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Critical Political Ecology

The politics of environmental science

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2 Environmental science and myths

This chapter outlines the key problems addressed by this book. The chapter will:

- summarize some of the uncertainties associated with many definitions and explanations of environmental degradation commonly discussed as "fact" by politicians, activists, and in the media. Perhaps surprisingly, the explanations associated with these so-called problems are sometimes highly uncertain and contested by a variety of scientific research and local experience.
- discuss the impacts of such contested explanations on attempts to manage environmental problems, and on the livelihoods of people accused of causing problems. Some environmental policies adopted to address "problems" may actually not address the underlying causes of biophysical changes, and, in some cases, policies may unnecessarily interfere with livelihood strategies. The problems of desertification, soil erosion, and deforestation are summarized as examples.
- introduce the concept of "environmental orthodoxies" to describe common explanations of environmental problems that are considered to be simplistic and inaccurate. Some writers have also called these "myths." The chapter discusses how far such explanations can reasonably be called "science" or "myths" and explains how a focus on these problems does not mean supporting destructive land uses, but a greater attention to how science can engage with environmental problems.

This chapter therefore introduces the book's central theme of showing that many supposedly "factual" explanations of environmental problems are highly problematic and overlook both biophysical uncertainties and how people value environmental changes in various ways. The aim of this discussion is not to deny the existence of environmental problems, nor to legitimize destructive practices. Instead, there is a need to understand the complex social and political influences upon how we explain environmental problems, and then see such explanations as factual. A "critical" political ecology achieves these objectives, and offers the chance to construct more meaningful and effective forms of explaining environmental problems.

Overturning conventional environmental degradation

This chapter describes a problem relating to environmental science and politics that is growing in significance all the time. The problem is that many attempts to find political solutions to environmental problems are based upon well-known, or "orthodox" explanations of how environmental problems occur. Yet, increasingly, people are realizing that many of these orthodox environmental explanations are not as accurate as commonly thought.

It may come as a surprise to many people concerned about environment that some widely known definitions and explanations of environmental degradation are, in actuality, uncertain, highly contested, and misleading. Scientific disagreement about environmental explanations is already well recorded. For example, the media commonly reports on disagreements about whether "global warming" is occurring or not. Yet, in addition to these concerns, there are many other disagreements about topics that are commonly assumed factual and without disagreement. These disagreements can sometimes have serious implications because they can challenge many of our concerns about the impacts of other environmental changes such as global warming.

This chapter starts by analyzing three commonly identified causes of environmental degradation: desertification, soil erosion, and deforestation. These themes are referred to throughout the rest of the book, although other topics may be challenged in similar ways. The purpose of this analysis is to summarize how approaches to environmental degradation relating to these topics may overlook the complexity of changes, and the diversity with which people may view them. As further chapters show, such factors have importance for analyzing the political influence on, and of, environmental science.

Readers should note that the objective of this chapter is not to suggest that environmental problems do not exist, or that desertification, erosion, and deforestation may not, under certain circumstances, present serious problems. The objective, instead, is to show some problems that occur from using these concepts uncritically. Such problems often include the use of common terms such as "deforestation" to denote both environmental changes and degradation at the same time, or the implication that such changes have clearly defined human causes. As later chapters show, these assumptions overlook two key factors: the difficulty of making explanatory statements about long-term and complex biophysical processes; and the social and historical framing of explanations based upon one society's experiences of such changes.

The following discussions are, of necessity, brief, and cannot summarize all debates and uncertainties. The objective is to indicate how these terms have become synonymous with "degradation," yet are rooted in the experiences of particular groups over time, and represent only partial understandings of complex biophysical changes.

Example 1: desertification

Desertification is the concept that refers to land degradation in drylands. It is commonly referred to as an urgent and pernicious process that can lead quickly to associated problems such as drought, agricultural failure, and famine. The co-founder of the Worldwatch Institute, and well-known environmentalist, Lester Brown wrote:

> Easily a third of the world's cropland is losing topsoil at a rate that is undermining its long-term productivity. Fully 50 percent of the world's rangeland is overgrazed and deteriorating into desert... The doubling of the world's herds of cattle and flocks of sheep and goats since 1950 is damaging rangelands, converting them to desert.
>
> (2001: 8, 79)

Such concerns are highly questioned by a variety of scholars. Yet the image of desertification as the dangerous encroachment of deserts remains a popular theme in much environmental rhetoric. In 1975, one report suggested the Sahara might be advancing at the rate of 5.5km per year (Lamprey, 1975). In a website quoted by Katyal and Vlek, one disaster relief manager wrote: "Like an aggressive cancer, deserts are consuming more and more earth" (2000: 7).

The purpose of this discussion is to show the disparity between such emotive descriptions of environmental degradation, and a wide range of research that questions these statements on grounds of biophysical accuracy, and social relevance to the experiences of local people. These disparities suggest a variety of criticisms concerning how environmental degradation is discussed and explained.

Desertification is sometimes portrayed as an uncontrollable, human-induced phenomenon involving the sudden onset of drought, the death of vegetation, and eventually the transition of fertile land to sandy desert. This image has a long history. Scholars in the eighteenth century, for example, considered the Sahara desert to have been created by the Romans and Phoenicians as the result of deforestation, overgrazing, and overcultivation (Goudie, 1990). Such beliefs were strengthened by the apparent collapse of local empires in North Africa. In 1324, the Emperor of Mali, Mansu Musa, crossed the Sahara to Mecca with 500 slaves and 100 camels laden with gold (Bass, 1990: 13). The caravan's arrival en route in Egypt depreciated the precious metals market there by 12 percent, and spread rumors of the fabulous wealth of the empire's capital in Timbuktu. The empire declined, however, as the result of competition from new Portuguese and Spanish empires, and in 1738 half the population of Timbuktu

died of famine. When the city was visited in 1828 by a French traveler, he wrote graphically of his shock at finding apparent evidence of human failure in a barren land:

> I looked around and found that the sight before me did not answer my expectations... [The city] presented, at first view, nothing but a mass of ill-looking houses, built of earth. Nothing was to be seen in all directions but immense plains of quicksand of a yellowish-white color. The sky was a pale red as far as the horizon, all nature wore a dreary aspect; and the most profound silence prevailed; not even the warbling of a bird was to be heard.
>
> (René Caillié, 1828, in Bass, 1990: 13)

Research has since showed, of course, that the Sahara has resulted from the effects of large volumes of rising hot air at the equator, influenced too by the progressive desiccation of northern Africa since the end of the Pleistocene period, 10,000 years before present, when much of northern Europe was under glaciers (Goudie, 1990). Furthermore, other studies have argued conclusively that no threat from expanding deserts existed (Warren and Agnew, 1988). But it is difficult to separate such large-scale biophysical causes of deserts from the effects of apparent land mismanagement on the margins of deserts, such as in the Sahel, south of the Sahara. Paul B. Sears – the author of "Ecology: a subversive subject" (1964) referred to in Chapter 1 – wrote about desertification at the same time as the USA was experiencing the crisis of the Dust Bowl:

> The white man in a few centuries, mostly in one, reversed the slow work of nature that had been going on for millennia. Thus have come deserts, so long checked and held in restraint, to break their bonds. At every step the girdle of green about the inland deserts has been forced to give way and the desert itself has been allowed to expand... If man [sic] destroys the balance and equilibrium demanded by nature, he must take the consequences.
>
> (Sears, 1935: 67, in Worster, 1979: 200)

And Edward Stebbing, a British colonial forester, wrote in a similar vein about the dramatic invasion of deserts:

> Anyone possessing some knowledge of the desert-country types can come and study the stages, quite sufficiently clear-cut once the eye is attuned to discerning them, by which the desert has through the centuries, assisted by man [sic], advanced over rich and fertile regions.
>
> (Stebbing, 1937: 1, in Bass, 1990: 11)

Stebbing's comments also indicate how he considered desertification to result from the actions of irresponsible and misinformed people; and how he considered his own apparently greater knowledge to mark him as an obvious expert.

