" of the savannas of Southern Africa is much higher than has been reflected in official statements on rangeland degradation in Zimbabwe.

**Soil Erosion**

The uncertainties in the case of soil erosion assessment have been reviewed in detail in the Chapter 2 of this paper outlining the theoretical framework of this document. Most of those apply to the case of Zimbabwe, where soil erosion research has been carried out for a long time. Fundamental work by Hudson (1957, 1965) followed by Elwell and Stocking (1975 and 1976), Stocking (1971) and Stocking and Elwell (1973) has been based on erosion plot experiments that, for logistical reasons, were not always replicated, and on erosion– hazard mapping that relies on a simple linear model of erosion, which does not provide adequate weights to each individual factor (Whitlow 1990). The soil–loss estimation model derived from this work (SLEMSA: Elwell and Stocking 1982) is of a parametric nature that makes it unsuitable for use in cases beyond the confines of its calibration (such as in the dry areas with their highly variable rainfall), and relies on attributes of the environment (such as the soil erodibility index) for which information is, most often, not available.

Rates of erosion are either measured from or estimated for small, confined plots of land. Extrapolation of the results from such experiments to large tracts of landscape such as are managed by livestock producers is unreliable. In the semi–arid rangelands of Australia, for instance, Pickup (1985) demonstrates how, on erosion, the area of sedimentation increases within the range, with subsequent increases in biomass production. There is, as yet, no information on the net impact of such productivity increases through increased sedimentation in the range, although the discrepancies between erosion estimation using SLEMSA on the one hand, and using river sediment load gauging on the other do indicate that substantial amounts of sedimentation are likely to occur—see Biot et al, (1991) for a full discussion of this point.

Assuming for a while that rates of erosion are high, and are accelerated by high stocking densities, the following question still needs answering: is it a problem? In the case of Botswana, Biot (1988, 1990, 1991) has indicated how, even when increased erosion from densely stocked land can be proven, this does not necessarily mean that its impact on livestock production warrants urgent government intervention. No such analysis has yet been carried out for the rangelands of the dry Communal Areas of Zimbabwe. Abel and Blaikie (1989) have shown that, even if soil erosion were seriously affecting livestock production, its control through de–stocking is not only ineffective but also prohibitively expensive as far as the economics of Communal Areas is concerned.

**Ecological and Economic Carrying Capacity**

Livingstone (1991), Scoones (1989b) and Behnke and Scoones (1991) make the crucial distinction between the ability of the land to physically support livestock (the ecological carrying capacity), and the ability of the land to maximize livestock production (the relevant concept of economic carrying capacity). The latter is crucially dependent on the management objectives of the livestock producer. In the case of production of quality meat, such as in the production systems towards whose management rangeland scientists have traditionally been trained, the economic carrying capacity is significantly lower that the ecological carrying capacity. When the management objectives of the livestock producers in the Communal Areas of Zimbabwe are taken into account (draught power, milk, manure and meat), the same does not apply, and the economic carrying capacity is found much closer to the
ecological carrying capacity.

The official carrying capacity estimates quoted earlier do not make this distinction, and are based on the management objectives of large-scale beef producers. Scoones (1989b) discusses how, here again, the "actual" carrying capacity of communal rangeland could be much higher than the officially recommended one.

**Dealing with Uncertainties**

Uncertainties are not a new phenomenon in science, and scientists, as well as policy makers, have designed a range of strategies to deal with them. Biot et al. (1991), for instance, show how it has been known for some time that the estimates of rates of land degradation are, at best, coarse, and at worst, erroneous. Despite these uncertainties, systematic choices have been made: "worst scenarios" have been chosen as "typical," impacts of environmental changes on the land's productive potential have been assumed, unjustified extrapolations have been made from plot-scale to large catchments, ethnically biased judgments have been made with respect to farmers' abilities to respond to problems of degradation.

This typical way of dealing with uncertainty is far from ideal, but is all too common in developing countries. There are several reasons why such (often deliberate) choices are made, which have been given in Chapters 1 and 2. Their implication is that the facts portrayed are conditioned by the world-view and personal perceptions of those who do the research, and make the policies. In the case of land degradation studies in Zimbabwe, it appears, indeed, as if the **institutions** (rather than "reality") construct the facts.

Various agencies, both national and international, have responded to this problem by trying to implement a more "populist" approach to development. The implementation of official conservation measures is now channelled through local democratic structures at village and ward level. The "Villagization Program" is responsible for the demarcation of crop and grazing land, and the formation of villages using advice on land management by AGRITEX (the Agricultural Technology and Extension Department of the Ministry of Agriculture). The latter organization has designed a National Land-use Program, which aims to achieve a "voluntary, community based land-use reform."

There are also non-government initiated programs of integrated resource use in the dry Communal Areas of Zimbabwe, which are grounded in a strong community spirit forged during the long war for independence, get some kind of government support and are supported by overseas aid (see, for instance, Freyer et al. 1987). Most of these are based on some kind of Farming Systems, or Farmer Participatory Research model.

The populist approach to development, however, is meeting with severe difficulties. When government involvement is scrutinized, it is realized that much of it still is based very strongly on the "one-source model"; interventions such as de-stocking and stock rotation are designed and tested by scientists in research ranches. Policies are derived from these and surveys of the state of the Communal Areas" rangelands by civil servants and enshrined in Natural Resource Acts. Even where the multiple-source model of agricultural innovation is given due credit, it is hampered by the history of and structures within which technology development has evolved. There is a serious lack of communication between social and physical scientists, research and extension and, most of all, farmers and researchers.

To summarize. The scientific certainty of the past, in which rangeland degradation was believed to be acute, and the political certainty of the colonial state, that this was caused by irrational peasant behavior requiring forced de-stocking, has shifted. The scientific community is beset by doubts as to whether degradation is occurring, at what rate, how it can be measured and of what economic significance it is. In policy circles, however, the commitment remains to the belief that degradation is an acute problem. Although the cause is now seen as over-population, the land-reform option has partially stalled for a number of reasons—political and...
economic—and cannot realistically be expected to ameliorate the situation.

The Socio−Political Context of Land Degradation

The difficulties in implementing effective programs of soil and water conservation can be explained by either the absence of a serious problem of land degradation, or inappropriate project implementation, or both. Avila (1987) and Reynolds and Tsanga (1987) raise an additional problem. These latter authors make the important point that many of the problems faced by farmers in the dry rangelands of Zimbabwe's Communal Areas cannot be solved by agricultural innovation, even if realized in the best participatory mode that can be envisaged. Both authors, indeed, talk about structural rather than technical problems as being the main cause of stagnation in the agricultural development of the Communal Areas i.e., a restricted access to resources—see, for instance, the Gaidzanwa et al. (1987) analysis of the successes and failures of the Mwenezi Land Reform Program. Thus, the problem is one of land degradation nested in poverty, a point often made with regards to soil and water conservation programs.

As we argued above, we need to avoid reducing all explanation of decision making to a determinant view of structural constraints (e.g., state−generated poverty) that preclude any choice. Agents have (admittedly variable) power to remake the structures that constrain them—political, social and environmental. In the following Chapters, we first describe the historical context and farming system, before going on to apply the idea of agency to environment and decision making.

A Brief History

Our explanation starts with a brief historical and geographical narrative to demonstrate the legitimacy of our focus on structure and action—for it can be said that, to borrow a formula, the Zimbabwean peasantry have made their own environment, but not in circumstances of their own choosing.

Historical Context

The central and southern areas of Zimbabwe are characterized by low and uncertain rainfall. They were farmed in the nineteenth century (Beach 1977) by a system which relied on the intensive use of small areas of wetlands found within the sandvelt hills and a variable amount of shifting cultivation.

In the early colonial era an expansion of shifting cultivation occurred on the sandvelt, which gained pace as ox ploughs became widespread in the 1920s, pacification allowed settlements to disperse, and younger men were able through wage work to escape dependence on patriarchal elders. Security of food supply improved through rising levels of cattle holding and cash entitlements from wage work. This led to the establishment of the riskier but potentially higher yielding strategy of extensive crop production on the sandvelt, and, eventually, to an expansion onto the clayvelt. Here farmers depended on ox ploughs for heavier land preparation and were more vulnerable to drought but benefitted from higher crop yields and nutritious grazing in wetter years. Exchanges (e.g., grain trade, cattle loaning arrangements and marriages) between these two zones (Wilson 1990) were based on their differing seasonal and agroclimatic comparative advantages.

In 1931 the Land Apportionment Act divided the country into mutually exclusive areas for white and black occupation. Apart from the 7.4 million acres of Native Purchase Areas where blacks could purchase freehold tenure farms, all black farmers were confined to the 21.6 million acres of African Reserves (with communal tenure) whilst the tiny settler population could occupy 49.1 million acres. This legislation initially emerged from a desire to protect investments—successful and influential white farmers felt that "bad methods of native farming" would lead to "depreciation of the value of neighboring land" (Phimister 1988,194). Mongrel stock, low grade
bulls, resistance to dipping and use of unimproved seed were cited as examples. The Act also served to contain black farmer competition, which was the concern of the mass of undercapitalized white farmers.

The 1930s was a period of depression, falling wages and the Maize Control Acts, which penalized black maize producers and restricted their markets dramatically. In earlier decades there had been considerable market opportunities for peasants but they became increasingly confined to the production of low−value subsistence crops, and there was no promotion of high−value export crops, as happened in Kenya (Mosley 1983,73).

From the 1930s on, land−use planning policies aimed at ending shifting cultivation in order to accommodate growing population densities, and in order to address mounting concern over environmental degradation. The significance of conservationism in the Southern Rhodesian colonial state has been debated. Beinhart (1984) attributes much greater importance to this as a driving force in policy and intervention; Phimister (1986) suggests that he over−estimates the significance of conservationism. The colonial state was composed of a number of branches with differentiated sociopolitical and intellectual behavior. Important points to note are the complexity and at times contradictory nature of state policies and perceptions of environmental degradation which cannot be reduced to a single dimension, and also the wide−ranging influences forming environmental belief systems—even before mass communications, the American dust bowl experience was as important as any "scientific" data in forming the apocalyptic justification for soil conservation. Recently it has also been suggested that the driving force of the early land−use planning in the reserves was modernizationism rather than conservationism, which was later used to buttress the policy (MacGregor 1991).

Either directly or indirectly, policies were pursued (Drinkwater 1988) to eliminate the cultivation of wetlands, to forbid the growing of crops close to watercourses, to allocate certain areas (toplands) for cropping and others (riverine zones) for grazing, to force the people to construct their villages in "lines" between these designated arable and grazing lands, to promote soil fertility management based on rotations, legumes and manure use, to impose soil conservation methods and so on.