Such comments today are criticized for a variety of reasons (Correll, 1999). Perhaps most importantly, there is a greater understanding of the underlying biophysical causes of deserts, and particularly the role of climate in controlling relatively wet and dry periods that influence vegetation growth and sand movement in drylands (e.g. Thomas and Middleton, 1994). This research has also questioned the value of some historic approaches to "managing" desert growth by placing fences in the way of sand dunes. Indeed, such fences may even exacerbate the processes of sand movement.

There has also been a much deeper appreciation of adaptive practices adopted by people in drylands in lessening the impacts of drought, and in increasing the efficiency of rangeland management despite uncertainty about rainfall (e.g. Turner, 1993; Scoones, 1994). As such, adaptation strategies may not "prevent" the onset of drought, but they can reduce the immediate economic impacts of drought. Together with the advances in understanding the biophysical causes of "desertification," these responses show that farmers' actions may play only a limited role in causing dryland degradation, and in many cases may actually redress degradation of soils and vegetation (see also Anderson, 1984).

So where does this leave the concept "desertification"? Many writers have now strongly rejected attempts to link so-called desertification with purely social causes. Dregne (1985: 30) wrote "very little land has been irreversibly desertified as a result of man's [sic] activities." And Blaikie commented:

> The case for the globalization of capital being causal in desertification looks rather amateur, since the scientific evidence of permanent damage to the environment points in other directions ... For want of attention to a large and accessible body of climatological and ecological information, the case for adding desertification to the long list of other socially induced woes now looks very thin.
>
> (1995: 12)

Moreover, other writers have called upon the rejection of the term "desertification" itself. Thomas and Middleton (1994: 160), in a book called *Desertification: Exploding the Myth*, identified three commonly held "myths" of desertification: desertification is a voracious process which rapidly degrades productive land; that drylands are fragile ecosystems; and that desertification is a primary cause of human suffering and misery in drylands. In particular, Thomas and Middleton criticize the role of the United Nations Environment Program (UNEP) in prolonging these falsehoods. They wrote:

> The UN has played a major role in conceptualizing desertification since 1977 [the year of the first major UN conference on desertification]. It could be considered to have created desertification, the institutional myth. It has been the source of publicity that has frequently had little reliable scientific foundation. The success of UN-derived anti-desertification measures have yet to be reliably demonstrated and, in many cases, appear to have had little relevance to affected peoples. Without the UN, desertification may not be as high on the environmental agenda as it is today.
>
> (Thomas and Middleton, 1994: 161)

Many authors now suggest that the term "desertification" should be avoided as it implodes a variety of different "problems" such as drought, declining soil fertility, or local fuelwood scarcity, into one term that suggests the underlying problem lies in the land (e.g. Biot, 1995; Saberwal, 1997). Instead, critics have suggested official policy and development assistance should seek to provide "drought proofing" or other institutional support to farmers in drylands in order to increase the experience of drought as a life-threatening hazard.

But the old-fashioned images of desertification persist, and they also interfere with programs of social development. Thomas and Middleton (1994) noted, for example, that the government of Chad deferred the implementation of democratization measures during the 1980s because it claimed it needed to maintain control of anti-desertification programs. Many standard proposals for combating desertification, such as destocking, or the reduction of agricultural activities, may actually decrease the economic adaptability of people to drought (Turner, 1993). Some critics have suggested that on-going negotiations for the Convention to Combat Desertification (CCD) need to adopt the new thinking about desertification, and have instigated old divisions between so-called "expert" knowledge from researchers repeating the ideas about ecological fragility, and alternative knowledge relating to local adaptive processes to drought (Correll, 1999). Such criticisms of the CCD do not deny that millions of people face environmental problems in drylands. But evidence is growing that accepting uncritical explanations of desertification may actually impede biophysical understanding, and even inhibit social development.

Example 2: soil erosion

Soil erosion is another common concept of environmental degradation that is usually automatically interpreted as being problematic. Soil erosion refers to the physical removal of soil – primarily by wind or water – and commonly impedes agriculture because it removes nutrients contained in the topsoil. Erosion may also cause further problems in duststorms; unwanted deposition of soil (sedimentation); and in extreme cases, mudslides and landslides, although these may be better understood as a separate but related topic to soil erosion. There is no doubt that soil erosion causes severe problems of decreased agricultural productivity for millions of farmers worldwide. But it is not clear how far addressing "erosion" *per se* can alleviate these problems, or how far the assumptions made about erosion in development projects are applicable to all locations and farmers' practices (Morse and Stocking, 1995; Stocking, 1996).

Perhaps the most graphic illustration of the severe problems caused by erosion was the Dust Bowl in the southern Great Plains of the United States during the 1930s (Worster, 1979; Lookingbill, 2001). John Steinbeck's novel, *The Grapes of Wrath*, vividly captured the tragedy of sudden, apparently unstoppable erosion, and its impact on poor farmers in Oklahoma:

> Every moving thing lifted the dust into the air; a walking man lifted a thin layer as high as his waist, and a wagon lifted the dust as high as the fence tops, and an automobile boiled a cloud behind it ... Men stood by their fences and looked at the ruined corn, dying fast now, only a little green showing through the film of dust. The men were silent and they did not move often. And the women came out of the houses to stand beside their men – to feel whether this time the men would break.
>
> (1939: 1, 3)

Such images and consequences have been replicated in other works on erosion since. One classic example has been Eric Eckholm's (1976) *Losing Ground* that proposed how population growth in many fragile areas of the world would lead to food shortages and crisis.

But despite the obvious problems experienced during the Dust Bowl, the immediate attempt to address soil erosion through research proved exceedingly mixed. Following the erosion in the southern Great Plains area since the 1930s, researchers developed the Universal Soil Loss Equation (USLE) using varied measurements across the USA that intended to predict levels of erosion, and hence allow farmers to keep soil loss to within acceptable levels (USDA, 1961). The equation stated:

$$A = R \times K \times LS \times C \times P$$

Where A = average annual soil loss in tons per acre per year; R = the rainfall and runoff factor by geographic location; K = the soil erodibility factor; LS = the slope length–gradient factor; C = the crop/vegetation and management factor that limit soil loss for crops; and P = the support practice factor, such as contour farming, and other physical management of land locations (Morgan, 1986).

Yet, despite its name, the USLE is far from "universal." Three main problems with the equation have been identified. First, there is a general lack of information concerning the rates of soil formation, and consequently it is difficult to determine acceptable levels of soil loss rather than simply rates of soil loss. Second, the equation uses average rainfall

figures rather than referring to the intense storms that cause most erosion in the tropics. Third, no attempt was made in the initial equation to integrate soil erosion research into preexisting practices of soil conservation, or valuations of soil loss (Blaikie, 1985; Hallsworth, 1987).

> While the USLE works excellently across the Great Plains [of the USA], with but little variation from east to west, and sets out clearly the factors that need to be taken into account, the rainfall factor is based on average figures, whereas results from the subtropics have shown that the quantity of soil removed is determined by the occasional highly erosive storm and bear little relation to the average figures. Many attempts have been made to modify the USLE to make it suitable for use in the tropics, but with these two inherent deficiencies the problem is difficult to solve, and the attempts have probably absorbed too much of the relatively slim resources available for conservation work, with the inevitable neglect of work that would have been more relevant.
>
> (Hallsworth, 1987: 145)

Similarly, research has increasingly indicated the role of preexisting biophysical causes of erosion. Carbon dating of soil cores in Australia, for example, revealed that the cycle of erosion starting from the 1850s (when plowed cultivation started) was similar to early cycles of erosion at 390, 3,740 and 29,000 years before present – although these may have been caused by the burning of undergrowth by early human settlers (Walker, 1962). Much research in the Himalayas too has suggested that conventional concerns about soil loss have overlooked the normally high rates of soil movement under tectonic uplift and monsoonal rainfall, and also the roles of naturally occurring gullies on steep slopes in transporting sediment from highlands to lowlands (Höfer, 1993). It has also been shown that only part of erosion occurring on slopes may end up eventually in rivers or deltas (Trimble, 1983). Malin (1946) also argued that drought and dust storms had always existed in the southern Great Plains, and so the Dust Bowl could not always be attributed solely to human action.