People's reaction to these programs of land−use reform is well known: it was prominent among the factors that led to the long war for Independence. Land reform was the centerpiece of the struggle (Ranger 1985) but promises of land reform through resettlement of the peasantry in the Commercial Areas have not materialized. This is partly explained by the specific terms of the Lancaster House agreement, which stated that land acquired for resettlement should be on a willing−seller−willing−buyer basis and this has been compounded by the fact that many white farmers chose to remain in farming. The British have also been dilatory in the release of funds, and the costs of resettlement have been high. In addition there has been wide−scale acquisition of commercial farms by the black political elite as well as a conscious policy of realization of the export value of commercial agriculture (Herbst 1990). It also appears, however, that (arable) land shortage is not very highly prioritized by the majority of Communal Area farmers (L. Zinyama, personal communication), and that pressure from below for resettlement has remained lower, than expected. Reasons for this will be explored in the next Chapter.

The current official approach to solving problems of farming system degeneration in the Communal Areas relies upon "internal land reform" and intensification—for example, the prescription for rangeland degradation is grazing schemes based upon short−rotation grazing (Cousins 1987).

The main theme running through much of Zimbabwe's recent history is one of an extensive, elaborate, and strong state. The concomitant evolution of the farming system is charted in the next Chapter.
Changing Human and Human–Environment Relations

The history of the Zimbabwean peasantry is one of considerable upheaval. After an initial period of positive adaptation to the early colonial policies, the Land Apportionment Act has irreversibly altered the set of constraints and opportunities farmers have to deal with.

The consequences of land apportionment for black farmers were profound and increasingly limiting—not only because of the artificially high population densities created but also because of the quality and topography of land designated as Reserves. When during the recession in the 1930s, poor peasant men became migrant laborers "women in this class were forced to shoulder a heavier agricultural burden... Ploughing became the work of all women during precisely the period in which agricultural returns fell most sharply. The reproduction of poor peasant households turned not only on female labor alone. It also hinged on cash remittances from male migrant workers” (Phimister 1988:205). The declining viability of the Reserves (today the Communal Areas), the pressures on women's labor, the deepening of the migrant labor system and the concomitant absence of agricultural entrepreneurship, accumulation and growth became, and remain, major factors driving environmental degradation.

Land–use changes were occurring within a larger context of social and economic change, not all orchestrated by the state. Changing gender and generational relations were both influenced by changing marriage laws and practices, the mobility of women, the commoditization of male labor and of the economy in general. And these relations themselves patterned the manner, form and intensity of processes of change. Whilst class differentiation of the peasantry proceeded in uneven fashion, and was discouraged by the state, gender differentiation into essentially male "producers" and female "reproducers" was important to the colonial state, to mining and agricultural employers and to rural patriarchal elders (Folbre 1988). The consequences of migrant labor systems for resource–management were, and are, locally specific but everywhere significant.

Some of the land–use planning policies, which tried to regulate problems of land degradation and growing population densities, were actively adopted by farmers (e.g., the use of manure—today the cattle of cattle and collection of manure for use on crop lands is universal), others were complied with to varying degrees and yet others became the focus of mass resistance, which culminated in the war for independence.

Today, the human population of the dry communal areas contains large numbers of the descendants of "displaced" people from the Commercial Areas, and recently returnees after the war. Farming systems are of a mixed nature (crop/livestock ratio: 1/3), with communal grazing, and private arable and residential lands (Gaidzanwa et al. 1987). On average, the inhabitants of the Communal Areas derive 40 percent of their income from agriculture, 30 percent from cash transfers from towns, and 30 percent from other, non–agricultural employment (Reynolds and Tsanga 1987). The variation within the communal sector must be recognized—the dramatic expansion in the proportion of marketed maize produced by the communal–area farmers since independence has been derived from the Communal Areas in regions II and III and from a small proportion of farmers within those areas (Stanning 1989).

On first sight the prime constraint faced by the peasantry seems to be an obvious problem of land shortage, however, this is contradicted by problems of shortage of labor, underutilized land and a lack of enough oxen to till the land (Cliffe 1986). Part of this has already been explained in the previous Chapter. The internal evolution of the farming system may well provide an additional explanation, for this has occurred in the context of widespread male migration to work at wage rates much higher than the returns to crop or livestock production. (Low 1986)

The arguments for severe land pressure in communal areas are predominantly expressed in terms of livestock carrying capacity, degradation, tree and soil losses (Cliffe 1986:22). When we question the validity of the scientific evidence supporting these views then we also need to reevaluate our understanding of land pressure. In
a society where remittances are a major source of revenue, and the proportion of income generated by agriculture is low (CIMMYT 1982, Jackson and Collier 1988), land is perhaps not as crucial a resource as it may be assumed to be. This is not to say that this is true for all for, although there are few landless households, the great majority of women are "landless" since they have no primary rights to arable land allocations (May 1983, Gaidzanwa, 1988). There are also marked agroecological variations in land availability and quality, and there are clear pressure points as indicated by the incidence of squatting. The dramatic gap between official perceptions of the environmental problem and peasant perceptions, with all their variations, continues to be a problem, despite a number of years of FSR, and constitutes a key research topic.

Zimbabwean history reveals the profoundly political nature of environmental degradation—the definition of the problem, the solutions envisaged, the form of implementation, the responses of the peoples and the short and long-term effects of these, all lead to the conclusion that we must understand the choices and the power that even the apparently powerless have to disrupt, divert and resist state-generated conservation policies.

**Structure and Action**

In Part 1 we suggested the need to understand natural resource-management decision making as more than a mechanical sequence of perception, diagnosis and action. We need to examine:

- the varying significance of the freedom to choose, on the one hand, and the structural constraints negating choice, on the other; and

- the aggregate effect, over time, of individual actions on the institutions influencing choice, i.e., how institutions, with variable influence on resource-management, reproduce themselves (or not).

**Changing Paradigms**

The ways in which processes of decision making are examined depend on the prevailing world-view adhered to by the observer. When science (itself responding to social change) challenges the foundations of this world-view, a paradigm shift ensues, which alters the explanation of such processes. Chapter 1 has mentioned two paradigm shifts involving three world views: a paternalistic and populist one, and an emerging counter-revolution. The shift in paradigm from paternalism to populism is clearly illustrated by the livestock debate.

The classic view of rangeland degradation is as a problem of overstocking beyond carrying capacity. A number of studies (Sandford 1982, Cousins 1989, Scoones 1990b) have sought to examine the socioeconomic dimension of livestock in the communal areas. The picture that emerges is of an increasing total cattle population in the communal areas, periodically decimated by drought, and held in decreasing average herd sizes, although ownership remains unequally distributed. This is usually expressed per household but inequality expressed by individuals is even more dramatic given the extremely low levels of ownership by women. The proportion of stockless households shows uncertain trends, but there is little evidence for increasing stocklessness that is unrelated to drought. Stock owners with large herds suffer lower losses during droughts, but it is arguable that the increasing pressure on rangelands derives less from accumulation by large stock owners than from population growth. Cattle are acquired through cash earned as migrant workers in urban areas, reproduce erratically, given the exigencies of climate, and tend to be disposed of in old age. The main purposes of cattle are as inputs into the farming system—draught, manure, transport—and as assets for security, accumulation and social reproduction. Milk production is significant but meat less so. The value of cattle is essentially as live animals rather than as meat.

The livestock problem is no longer viewed, scientifically, in simple terms of overgrazing, but within the context of an ecosystem that is not at equilibrium, and as a complex set of inputs into the farming system, which go far
beyond the simple financial models used to decide on management in traditional rangeland science.

The populist perspective is comparatively weakly developed in Zimbabwe—officials of the state and scientists of state research bodies are still dominated by the classic paradigm. However, as noted above, populist approaches are becoming more influential in certain branches of state activity. For example, the materials used for training community workers cover "the theory of Paulo Freire on developing critical awareness and how to put this into practice ... the skills necessary for participatory education.... (and) the social analysis necessary to develop critical awareness and long–term planning with the steps needed for building solidarity in people's movements" (Hope and Timmel 1984:i). Although NGO activity is limited, NGOs have a high profile.

One element of state policy that has created a favorable climate for the growth of populism is the emphasis on decentralization through the local government reforms that created elected Village Development Committees (VIDCOs) and Ward Development Committees (WADCOs) in 1984. Devolution of planning is also central to populist analysis where a key problem with research and development planning is seen to be scale. Generalized research findings, regional–level stocking density figures, blanket recommendations, undifferentiated policies and universal planning techniques are reflections of centralized power and knowledge. Understanding and ameliorating degradation requires a finer resolution in study and localized control of intervention design and implementation. For example, the problem of how cattle affect the range needs to be understood with a more detailed understanding than that of gross stocking levels, for several reasons—because of the patchiness of the environment and hence very differing productivity and resilience within small scale variations, because the vegetation dynamics under different forms of management are little understood and because management itself is more diverse, flexible and responsive to environmental change than is implied by the use of stocking levels as an indicator of environmental pressure. Research into micro variation and management may be able to identify particular commonly encountered degradation pressure points and thereby target these with locally identified interventions.

Against this backdrop of history and shifting paradigms we need to look at how far decision making has appeared to both reflect determining constraints and also agency.

**Choices, Constraints and Environmental Change**

Here we examine some elements of how environmental choices and constraints are distributed, the significance of social reproduction, or failure to reproduce, for decision making and changing official perceptions of the problem. The time dimension is of great importance for analyzing processes of environmental degradation. If we are to understand how collective action is generated, reproduced or eroded we need to look at the aggregate effect of individual decisions and actions on social institutions.

The conventional paternalistic view of peasant decision making was, on the whole, formed by and consistent with colonial prejudices (Drinkwater 1988). Peasant men were seen as irrational, lazy and short sighted—they managed cattle in a manner consistent with religious beliefs, they squandered great quantities of grain on beer and they farmed with minimal effort. Peasant women were sometimes characterized as overworked and submissive objects of exchange but always as immoral and opportunist (Folbre 1988). With such perceptions, the causes of deforestation, soil erosion and overgrazing were blamed upon choices made by ignorant peoples with short–term interests.

The current perception of peasant decision making continues to reflect this view but populist perspectives are also significant and give much more emphasis to constraints —people are forced into environmentally negative behavior as a result of poverty. This has yet to
be extended to include gender subordination as a constraint governing resource-management decision making. Where peasant actions can be seen to be responsible for degradation (and this is seen as grossly exaggerated by some) then explanations are found in the overwhelming constraints of access to resources, population growth, drought, etc. The policy prescription for degradation is thus poverty alleviation and equity. Our approach attempts to examine decision making as constrained choices. How then are decision makers differentiated with regard to constraints and choices?

**Access to Resources**

Property rights to land in the communal areas consist, for men, of individually allocated and inherited arable land rights and use rights to grazing land, whilst for women both allocation and inheritance of arable land is rare and land access is conditional upon marriage (Gaidzanwa 1988). There has been much debate about the environmental consequences of privatization and security of tenure, but no application of this to understanding the impact of alienation from the land on women's decision making.