Related to these criticisms, it is also clear that "erosion" *per se* need not always be a problem for some farmers because it may also lead to sedimentation of soil on agricultural land that provides nutrients for further agriculture. As Blaikie and Brookfield (1987) wrote, "one farmer's soil erosion is another farmer's soil fertility." Furthermore, in some localities there is evidence to suggest that the perception of sedimentation as a hazard may increase as more and more lowland farmers live in areas close to mountains (Ives and Messerli, 1989). Under such conditions, sedimentation may not have increased in absolute terms over time – or have been caused by upland farmers – but the impression of these may have been given because more lowland farmers experience it as a problem. Such complexity of impacts also suggests that referring to processes of declining soil fertility (or nutrient depletion), plus soil removal (erosion) and deposition (sedimentation) under the general single label of "soil erosion" may be insufficient to appreciate the various physical causes and social implications contained within it.

Yet, perhaps most crucially, research of practices used by farmers in many developing countries has questioned the extent to which erosion may be a "problem" according to both the impact of such erosion on agricultural productivity, and if managed well by local conservation practices. The orthodoxy that erosion is always a problem was shaken by research in Nepal showing that some hill farmers trigger some landslides in order to *improve* soil fertility, and facilitate the construction of terraces (Kienholz *et al.*, 1984). Similarly, other research has revealed that increasing population may also not lead to accelerated erosion. For example, in both the Machakos region of Kenya and in Peru, Tiffen and Mortimore (1994) and Preston *et al.* (1997) argued that careful land management could mean "more people, less erosion" (although these claim have been questioned). In Thailand, research showed that hill farmers deliberately avoided creating erosion on steep slopes (Forsyth, 1996). And in Papua New Guinea, the Wola people have maintained high agricultural productivity despite rising populations by integrating compost into complex soil mounds, and by using crops that do not exhaust nutrients (Sillitoe, 1993, 1998). There are many other examples (Millington, 1986; Richards *et al.*, 1989; Zimmerer, 1996a).

The point of these studies is not to suggest that "erosion" is never a problem, or that the experiences of the Dust Bowl should be discounted. Instead, the implication of this immediate discussion is to question how far the word, "erosion" – with its myriad associations of crisis resulting from the movement of soil by wind or water – is necessarily the best indication of the causes of soil degradation, or the most fitting policies to address it. Some researchers have suggested that it may be more appropriate to assess declining soil fertility as the key problem, rather than erosion (in the same way some have suggested drought is more relevant than desertification) (Reij *et al.*, 1996). Erosion may also preexist human impacts, and not necessarily be enhanced by them.

At present, lumping different experiences of environmental problems under the single category of "soil erosion" may hinder addressing the underlying biophysical causes of soil degradation, and may support proposed solutions that accentuate problems. Where proposals aim to restrict upland agriculture, policies may also impose hardships on agriculturalists when there may be diverse causes of apparent lowland sedimentation. Research of reforestation as a tool to combat erosion, for example, has indicated that many projects have actually increased lowland sedimentation by overlooking the relationship between sheet and gully erosion, and the influence of farmers' activities on reducing runoff (Zimmerer, 1996a, b; Calder, 1999; Driver, 1999). Reforesting land in order to control erosion may therefore have surprisingly counterproductive results.

Example 3: deforestation

Deforestation is probably the most emotive topic of popular environmental debate today. Many people concerned about environment have been persuaded by graphic images of burning forests, or the sight of complex, ancient forests being felled in minutes by loggers who care little for losses to global heritage, biodiversity, and impacts on global climate change. Deforestation has also been linked to causes of desertification and soil erosion too. Such common assumptions were listed by the report of the 1992 Earth Summit:

> The impacts of loss and degradation of forests are in the form of soil erosion, loss of biological diversity, damage to wildlife habitats and degradation of watershed areas, deterioration of the quality of life and reduction of the options for development.
>
> (UNCED, 1992: 233)

Undeniably, forest loss causes a variety of impacts. But again, the key contentions of this statement, and other commonly heard generalizations about deforestation, can be challenged. The commonly ascribed notion that forests – and particularly tropical rainforests – are fragile and pristine ecosystems is highly controversial. Experience of deforestation in the Amazon, for example, has indeed shown that forest regrowth after deforestation may be difficult on account of the lack of nutrients in soils, and the rapid erosion and degradation of soils following deforestation. Yet, new thinking has questioned the permanency of such disturbance; the ability to transfer such experiences to other locations; and the social values that attribute importance to different levels of disturbance.

First, much research has revealed historic rates of change and disturbance in forests. Crapper (1962), for example, estimated that some 90 percent of the forests of Papua New Guinea had been cleared at some point, mostly by fire. Areas now covered with rainforest were also much cooler and drier following the end of the Pleistocene, 10,000 years before present, and so current rainforests are generally newer biomes than sometimes claimed and also have evolved during a variety of changes (Whitmore, 1984).

Second, the role of deforestation in biodiversity loss has also been challenged. It is well reported that forests – again, particularly rainforests – contain significant proportions of the world's species. Early commentaries on rainforest destruction assumed a directly proportional relationship between area of forest lost and species made extinct. Norman Myers (1984), for example, wrote that tropical rainforest destruction represented "the greatest single setback to life's abundance and diversity since the first flickering of life four billion years ago," and estimated that one species was being lost every half hour. Later research has shown, by contrast, that this direct relationship is overstated, and that large numbers of species survive in remaining clumps of forest; that some historic extinctions, such as in the Permian age, were of greater significance; and that other ecosystems such as savanna also have high levels of biodiversity (e.g. Wu and Loucks, 1995).

Such research, of course, is not intended to justify rapid destruction of forests, but they do question the urgent calls of some conservationists that all forests be protected from human impacts. Indeed, other research has shown that forest disturbance itself can provide a boost to certain types of biodiversity. Many studies have indicated wide varieties of species under well-maintained shifting cultivation systems, which often use fire as a way to clear areas of closed forest (Schmidt-Vogt, 1998; Fox *et al.*, 2000). Much biodiversity under shifting cultivation, however, may exclude some "wild" genetic resources and large endangered animals such as tigers and hornbills that require large areas of forest, and are often incompatible with human land use in the form of settled villages or agriculture. Asserting "deforestation reduces biodiversity" therefore depends in part upon particular definitions of deforestation and biodiversity.

Third, an increasing number of studies question assumed links between deforestation and impacts on climate, hydrology, and erosion. Some of these studies were mentioned above in relation to soil erosion, and the relationships between climate change policy and forests are discussed more in Chapters 6 and 7. But it is now clear that many commonly held assumptions linking deforestation to erosion, water shortages, and even rainfall shortages have been shown to be either poorly supported by data, or contingent upon particular types of measurements (Thompson *et al.*, 1986; Hamilton, 1988; Hamilton and Pearce, 1988; Ives and Messerli, 1989; Calder, 1999). For example, Pereira wrote:

> The worldwide evidence that high hills and mountains usually have more rainfall and more natural forests than do the adjacent lowlands has historically led to confusion of cause and effect. Although the physical explanations have been known for more than 50 years, the idea that forests cause or attract rainfall has persisted. The myth was created more than a century ago by foresters in defense of their trees ... The myth was written into the textbooks and became an article of faith for early generations of foresters.
>
> (1989: 1)

Fourth, much new thinking has also highlighted the importance and diversity of social valuations of different kinds of forest and land uses associated with forest (Barraclough and Ghimire, 1996). It has already been mentioned that some shifting cultivator groups manipulate forest growth to maximize the production of valued species. Such actions may also enhance forest protection. Fairhead and Leach (1996), for example, demonstrated that villagers in Guinea, West Africa, had worked over a period of two or more centuries to produce "islands" of closed forest in

the boundary zone between savanna and forest. These "islands" had been created for various reasons, including the facilitation of defense, and the production of forest products. Yet, the finding comes in stark contradiction to official government explanations of forest loss (assisted by historic colonial experts), which alleged such islands were relics of a once larger forest area now lost because of deforestation.

Fifth, partly as a result of preceding challenges, our understandings of deforestation rates are also being challenged. Comparisons of satellite data and ground surveys of forest in many developing countries suggest great statistical ranges in estimates of forest area and quality (Leach and Mearns, 1988; Robbins, 1998). Taking such errors into account, Fairhead and Leach (1998: 183) have estimated that total forest loss in six West African countries since 1900 may reach 9.5–10.5 million hectares, rather than commonly-discussed estimates of 25.5–30.2 million hectares. (Indeed, some agencies, such as the World Conservation Monitoring Center, have placed deforestation in this region even higher, at 48.6 million hectares.) In the Himalayas, a survey of deforestation estimates between 1965 and 1981 revealed a variation in rates by a factor of 67, even after excluding some apparent typing errors (Donovon, 1981; Thompson *et al.*, 1986; Cline-Cole and Madge, 2000). Despite continuing high rates of deforestation in many locations, such statistical uncertainties are often not acknowledged, and as a result, some estimates become seen as factual and unchallenged.

There are clearly many debates about the accuracy of common perceptions of deforestation: this chapter cannot summarize them all. There is no implication in any of the challenges reported here that forest loss should be ignored, or that unregulated destruction of forest ecosystems should be tolerated. Also, it is clear that forests – and other ecosystems – are facing important, and still partially understood, threats from multifarious sources such as from the varied impacts of El Niño, or from projected future changes in climate. But it is clear that many previous accounts of deforestation's impacts have important flaws. Moreover, simply asserting that deforestation is always problematic overlooks both the physical complexity of how deforestation is carried out, and its variety of purposes and impacts:

> The generic term "deforestation" is used so ambiguously that it is virtually meaningless as a description of land-use change ... It is our contention that the use of the term "deforestation" must be discontinued, if scientists, forest land managers, government planners and environmentalists are to have meaningful dialogue on the various human activities that affect forests and the biophysical consequences of those actions.
>
> (Hamilton and Pearce, 1988: 75)

In addition, simply asserting that deforestation should be stopped may both neglect the diverse biophysical causes of supposed impacts such as biodiversity loss and soil erosion, and consequently may not address these problems. It may also impose unwarranted restrictions on agricultural practices used by people in affected zones. These dilemmas may occur in China, for example, where the government imposed a ban on logging in 1998 in order to avoid downstream flooding, and also in other locations where reforestation is now seen to be a panacea for various environmental problems including erosion control, biodiversity conservation, and climate change mitigation.

There is a need to define "deforestation" in more complex ways in order to distinguish between different levels of forest disturbance. Related to this is also the need to identify how and why "forests" may be identified and distinguished from other ecosystems. For example, it is clear that much attention given to tropical rainforests has tended to essentialize various different forest types into one, and also tend to diminish the importance of other forest ecosystems such as savanna (Whitmore, 1984; Solbrig, 1993). But more importantly, there is also a need to understand how such orthodox, and now widely challenged, powerful organizations and campaigners adopt conceptualizations of environmental degradation despite the growing evidence of the inadequacy of such concepts.

> The mindset created by the paradigm which links the absence of forests with "degradation" of water resources, and "more forest" with improved water resources, has not yet been destroyed. Until it is replaced it will continue to cause governments, development agencies and UN organizations to commit and waste funds on afforestation or reforestation programs in the belief that this is the best way to improve water resources.
>
> (Calder, 1999: 37)

Environmental orthodoxies

So, what are the implications of these problems for environmental science and politics? It is important to reiterate that these discussions of desertification, soil erosion, and deforestation do not deny the existence of environmental degradation, but illustrate the inadequacy of the concepts we use to define it. Concepts such as desertification, soil erosion, and deforestation have clearly been associated with severe environmental problems within particular contexts. Yet, used universally and uncritically, these concepts may actually undermine both environmental management and social development by adopting simplistic approaches to the causes of biophysical change, and by encouraging the imposition of land use policies that may only restrict local livelihoods.

Perhaps the most significant feature of such common definitions of environmental degradation is that they continue to be used despite the accumulation of evidence to suggest they are flawed. The continued use of these terms is analyzed in this book, and is seen to be a product of a

variety of political influences. Politics underlie the construction of these terms, their continued adoption, and the presentation of them by particular actors as legitimate and accurate representations of reality.

This book uses the term "environmental orthodoxies" to refer to these institutionalized, but highly criticized conceptualizations of environmental degradation. The concept of environmental orthodoxies was used by Leach and Mearns (1996) to describe the persistence of particular explanations of environmental change in policy processes despite the accumulation of evidence to reject or redefine them. Other authors have used similar terms. Calder (1999), for example, uses the term "mother statements," and Adger *et al.* (2001) refer to them as "truth regimes." More generally, these explanations may also be referred to as "environmental narratives" (Roe, 1991, 1995; Harré *et al.*, 1999), and environmental "storylines" (Hajer, 1995). The existence of "myths" or "simplifications" in debates about land-use-cover change have also been noted by a variety of authors in policy debates elsewhere (also see Holling, 1979; Thompson *et al.*, 1986; Batterbury *et al.*, 1997; Adams, 2001; Lambin *et al.*, 2001).

Box 2.1 contains a definition of environmental orthodoxies that is useful for further discussion in this book. Box 2.2 contains some examples of environmental orthodoxies and includes a variety of themes of land-use-cover change. It is also worthwhile defining so-called "environmental adaptations" which are often the examples of local land management that provide exceptions to environmental orthodoxies. Such adaptive practices are discussed further throughout the book.

"Environmental orthodoxies" reveal a variety of characteristics. First, as Boxes 2.1 and 2.2 indicate, orthodoxies are often vague statements or "received wisdom" rather than a narrowly defined scientific theory or hypothesis. Indeed, many physical environmental scientists agree with some of the concerns about vague generalization or biophysical inaccuracies exhibited by orthodoxies (Schumm, 1991; Holton, 1993). Box 2.2 describes some specific orthodoxies relating to topics of land-use-cover change. It is worth noting, however, that similar environmental "myths" or meta-narratives exist in other aspects of environmental debate. For example, the concept of "balance-of-nature" (or non-equilibrium ecology) is examined in Chapter 3; assumptions about environmental impacts concerning gender and other social divisions are discussed in Chapters 4 and 6; debates about environmental "fragility" or "crisis" are covered in Chapter 5; and questions about the supposedly "global" nature of problems are considered in Chapter 7.

Second, the discussion of environmental orthodoxies might appear hostile to many tenets of popular environmentalism because it questions the urgency or role of human action in environmental degradation. This perception may be misplaced, because the purpose of discussing orthodoxies is to improve our understanding of environmental change, and to enhance our means of preventing environmental problems. Furthermore, the discussion of environmental orthodoxies is not necessarily based on a

Box 2.1 Environmental orthodoxies and adaptations

Environmental orthodoxies are generalized statements referring to environmental degradation or causes of environmental change that are often accepted as fact, but have been shown by field research to be both biophysically inaccurate and also leading to environmental policies that restrict socio-economic activities of people living in affected zones. Environmental orthodoxies are frequently based upon images of environmental changes as crises brought about by human action, and overlook the role of adaptive practices performed by particular land users in either mitigating or even reversing environmental degradation. They also commonly overlook the role of long-term, complex biophysical factors in causing apparent degradation, such as non-anthropogenic climate change; tectonic uplift; or the historic frequency of events such as floods or fires. Research on environmental orthodoxies has been associated with, yet is not necessarily part of, the discussion of "non-equilibrium" (or non-linear) ecology that emphasizes the prevalence of disturbance and change within ecological systems, and the social influences on the identification of time and space scales.