Access to resources by individuals depends upon a structured set of endowments and also upon trajectories of accumulation or impoverishment. There appears to be accelerating differentiation in the communal areas (Amin 1989) based on access to migrant remittances and livestock accumulation. The more limited access to resources, the more likely it is that decision making is determined by constraints rather than a reflection of the operation of choice. When herd size is below subsistence needs, the strategy of increasing stock numbers results from survival imperatives and cannot be characterized as "free riding" behavior in the sense of a noncooperative choice, cooperative conservation may be an option open only to some.

As successful individuals accumulate and others become impoverished, what happens to the institutions of sharing (e.g., shared. draught cattle) and redistribution (land usufruct, or labor saving herding groups)? Of relevance here are the models of class formation as well as those of demographic differentiation—even recent studies find that patterns of livestock accumulation are related to age (Scoones 1990a) although there is increasing divergence from ideal—typical domestic development cycles as families become fragmented, gender relations metamorphose, class divisions ossify and reproduction for some becomes threatened by impoverishment. The dynamics of institutional change, including the family itself, would appear to be a key area for research into environmental degradation.

Access to resources of different kinds can be expected to create different kinds of "play" in the system of structural constraints—most convertible and flexible of all being cash. Peasant differentiation is based primarily upon access to migrant earnings (Bonnevie 1987) and it would seem that the migrant labor system simultaneously undermines the rural environment and potentially sustains it. Given the low incentives to women farmers to pursue SWC, we may anticipate negative environmental consequences when women acquire greater decision making power, e.g., in the absence of men.

The process of commoditization is now well established in rural Zimbabwe and cash is necessary to daily, generational and social reproduction. The imperatives of the "simple reproduction squeeze" have been met with compliance and with resistance, but perhaps most of all with adaptation, i.e., with an active accommodation that differs for differing categories of people. Commoditization has affected property relations and livestock directly as well as affected rangeland quantity, quality and management indirectly through the spread of market relations in the economy in general.

Understanding the different balances of decision making choice and constraint for groups of farmers may allow differentiated approaches to be effectively targeted—if resource constraints are preventing poor peasants (i.e., those without remittances or stock) from adopting SWC techniques then FSR needs to identify farmer conditions more accurately. If prosperous farmers, who do have choices, elect not to invest in sustainable agriculture or favor
individual accumulation, then targeted interventions here may include improved returns to farming, reconsideration of the desirability of high rural–urban wage differentials, removal of crop price controls or institutional support for environmentally favorable collective action, such as herding groups, draught sharing institutions or mushandire pamwe.

The state itself has historically been one of the greatest constraints limiting the possibilities of choice in Zimbabwe, and free decision making has been, in the past, tantamount to insurrection. Land–use planning has been a significant mechanism for the state (pre and post independence) to achieve political control as well as to attempt to impose what it perceived as sound conservationist policies (Drinkwater 1988). It is probably crude but fair to characterize responses to land–use planning as forced compliance in the colonial era, resistance during the war and adaptation currently. Access to state resources (extension information, credit, marketing service etc.) can also be seen as widening the arena of choice for farmers.

A review of which technical recommendations are widely followed reveals aspects of the interplay of constraint and choice. From the perspective of development interventions a number of technical innovations in livestock and rangeland management could be characterized currently as generally adhered to—e.g., dipping of cattle, the storage of maize stover for dry–season feed, winter ploughing, the limitations on the movement of cattle and the promotion of grazing schemes.

A close examination of those recommendations that have been adopted is likely to reveal widely differing reasons for adoption, and give insights into the nature of household–level decision making, as well as the range and limitations of state action. Cattle dipping was initially strongly resisted, and enforced by the state but is now a largely accepted part of stock management, winter ploughing adoption mainly reflects stock access constraints, stover saving appears to meet a need within the grasp of most farmers, maintaining soil conservation works (or not doing so) reflects labor constraints.

Compliance with a particular recommendation cannot be taken to be based on the logic of scientists or officials—for example, grazing schemes have been widely promoted by AGRITEX for their productivity effects and conservation of rangeland, and they have been enthusiastically adopted in many areas, but often because they offer a point of leverage on increasingly pressured grazing lands for stock owners wishing to establish exclusive use–rights to a previously communally used resource. Another example of unforeseen decision making is seen in the high rates of adoption of hybrid maize in communal areas which were thought to have unsuitable climates. Low (1986) explains this as a result of the higher yields leading to the liberation of time for use on income earning activities—hence high rates of adoption are found not where conditions allow commercial surplus production but where subsistence production combines with high rates of off–farm employment.

Perceptions

An approach that considers both choice and constraints to be of significance, such as the notion of agency, needs to look at how the actors perceive those. This involves an analysis of farmers' perceptions of choice and constraints, norms, peasant knowledge systems and official perception of farmers' decision–making processes.

Perceiving Choices and Constraints

There have been shifts in the way science has perceived the limits and capacity of the environment—and so too we should expect shifts in folk perceptions of limits and capacities, causes and effects. Several studies have shown the widespread perception of rainfall decline (du Toit 1985), yet meteorological records do not support this view. We may speculate as to why there is this perception (because of the increased severity of the consequences...
of rainfall failure? because the past is always remembered selectively and positively? ... ) but the important question is whether and how this perceived constraint affects actions.

Similarly, there is a need to understand how the actor perceives the choices confronting him or her. In Chapter 3 we introduced the idea of pre−attentive processing i.e., that people subjectively sift the range of potential choices to a subset of considered options. If women in areas of severe deforestation do not consider tree planting as a potential solution to fuelwood shortage, despite apparent appropriateness, the reasons for this require investigation (Bradley 1991).