Environmental adaptations are practices adopted by people to mitigate the environmental impacts of resource scarcity or environmental change on local resources. Adaptations may be divided into adaptive *strategies* and adaptive *processes*. Adaptive strategies are practical decisions by an individual to change productive activities, such as selling livestock during drought years, or building small-scale soil conservation measures such as mounds or *diguettes* (stone lines) to prevent declining soil fertility. Adaptive processes are more long-term decisions that create socio-economic trends, such as the decision to undertake long-distance migration, or the building of terraces on agricultural land. Usually, the adoption of environmental adaptations may be associated with actions that contradict the predictions of environmental degradation resulting from environmental orthodoxies. Moreover, environmental adaptations may also be seen as the opposite to environmental orthodoxies, as orthodoxies represent generalized expectations based on prior assumptions about population growth and ecological fragility, whereas environmental adaptations illustrate local instances where the negative impacts of degradation have been avoided.

Sources: Leach and Mearns, 1996; Batterbury *et al.*, 1997; Batterbury and Forsyth, 1999.

statement that environmental problems do not exist, but instead that the terms used to describe them are inaccurate and unhelpful. In this sense, discussing environmental orthodoxies is different to some attempts to dismiss environmental concerns on grounds of optimism about economic growth (such as Björn Lomborg's *The Skeptical Environmentalist,* 2001). (The potential clashes between environmental orthodoxies and environmentalism are discussed later in this chapter.)

Third, engaging in debates about environmental orthodoxies also implies raising questions about scientific realism. By their very nature,

Box 2.2 Examples of environmental orthodoxies

Orthodoxy and new findings (simplified)	*Sample references*
Desertification	
• Orthodoxy: the belief that population growth, deforestation, and intensive agriculture on the margins of desert areas is leading to irreversible increase in desert areas, decline in rainfall, and associated famine. (Such beliefs have often led to policies that seek to restrict livestock and agricultural holdings in drylands; or strategies to "prevent" desertification by planting trees or building fences to prevent the spread of sand dunes.)	**Pro-orthodoxy** Sears, 1935; Stebbing, 1937; Lamprey, 1975; Brown, 2001
• New findings: researchers now understand the greater significance of long-term fluctuations in rainfall and climate in drylands, and that efforts to prevent movement of sand by placing barriers to sand dunes may make problems worse. Farmers may not be culpable for causing desertification, as there are ways in which they reduce impacts on soils, and the diversity of causal factors is high. "Desertification" has often been confused with "famine" and "drought," but "drought" may be a more effective means of assessing livelihood concerns than "desertification."	**Anti-orthodoxy** Dregne, 1985; Biot, 1995; Thomas and Middleton, 1994; Blaikie, 1995; Hoben, 1995; Saberwal, 1997; Rasmussen *et al.*, 2001
Tropical deforestation	
• Orthodoxy: a variety of beliefs referring to the fragility of tropical (often rain) forests; the role of forests in maintaining biodiversity; and the pressures upon forests from rising populations, especially of local agriculturalists such as shifting cultivators or poor people in search of fuelwood. Disturbances such as deforestation and fire may cause severe and long-lasting damage to forests and biodiversity. (Such beliefs have led to a variety of policies that seek to protect forests from interference from local people.) (See also "Shifting cultivation.")	**Pro-orthodoxy** Richards, 1952; Myers, 1984; Mather, 1992; Mather and Needle, 2000; Brown, 2001
• New findings: research has questioned many aspects of orthodox concepts of deforestation. While not denying a role for population growth or poverty, movements of people who undertake deforestation are more likely to be	**Anti-orthodoxy** Leach and Mearns, 1988; Agarwal and Narain, 1991; Rocheleau and

affected by government policies that encourage migrants, or loss of political stability in frontier regions. Similarly, "deforestation" need not signify clearfelling, or complete loss of land cover, but instead a variety of impacts, sometimes minor. Some farming communities may even contribute to the growth and protection of forests. The role of disturbance, such as by fire, is acknowledged as a source of change and development of biodiversity within certain forest ecosystems. Biodiversity also need not be maintained only through preserving forest areas, as neighboring grasslands or savanna systems may also have high biodiversity. Impacts of population growth on rural energy requirements need not necessarily lead to uncontrolled deforestation, and instead need to be understood alongside other sources of energy.

Ross, 1995; Barraclough and Ghimire, 1996; Fairhead and Leach, 1996, 1998; Cullet and Kameri-Mbote, 1998; Robbins, 1998; Angelsen and Kaimowitz, 1999; Cline-Cole and Madge, 2000; Kull, 2000; Lambin *et al.*, 2001

Shifting cultivation

- Orthodoxy: the belief that shifting cultivation, or "slash and burn" agriculture, is of necessity destructive of forests; has low agricultural productivity; and causes a variety of lowland impacts such as water shortages and sedimentation. (These heliefs have led to policies that identify shifting cultivators as responsible for various forms of environmental degradation, and, consequently, efforts to resettle them, or restrict upland agriculture through re/afforestation.) (See also "Himalayan degradation" and "Watershed degradation.")

Pro-orthodoxy
Myers, 1984; Mather and Needle, 2000

- New findings: research has indicated that there are many different forms of shifting cultivation, and that environmental impacts depend on the length of tenure at specific sites by settlers: some cultivators adopt semi-sedentary practices such as terracing, soil conservation, or coppicing of forests. Shifting cultivation in general may not cause "loss" of forest, but instead may encourage development of specific types of forest and biodiversity. Many supposed impacts of upland agriculture may be caused by preexisting and long-term biophysical processes such as gullying or factors leading to low levels of water retention in highland zones.

Anti-orthodoxy
Conklin, 1954; Geertz, 1963; Angelsen, 1995; Fairhead and Leach, 1996; Sillitoe, 1993, 1998; Schmidt-Vogt, 1998; Fox *et al.*, 2000

Rangeland degradation

- Orthodoxy: the belief that rangelands (or grasslands) are natural "climax" vegetation systems that are determined by edaphic factors such as soil or climate. Rangelands may also therefore have natural "carrying capacities" for people and livestock. (Such beliefs have led to policy proposals to limit numbers of livestock or restrict agriculture.)

Pro-orthodoxy
Harris, 1980

- New findings: research has indicated that large areas of rangelands are maintained by interactions of human impacts on longer-term biophysical changes. Restricting human activities may therefore lead to rapid changes. Multiple states of stability may be experienced with different forms or stages of vegetation growth. Grazing may be necessary to maintain such states.

Anti-orthodoxy
Solbrig, 1993; Turner, 1993; Scoones, 1994; Bassett and Zuéli, 2000; Oba *et al.*, 2000

Agricultural intensification

- Orthodoxy: the belief that population growth is leading smallholders, especially in developing countries, to increase agricultural intensification toward unsustainable levels. High levels of agricultural intensification may lead to erosion, or exhaustion of land and water resources. (These beliefs have, in part, led to policies that seek to rationalize agriculture in many developing countries.) (See also "Shifting cultivation.")

Pro-orthodoxy
Eckholm, 1976; Ehrlich and Ehrlich, 1991

- New findings: research has indicated that methods of agricultural intensification are complex, and may involve a variety of livelihood strategies including income diversification (perhaps involving part-time migration or non-agricultural income); or intensified methods of increasing production without environmental degradation.

Anti-orthodoxy
Netting, 1993; Tiffen and Mortimore, 1994; Mortimore and Adams, 1999; Bebbington and Batterbury, 2001

Watershed degradation and water resources

- Orthodoxy: a series of inter-connected beliefs relating to the degradation of soils and forests on watershed areas (or zones, commonly mountainous, that are seen to supply water to other areas, often in lowlands). Beliefs may include: that forests increase rainfall; forests increase runoff; or that forests reduce erosion and floods. (These beliefs have often led to policies that seek to relocate farmers from watershed zones; to reforest watersheds,

Pro-orthodoxy
Wittfogel, 1956; Openshaw, 1974; Postel, 1993; Revenga *et al.*, 1998

often with plantation forestry; or to achieve all of these by converting watersheds into national parks or other protected lands.) (See also "Himalayan degradation.")	
• New findings: a wide variety of research has questioned either the scale or the uniformity of orthodox beliefs. For example, the effects of forests on rainfall are small, but cannot be totally dismissed. Similarly, the impact of forests on erosion is highly variable, depending on types of forest and types of erosion (plantation forests may increase sheet erosion; much gully erosion may be greater under "natural" forests than on cultivated slopes). The belief that forests increase runoff, however, has been widely dismissed (although there are commonly changes to the speed and seasonality of discharge, although evidence linking floods to deforestation is highly variable). The influence of lowland increase in demand for water in causing apparent water shortages also needs to be acknowledged.	**Anti-orthodoxy** Hamilton, 1987, 1988; Hamilton and Pearce, 1988; Pereira, 1989; Alford, 1992; Chapman and Thompson, 1995; Chomitz and Kumari, 1996; Calder, 1999; Custodio, 2000; Gyawali, 2000; Calder and Aylward, 2002
Theory of Himalayan environmental degradation	
• Orthodoxy: the belief that increasing population and agricultural intensification in the Middle Hills of the Himalayas (and similar regions) is leading to a downward cycle of deforestation, erosion, landslides, and lowland sedimentation. (Beliefs have supported policies seeking to restrict highland land use, resettle villages, or reforest large areas of hillslopes.)	**Pro-orthodoxy** Eckholm, 1976; Cronin, 1979
• New findings: research has since shown that much erosion is caused by processes other than agriculture (such as gullying or the effects of tectonic uplift); that farmers may adopt practices to mitigate erosion and land failure; that much degradation of agricultural land has been related to historic large-scale land clearance; and that lowland floods have diverse causes. Increasing population is more likely to decrease soil fertility on gentle slopes where fallow periods decline, rather than lead to cultivation on steeper slopes, as many farmers appreciate that this is where erosion, and hence declining soil fertility, is highest.	**Anti-orthodoxy** Thompson *et al.*, 1986; Hamilton, 1987; Ives and Messerli, 1989; Metz, 1991; Forsyth, 1996; Gyawali, 2000; Calder and Aylward, 2002

environmental orthodoxies are explanations that have questionable accuracy and relevance. Seeking more accurate, and more relevant, explanations must therefore require examining questions of epistemology and ontology concerning environmental science and biophysical change (see Chapter 1). This kind of analysis may be different to many other debates in environmental sociology or politics that focuses on contested environmental values (e.g. McNaughten and Urry, 1998) because it also considers how far a "real" biophysical world may exist alongside the biophysical explanations of it. Such analysis, therefore, needs to incorporate debates about science studies and biophysical epistemology in ways that environmental sociology or politics commonly do not do.

Fourth, the ability to learn about environmental orthodoxies has usually come when existing conceptualizations of environmental degradation have been shown to be deficient. Deficiencies may be in terms of biophysical environmental management, such as in the case of fences to stop desertification, or when policies have caused widespread local resentment. These factors have significance for debates about how we learn about the inaccuracies of environmental science, and are discussed more in Chapter 8.

Finally, it is important not to underplay the potential impacts of environmental orthodoxies on affected peoples. Some proposed "solutions" to problems of desertification, soil erosion, and deforestation, for example, have included placing restrictions on livestock numbers or planting practices of poor people living in zones considered to be at risk from degradation. Other forms of control, such as taxation, fines, and even imprisonment have been applied to practices that may be claimed to be not degrading. Fairhead and Leach described such social injustices in relation to the Kissidougou region of Guinea:

> It is hard to underestimate the importance of the degradation discourse's instrumental effects on many aspects of Kissidougou's life. These have impoverished people through taxes and fines, reduced people's ability to benefit from their resources, and diverted funds from more pressing needs. They have accused people of wanton destruction, criminalized many of their everyday activities, denied the technical validity of their ecological knowledge and research into developing it, denied value and credibility to their cultural forms, expressions, and basis of morality, and at times even decried people's consciousness and intelligence. The discourse has been instrumental in accentuating a gulf in perspectives between urban and rural; in undermining the credibility of outside experts in villagers' eyes; in provoking mutual disdain between villages and authority, and in imposing on the farmer images of social malaise and incapacity to respond to modernity.
>
> (1996: 295)

Challenging the I = PAT equation

The preceding discussion of environmental orthodoxies highlighted the problems of environmental explanations on specific themes. Yet these specific explanations also reflect some broader debates that underlie much general environmental concern. One of these frameworks is the so-called I = PAT equation.

The I = PAT equation has been employed – often implicitly – as the basis for the study of environmental degradation since the early 1970s (Ehrlich and Holdren, 1974; Kates, 2000a). The equation states, simply, that environmental impacts (I), are a function of population growth (P); the affluence, or rate of consumption of particular societies (A); and the technological innovations that may either enhance rates of consumption, or allow societies to reduce impacts on resources through greater efficiency or by the management of degrading influences (T). The equation is closely linked to the long-running Limits to Growth debate, in which Malthusian notions of environmental change (accentuating the adverse effects of population increase on limited resources) may be offset by more optimistic Boserupian thinking (that stresses the ability for technological innovation and adaptation to allow apparent limits to be exceeded). It is also linked to the "tragedy of the commons" model that proposes environmental collapse will result following unrestricted access of private actors upon public resources (Hardin, 1968).

The I = PAT equation has also been linked to many "orthodox" conceptions of the role of poverty (or lack of affluence) in environmental degradation. Some statements reflecting the equation were made in the 1987 Brundtland Commission (WCED, 1987), for example:

> Poverty is a major cause and effect of global environmental problems. It is therefore futile to attempt to deal with environmental problems without a broader perspective that encompasses the factors underlying world poverty and international inequality.
>
> (1987: 59)

Or:

> Many parts of the world today are caught in a vicious downwards spiral: poor people are forced to overuse environmental resources to survive from day to day, and their impoverishment of their environment further impoverishes them, making their survival ever more difficult and uncertain.
>
> (ibid.: 27)

Increasingly, however, there are important reasons to question the uniformity of these statements. Indeed, some observers have called these statements a further set of "myths" (see Box 2.3). These claims reiterate the

Box 2.3 Myths and oversimplifications concerning poverty and environment

	"Myth"	*"New thinking"*
1.	The poor cause most environmental degradation.	In general, the rich use more resources and have greater environmental impact than the poor. Poverty, however, often forces people to use resources unsustainably.
2.	Economic growth inevitably leads to environmental degradation.	Economic growth can help pay for a better environment, and improved environmental management enhances and sustains growth.
3.	The poor don't care about the environment.	The poor are acutely aware of the negative effects of a poor environment on their lives, particularly as they often depend directly on the environment for survival.
4.	The poor lack the knowledge and resources to improve their environment.	The poor can and do invest in better environmental management, particularly where incentives and information are available. Their traditional knowledge is often undervalued or ignored.

Source: DFID, 2002; also see Forsyth, Leach and Scoones, 1998; Leach and Mearns, 1991.

importance of so-called "environmental adaptations" as means of establishing environmental protection and livelihoods.