**Norms**

Alternative paradigms have discovered a considerable body of knowledge and common property management and social institutions have been re−interpreted in the light of their roles in acceleration or containing degradation processes. The social institutions related to livestock and rangeland management represent sets of norms that structure decision making. Examples are bridewealth practices based on the exchange of livestock, *kuronzera* (the long−term loaning of cattle), draught sharing and collective herding groups. There can appear to be an unchanging quality to these institutions, but it is important to deconstruct the "traditional" and examine the meaning attributed to them, their origins, incidence and reproduction of such institutions as well as the impact they have on decision making regarding environmental matters.

**Peasant Knowledge Systems**

Peasant knowledge systems have been the focus of much recent populist interest. Since greater choice derives from greater knowledge, this interest coincides with the emphasis on agency, i.e., on peasants pursuing strategies, making conscious decisions, manipulating knowledge, experimenting and innovating. "Traditional" resource−management appears as environment friendly (Wilson 1989a) and regulatory. Folk models of the movement of soil in the landscape are one example of expanding awareness of indigenous knowledge and the options they offer to decision makers (Wilson 1989b). These clearly need further investigation and comparison with other knowledge systems, but we also need to know more about the political economy of such knowledge.

**Official Perceptions of Farmers' Decision−Making**

The conventional view of peasant social institutions relating to environmental management was simply uninformed through prejudice. Very little was "known" officially of indigenous technical knowledge or common−property management. What was known was seen as representative of a backward culture. Explanations of the unsuccessful attempts by the government to encourage beef production in the communal areas have moved from "cultural" factors (i.e., that in "cattle cultures" livestock have ritual and religious significance as ancestors spirits are carried by certain cattle, marriage exchanges require cattle, etc.) to a new understanding that culture is a good deal more flexible than it has been portrayed and that none of these is an insuperable obstacle to commercial cattle production (Sandford 1982). This is, however, a view still resisted within official circles.

Where there is evidence of a gap between peasant management and what is seen to be economically optimal, this may be because of faulty perceptions of farmer objectives. Recent research which has attempted to view livestock management from a peasant perspective through attempts to calculate the value of livestock in the farming system (Scoones 1990a). This reveals the value of stock in terms of draught, milk and meat, manure and investment to be much greater than the value as beef despite high beef prices. The majority of farmers have herds below subsistence levels and are thus constrained from the option of commercial beef production, but the low levels of beef sales show that, even for farmers with large herds, high beef prices do not stimulate commercial production. On the other hand, goats are more commoditized in that they have little non−terminal significance in the farming system, are less "lumpy" and thus more suitable for shorter term saving, and are significant mobile property for
Mythologies

In a previous chapter the meaning of land in farming systems was investigated in terms of uncertainties as to the very existence of a problem of over-population, on the one hand, and the varied sources of income within the peasants’ livelihood system, on the other.

Whilst the racist land mythologies of settlers are well known and the current political complexity of land reform much debated, we should also investigate the perceptions of communal area farmers. The arguments for severe land pressure in the communal areas put forward by FSR workers has to be seen within the context of the scientific and political mythologies they adhere to, and their farm rather than household perspective. When analyzing land pressure, we need clarification in terms of farmers’ own perceptions, and objective realities. These are largely under-researched, however, the limited amount of work done does indicate that land shortage is not prioritized to the expected degree, and that problems of labor shortage and under-utilized land exist (Cliffe 1986).

It is clear that the land issue is a complicated one, in which the mythologies of the observer play an important role. There is a great need for further research on the meaning of land shortage to a variety of people, including different members of the household.

Risk

Changing risk behavior has been identified as a problem for environmental management and this is likely to be an important research topic, but it requires a gender-informed household-based approach beyond the individual enterprise. To illustrate—in southern Zimbabwe, when in the early decades of the century, farmers developed livestock holding and wage labor as elements in their livelihood systems, it was possible to pursue a cropping strategy that produced higher, but more variable yields—i.e., inter-annual instability could be borne as the cost of greater productivity in that enterprise in the context of other socioeconomic changes (Wilson 1990, Appendix 4). In this and other ways there are tradeoffs between productivity, stability and sustainability (Conway 1987). Crop choices, for example, the often observed trend towards maize growing in unsuitable agroecological zones, need to be seen in the context of security systems, which include wage work, stock ownership, transfers from the state and, in the case of married women, transfers from men.

Power

Given the variations in constraints and choices that individuals face, and given the conflicts in interest both within and between households, we expect that decision making is dominated by the more powerful members who can impose their own priorities upon others. But the extent to which a man, for example, is able to force his wife to maintain contour ridges or a woman to force a man to provide her with a fuel-efficient stove depends on complex, long-term reciprocity, the valorization of different categories of work, the threat points that individuals may credibly wield, etc. Models of intrahousehold relations, and detailed empirical study are central to understanding decision making.

In this scenario the constraints of subsistence cropping are important limitations, but nevertheless there are alternative strategies within this and it is likely that both class and gender will be important differentials in understanding the landscape of choice and constraint in resource-management decision making.

Understanding "management" is shorthand for understanding the property rights, resource access, knowledge, thought processes, perceptions, priorities, tradeoffs and conflicts which underpin any observable management
pattern. Understanding management also involves understanding the opportunities for collective action and the currents of change, which continually reshape both the forms and functions of resource—management institutions.

Organizations

We have indicated some of the issues of the social reproduction of institutions bearing on environmental management above (family, kinship and marriage, collective action groups, etc.) and we have looked at the decision—making process from the individual perspective. Of equal significance is an analysis of how institutions of the state, and NGOs, set priorities, interact with other institutions and over time are reproduced or changed. This is important because development organizations and organs of the state bring another level of objectives and priorities into the scenario (e.g., the regional or national interest). It is also important because these organizations clearly define to a certain degree what choices and constraints decisionmakers face.