There is no suggestion in the environmental orthodoxy debate that population, affluence/poverty, or technology play no role in environmental degradation, or that we should not seek to alleviate world poverty. But the implications of environmental orthodoxies are that the assumptions underlying much thinking influenced by the I = PAT equation are simplistic for two key reasons. First, the equation overlooks the diverse ways in which environmental changes and impacts may (or may not) be experienced as degradation. Second, it fails to acknowledge how poor people do not necessarily cause environmental degradation through the adoption of environmental adaptations or practices that conserve environmental resources, even in the presence of population growth and supposed ecological fragility. These flaws can be attributed to the failure of the I = PAT equation to acknowledge the role of social norms and organization on both sides of the equation, concerning how "population growth, affluence, and technology" (PAT) may be managed, or in relation to the definition and meaning of "impacts" (I).

Much research within cultural ecology has acknowledged the role of local adaptive processes in influencing how population, affluence, and technology may influence environmental impacts. For example, the soil mounds of the Wola in Papua New Guinea mentioned above may be considered a "technology," but the training, and integration of soil mounds into other forms of livelihood are all functions of social organization (Sillitoe, 1998). These factors suggest that it is difficult to assess the impacts of population, affluence, and technology without acknowledging the social setting.

Furthermore, environmental "impacts" may also be contextualized. As discussed above, a variety of changes in environment may be seen alternatively as positive or negative depending on the objectives of different land users. Such alternative objectives might include the vision of forest as a source of nutrients for soil, and a barrier to agriculture (as some shifting cultivators might perceive some areas of forest); or the appreciation of forests as aesthetically pleasing and endangered forms of landscape. The dilemma for the I = PAT equation is that, clearly, the discussion of "impacts" are dependent upon such valuations, yet the equation does not acknowledge how, or by whom, such valuations are made (see Hynes, 1993).

This book builds on the criticisms of the I = PAT equation by presenting a variety of analyses of how both "I" and "PAT" may be affected by social norms and organization. Again, this critique does not imply that population, affluence, or technology need never contribute toward environmental degradation (see also Kasperson *et al.*, 1995; Batterbury *et al.*, 1997; DeHart and Soulé, 2000; Lambin *et al.*, 2001). Instead, the objective is to ensure that environmental explanations are not made uncritically and universally in ways that overlook the biophysical complexities of how environmental degradation occurs, or that the policies linked to such explanations do not restrict local livelihoods.

Science or myths?

This book, therefore, examines the means by which different environmental explanations become dominant; the political implications of such different explanations; and the ways such dominant explanations may be democratized in order to make environmental science more accurate and relevant to a wider number of people. This task, however, requires rethinking approaches in both environmental science and politics.

It is tempting, for example, to refer to environmental orthodoxies as "myths," in the sense of "falsehoods," because they refer to statements that are commonly taken as "fact," but which have been shown to be highly flawed in practice. Thomas and Middleton (1994), for example, adopt this approach in their book, *Desertification: Exploding the Myth.* Consistent with orthodox science, this approach assumes that the problem of environmental orthodoxies can be overcome by improving the flow of information to policy debates and agencies in order to correct the falsehood.

Yet the word "myth" need not only refer to information that is "false," but also to systems of knowledge and belief that are seen essentially as "true." (For example, see the quotation from *Cyrano de Bergerac* repeated at the front of this book: "Call it a lie, if you like, but a lie is a sort of myth and a myth is a sort of truth.") Influenced by Roland Barthes, Rangan wrote: "Myths are produced through narratives that render particular social events significant by transporting them from their geographical and historical contexts into the realm of pure nature" (2000: 1).

Such "truthful" forms of myth may take various forms. On one hand, much "local" knowledge or cultural practices such as environmental adaptations may be referred to as mythology or "lore," because they represent embedded trusted knowledge (Johnson, 1992). On the other hand, environmental orthodoxies, or dominant scientific explanations from outside, may also be considered "mythical" if they form a source of conceptual organization and authority from which to approach environmental management. Indeed, Karl Popper, the great defender of the scientific method, wrote that much of the popular power of science lay in its "poetic inventiveness, that is, story-telling or myth making: the invention of stories about the world" (Popper, 1994: 40). The evolution of such orthodoxies from conventional "science" may therefore not diminish their mythic stature (see the debate between Metz, 1989 and Thompson, 1989; Forsyth, 1998a).

Instead of seeking a once-and-for-all definition of what may be considered true or false about environmental explanations, perhaps it is more constructive to examine how, and under which conditions, statements about environmental causality may be considered true. This book therefore aims for a different approach to that commonly adopted within orthodox science sometimes known as "synoptic rationality" in which decisions are made based on first collating "all the facts" (Collingridge and Reeve, 1986: 63). Synoptic rationality has often been applied to environmental science, such as through Baarschers' (1996) book, *Eco-facts and Eco-fiction.* In contrast, this current book questions the very meaning of the word "fact," although this does not mean that accuracy or realism are impossible.

Such an approach to ecological reality, however, commonly attracts two kinds of criticism. First, it is often thought (incorrectly) that the deconstruction of scientific discourse in the manner of the environmental orthodoxy debate is a movement toward cultural relativism – or the belief that social factors have more relevance to the dominance of particular scientific explanations than any resemblance to the "real world." Contrary to expectations, the environmental orthodoxy debate does not suggest that *any* scientific statement may be considered truthful, or that there is no "real world" about which to build explanations. The objective, rather, is to examine how explanations of biophysical events and processes may emerge as the result of different social and political experiences, and to analyze their political implications. This objective is discussed in more detail throughout the book.

Second, some observers have claimed that criticisms of dominant environmental science might also imply a rejection of environmentalism. Indeed, as noted in Chapter 1, Paul and Anne Ehrlich (1996) published a book on this subject entitled *A Betrayal of Science and Reason*. In particular, this book described "brownlash" as a form of environmental research that deliberately undermines environmental concern. Brownlash is commonly sponsored by large industries that seek to avoid environmental regulation such as research publicized by the Global Climate Coalition (http://www.globalclimate.org/). Indeed, some similar concern has been raised in Great Britain by the publication of some monographs about environmental orthodoxies by the British pro-market think tank, the Institute of Economic Affairs, even though these monographs do not explicitly discuss pro-market ideas (see Morris, 1995; Stott, 1999).

It is important to note that the debate about environmental orthodoxies is not a form of brownlash. There are many differences between brownlash and research focusing on environmental orthodoxies. First, most research on environmental orthodoxies has been unrelated to any work conducted on behalf of large industries. As discussed above, many studies highlighting environmental orthodoxies has come from cultural ecology, or work conducted by researchers working in regions where such orthodoxies are clearly inaccurate. Second, research on orthodoxies has often revealed that dominant scientific explanations *get in the way of* achieving environmentalist objectives. For example, research on water shortages in watershed regions has often indicated that plantation reforestation will reduce rather than improve supply of water to the lowlands. Indeed, research has also shown that some orthodoxies may result in insufficient regulation of other, more environmentally damaging activities, such as high water demand outside watershed areas (Forsyth, 1996; Calder, 1999). Third, much research on orthodoxies has been conducted within the frameworks of orthodox science – for example, by using detailed empiricism and a critical engagement with hypotheses – rather than an outright rejection of scientific practice. And fourth, many studies have sought to demonstrate the negative impacts of hegemonic environmental explanations on poor people who have often protected resources from degradation.

But while there are many ways in which the environmental orthodoxy debate should not be seen as brownlash, there are also ways in which this debate can still be critical of some environmentalist statements. As discussed above, such statements may include simplified explanations that overlook the complexity of biophysical changes; or those values or policies that restrict local livelihoods.