If "the institutions are the facts" in understanding environmental degradation, then this research must include institutional analysis of organizational actors. We have already discussed the sociology and politics of scientific and official perceptions of rangeland degradation, and we have also given a brief overview of the types of organizations involved and the problems they face in designing effective programs of soil and water conservation. In order to explain those problems, we need to understand the differing forces operating within different branches of the state and at different levels of state action. For example, at the national level, the Five Year Plan and the Ministry of Agriculture livestock policy documents express the concern to generate foreign currency through the export of beef, and the protection of the beef quota may favor high—output approaches to rangeland development based on grazing schemes and possibly privatization in the longer term. From this perspective, the view that private ownership leads to strong conservation incentives (despite the contrary evidence) has obvious appeal, in particular given the political powerlessness of the stockless and weak democratic forces.

At a regional level, more diversified policy perspectives come into play in which conservationism is a dominant theme in the work of the extension organization, AGRITEX, which exhorts farmers to build and maintain ridges, herd cattle away from contours, store stover for winter feed, give up the use of sledges, adopt grazing schemes, protect grazing lands from arable encroachment, etc. At the village level, the most pervasive presence comes from AGRITEX, for even though there are also representatives of other ministries (the Dept. of Veterinary Services are represented by Animal Husbandry Officers, Forestry Commission) they are both fewer and tend to depend on and defer to AGRITEX. NGO activities and bilateral development projects that have agricultural and conservation objectives usually collaborate closely with AGRITEX or rely on it for implementation (e.g., the GTZ project, CARD, in Masvingo Province).

Agricultural Extension

AGRITEX is a key institution for analysis. It has within it strong continuities with the paternalist and technicist approaches to development (Drinkwater 1988) and it is a confident and politically powerful body in a strategic position. Extension workers are technically well trained and updated regularly.

The predominant extension approach in the past has been the Master Farmer program whereby progressive farmers received instruction in modern husbandry over a period of years, and thereafter were certificated and eligible to purchase land in the Native Purchase Areas. Retention of the Master Farmer certificate depended on continued practice of recommended techniques and if inspection revealed intercropping, broadcasting or other "traditional" practices the certificate was withdrawn. Current approaches combine group extension (modified T&V) with continued Master Farmer programs and the mushandire pamwe groups. However, despite lip—service to more participatory extension, field workers do not learn from farmers or feed back farmers responses to recommendations in the manner T&V anticipates. Learning reversals face serious political obstacles and institutional inertia, and integrating indigenous technical knowledge of environmental processes is likely to be
difficult to implement. There is an awareness in AGRITEX of the need for more women extension officers but it remains a very male-dominated organization despite the fact that a majority of farmers are women, there are many women Master Farmers and the majority of mushandire pamwe are women's groups.

The interactive relationship between farmer and extension organizations has possibilities for adaptive behavior—in Zimbabwe this mostly means farmers adapting to official recommendations rather than research/extension organizations learning from farmers and adapting their technology design. In the communal areas there have not been appropriate off-the-shelf technologies for small farmers, but there have been adaptations, e.g., recommended rates of fertilizer use are difficult for cash constrained small farmers to apply but combinations of fertilizer and compost/leaf litter or termitaria, have been devised that are effective.

AGRITEX enforces many of the conservationist regulations—farmers are not allowed to farm less than 40m from a water course, not allowed to cultivate dambos, not allowed to use sledges, compelled to build and maintain conservation ridges, etc., and assiduous field workers are locally powerful. The interaction between extension workers and participating and non-participating farmers requires research to reveal the information, the pattern of choices and constraints offered to different groups, the responses, adaptations, compliance and resistance stimulated by extension workers.

**Agricultural Research**

Agricultural research is coordinated through the Department of Research and Specialist Services (DR&SS) of the Ministry of Agriculture, which has a long history of research geared to the needs of the commercial farming sector, including breeding its own hybrid maize at the same time as in the USA. Since independence in 1980, it has been attempting to reorient towards the needs of communal area farmers. This has not been very effective because of a number of reasons:

- the time lag in much agricultural research,
- the disruption to the informal but efficient (although elitist) communications between research and extension pre–1980, which occurred when the client group was dramatically redefined and personnel in both extension and research changed (Avila et al. 1989,689). Pre–1980 there was no link between DR&SS and the body serving communal area farmers, but very close links with the other extension organization serving white commercial farmers.

As a result of the common failure, AGRITEX has continued to work with the research findings and paradigm of pre–1980 agricultural research. DR&SS has a network of research stations, mainly in the highveld. A recent review of DR&SS concluded that links with the scientific community were excellent as were those with the private research sector (Agricultural Research Trust, seed companies and agribusiness units), links with farmers were weaker than in the past and links with policy makers unsatisfactorily informal whilst research–extension linkages are clearly problematic (ISNAR 1988). Agricultural research shows a shift towards FSR approaches but is still very scientistic in approach and does minimal interdisciplinary work involving social scientists.

**The Ministry of Natural Resources**

The most influential of other relevant agencies of the state is probably the Ministry of Natural Resources, which has produced a National Conservation Strategy and has a high public profile both nationally and internationally, e.g., the CAMPFIRE program whereby the elected ward councils of communal areas bordering on National Parks participate in the management of wildlife populations to fund community projects. These schemes are possibly not widely appropriate, but the effect of this Ministry on national–level policy perceptions and environmental
thinking is substantial and indicates the necessity for institutional analysis. The Forestry Commission has recently started researching trials with indigenous species and indigenous management of woodland but both these organizations have very strong continuities with pre-independence priorities and personnel.

**Other Organizations**

The relatively new elected bodies, the VIDCOs and WADCOs, which increasingly are taking responsibility for land allocation decisions and developmental priority setting, should be included in this research. VIDCOS appear to function in very varied ways and it is not clear yet who they represent, who the councilors are, how priorities are set and whether they can be a conduit for popular perceptions of environmental issues.

There are a number of active NGOs that engage in environment-oriented development—ENDA, Zimbabwe, ORAP, Lutheran World Federation, Save the Children, Oxfam—and these have local significance (Ndiweni et al. 1991). They operate with populist approaches, high levels of commitment, low budgets and a certain isolation from state development agencies.

**Conclusion**

It would seem that there is a struggle between the old technicist, centralized, paternalistic, modernizationist approach to environmental management based on scientific "truths" and enforcement, and a growing alternative of neo-populist, democratic and egalitarian approaches based on a revalued indigenous technical knowledge, small scale and localized interventions and decentralization. A "counter revolution," of the kind described in Chapter 1, of pricism and deregulation may well be emerging as Zimbabwe, urged on by external donors and Bernard Chidzero, undertakes economic restructuring.

Uncertainty and change open up space for peasants as agents to engage in shaping what emerges from this period, it also provides a challenging research arena for the understanding of decision making and an opportunity to initiate more effective interventions.

**Appendix 3—
Research Directions Indicated for Nepal and Zimbabwe**

In the sub-sections that follow, research questions common to both case studies are discussed first, followed by any which are specific to one case study only.

**Institutional Analysis**

Further research on either of these case studies would focus upon an institutional analysis of actors involved in SWC and sustainable agricultural projects.

In the case of Zimbabwe, how do the influential organizations (extension bodies, community development workers, Ministry of Natural Resources, government scientists, academics, bilateral aid projects, NGOs, Forestry Commission etc) perceive the nature and causes of environmental degradation and what is the sociology of their membership and history in terms of the shifting paradigms outlined in Chapter 1? (A case study of the Department of Research and Specialist Services may be a fruitful approach to this topic.)

In the case of Nepal, the organizations studied would be chosen from HMG (the Planning Commission, the Departments of Agriculture and Forests), multi- and bilateral donor agencies and NGOs. As there is an enormous
volume of papers about resource management in Nepal, which are full of wishful thinking and rhetoric on conservation, emphasis will be on actors (rather than on paper), and specifically those actors that can claim presence in the field for a minimum period of say, two years. How do these agencies perceive environmental degradation? What information are their perceptions based upon? What are their models of explanation of "the problem"? How do the structural characteristics of these agencies influence their perceptions and policy/project design?

What factors influence the decision making behavior of such organizations? International forces, national level policy and institutional conflicts as well as administrative constraints are likely to enter this analysis. How do these organizations perceive and interact with rural people and how does this interaction affect the reproduction of environmentally relevant development organizations?

In the case of Zimbabwe, the analysis will focus principally on AGRITEX (which has already been subjected to an excellent institutional analysis. (Drinkwater 1988), but also on other major projects concerned with SWC and NGOs. The local organizations that interact with them are WADCOs and VIDCOs, as well as residual chiefly powers, cooperatives, womens' groups, cooperatives, grazing scheme committees, etc.

In the case of Nepal, the local organizations will be the panchayats or transitional organizations after the abandonment of "panchayat democracy," panchayat forest committees, and other informal groupings such as caste organizations, cooperatives (sajha), and the individual household. How was participation conceived of by the different actors involved? Was participation of land users allowed, encouraged, ceded or prevented and why? What negotiations took place between local people and the agency over resources and requirements regarding SWC?

What impact are the elected local government bodies likely to have on environmental management and how will popular participation (if it occurs) redefine land management options for rural people? How might decentralized environmental planning be feasible? The only difference in defining the research questions for Zimbabwe and Nepal is that elected local government bodies are already in place in the former, and are in a process of active change following the institution of multi–party democracy in the latter.

**Individual Decision–Making**

1. How are perceived and actual environmental choices and constraints distributed amongst the rural population in terms of age, gender, ethnicity, migratory status, location variables etc? What social processes (e.g., differentiation, population growth and commoditization) are changing this distribution?

2. How does the differential distribution of knowledge (indigenous and western) pattern agency? What role do perceptions, norms and belief systems have on decision making on natural resource use?

3. How do rural people individually or collectively adapt their agronomic and pastoral practices to cope with changing patterns of opportunities and constraints? What impact do these changes have on the environment in both the short and long term?

4. What is the nature of "environmental contracts" for different categories of people and how are these reproduced, changing or collapsing? This refers to common–property–resource management institutions, primarily rangelands in Zimbabwe and forests in Nepal. It also refers to the maintenance of SWC on private lands for safeguarding future income streams for the children of farmers. What role do development agencies play in these changing contracts?
5. What factors explain responses to conservation technologies—compliance and adoption, adaptation, evasion, rejection or resistance—amongst individuals at any particular time and historically? What are the aggregate effects of these decisions on institutional reproduction (e.g., the household, user group, district agricultural office)?

6. What are the politics of decision making at the household level—i.e., to choose, to veto, to enforce, to subvert, etc.—and how do these intervene in redirecting expected divisions of environmental responsibility? What relevance do they have upon decision making on resource use and for policy?

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