One possible example of this kind of explanation could come from the Ehrlichs themselves. Writing about a visit to Rwanda in central Africa, they stated:

> Going around the world in search of butterflies also gave us a personal view of then little-recognized signs of environmental deterioration. . . . We would have been hard-pressed to find relatively undisturbed habitat at many of our stops in what we had imagined to be an "unspoiled" tropical paradise. . . . In the early 1980s we traveled through Rwanda to the Parc National des Volcans, home of the rare mountain gorilla. The nation presented a classic picture of overpopulation and environmental deterioration: steep hillsides farmed to the tops with little or no erosion control, patches of exotic (non-native) eucalyptus trees being heavily coppiced for firewood, and rivers running red with eroded soil.
>
> (1996: 5–6)

The problem with this kind of statement is that it ascribes a notion of "unspoiled paradise" to many locations of the developing world that experience rapid processes of rainfall, soil movement, and vegetation change regardless of human activities. Furthermore, while it is clear that human settlement does impact on ecosystems, in many locations such settlement (and agriculture) interacts with local ecosystems to produce different, yet no less viable, biogeographic systems. The quotation's romantic image of "rivers running red with eroded soil" – apparently because of human mismanagement – is misplaced because there is no other evidence (in this quotation at least) that erosion did not predate agriculture, or that it causes severe problems for the people in this village. Finally, many people in developing countries might object to the primacy afforded in this quotation to butterflies and the image of an unspoiled paradise when the villagers at this site are engaged in building livelihoods through agriculture. (One could ask whether the cities of North America and Europe also reflect forms of ecological sustainability and irresponsibility.) Many people living in such regions may be struggling with short-term survival against a range of social, economic, and political problems, and consequently may value butterflies and wildlife less.

The point of this discussion is not to denigrate the environmental concern shown by the Ehrlichs, or to suggest that brownlash should not be criticized. Furthermore, there is no intention to suggest that we have to choose between economic livelihoods and wildlife such as butterflies, or that economic growth should be tolerated whatever its costs.

Instead, the aim is to indicate that many discussions of what should count as "science and reason" under popular environmentalism reflect many tacit assumptions about environmental values and science that can be challenged on many grounds. Indeed, some of these themes can be described as mythical, either in terms of myths as falsehoods (such as the automatic assumption that erosion is degrading or human-induced), or myths as guiding principles about how things should be (such as in the vision of an "unspoiled paradise").

It is therefore difficult to distinguish between "myths" and "science," even though the stated intention of science is to achieve a privileged form of knowledge different from opinions and folklore. "Science" itself is subject to social influence, either in the formulation of objectives that reflect social agendas, or in its rhetorical use to legitimize particular conceptualizations of environmental explanation against others.

This book seeks to overcome some of these dilemmas by looking more closely at the social and political factors that influence the constitution and use of environmental science. Under a "critical" political ecology, there can be no unpoliticized use of the word "ecology," and every statement about the nature or causes of ecological degradation is examined to reveal how this link was established, and how far it may hide political assumptions and implications. This approach may challenge some commonly held beliefs about environmental degradation. But it may eventually create a more accurate and relevant form of environmental explanation.

Summary

This chapter has summarized some of the book's central questions that will form the basis for discussion in later chapters.

Many popular and political debates about environment are based upon conventional beliefs, or "received wisdom" about environmental degradation that are highly challenged and uncertain. Indeed, some observers have called these explanations "myths." The chapter summarized examples of such contested science in relation to desertification, soil erosion, and deforestation. Many conventional approaches to these problems have resulted in land-use policies that have either simplified the underlying biophysical causes of apparent problems, or even imposed restrictions on the livelihoods of local people.

These conventional – yet questionable – explanations are referred to as "environmental orthodoxies." Yet, such orthodox thinking may also include simplistic generalizations about the role of population, affluence, and technology in environmental degradation (the I = PAT equation), or the view that "nature" should be in balance. Discussing the problems of such explanations does not deny the existence of environmental degradation, but rather criticizes the concepts and approaches we have used to define it.

This book seeks to explain how such environmental orthodoxies have emerged, and how they may be challenged with more relevant approaches

to environmental science. Yet, rather than simply suggesting that environmental orthodoxies are "myths" in the sense of falsehoods, it may be more constructive to see how orthodox explanations are seen to be true. Dominating visions of environmental explanation and science may continue to exist because they are seen by many to be fair and accurate, and because they may uphold visions of how the world should be. The following chapters consider both the "false" and "true" aspects of environmental myths.

Bibliography

Adams, W.M. (1997) "Rationalization and conservation: ecology and the management of nature in the United Kingdom," *Transactions of the Institute of British Geographers* NS 22: 277–291.

Adams, W.M. (2001) *Green Development: Environment and Sustainability in the Third World*, 2nd edn, London: Routledge.

Adger, W. (2000) "Social and ecological resilience: are they related?" *Progress in Human Geography* 24: 3, 347–364.

Adger, W., Benjaminsen, T., Brown, K., and Svarstad, H. (2001) "Advancing a political ecology of global environmental discourses," *Development and Change* 32: 4, 687–715.

Agarwal, A. and Narain, S. (1991) *Global Warming in an Unequal World*, New Delhi: Center for Science and Environment.

Agger, B. (1992) *The Discourse of Domination: from the Frankfurt School to Postmodernism*, Evanston, IL: Northwestern University Press.

Agrawal, A. (1995) "Dismantling the divide between indigenous and scientific knowledge," *Development and Change* 26: 3, 413–439.

Agrawal, A. and Gibson, C. (1999) "Enchantment and disenchantment: the role of community in natural resource conservation," *World Development* 27: 4, 629–649.

Ahluwalia, M. (1997) "Representing communities: the case of a community-based watershed management project in Rajasthan, India," *IDS Bulletin* 28: 4, 23–26.

Alford, C. (1985) *Science and the Revenge of Nature*, Gainesville, FL: University Presses of Florida.

Alford, D. (1992) "Streamflow and sediment transport from mountain watersheds of the Chao Phraya basin, northern Thailand: a reconnaissance study," *Mountain Research and Development* 12: 3, 257–268.

Allen, B. (1993) *Truth in Philosophy*, Cambridge, MA: Harvard University Press.

Andersen, I. and Jaeger, B. (1999) "Scenario and workshops and consensus conferences: towards more democratic decision-making," *Science and Public Policy* 26: 5, 331–340.

Anderson, D. (1984) "Depression, Dust Bowl, demography and drought: the colonial state and soil conservation in East Africa during the 1930s," *African Affairs* 83: 332.

Anderson, J. (1968) "Cultural adaptation to threatened disaster," *Human Organization* 27: 298–307.

Anderson, L. (1994) *The Political Ecology of the Modern Peasant: Calculation and Community*, Baltimore, MD: Johns Hopkins University Press.

Angelsen, A. (1995) "Shifting cultivation and deforestation: a study from Indonesia," *World Development* 23: 1713–1729.

Angelsen, A. and Kaimowitz, D. (1999) *Rethinking the Causes of Deforestation: Lessons from Economic Models*, Washington, DC: World Bank.

Archer, M., Bhaskar, R., Collier, A., Lawson, T., and Norrie, A. (eds) (1998) *Critical Realism: Essential Readings*, London: Routledge.

Arnold, D. (1996) *The Problem of Nature*, Oxford: Blackwell.

Aronowitz, S. (1988) *Science as Power: Discourse and Ideology in Modern Society*, Basingstoke: Macmillan Press.

Aronson, J., Harré, R., and Cornell Way, E. (1994) *Realism Rescued: How Scientific Progress is Possible*, London: Duckworth.

Atkinson, A. (1991) *Principles of Political Ecology*, London: Belhaven.

Baarschers, W. (1996) *Eco-facts and Eco-fiction: Understanding the Environmental Debate*, London: Routledge.

Baden, J. (ed.) (1994) *Environmental Gore: a Constructive Response to "Earth in the Balance,"* San Francisco, CA: Pacific Research Institute for Public Policy.

Bandyopadhyay, J. (1999) "Chipko movement: of floated myths and flouted realities," *Economic and Political Weekly* 34: 15, Apr, 10–16.

Bankoff, G. (1999) "A history of poverty: the politics of natural disasters in the Philippines, 1985–95," *Pacific Review* 12: 3, 381–420.

Bankoff, G. (2001) "Rendering the world unsafe: 'vulnerability' as western discourse," *Disasters* 25: 1, 19–35.

Banuri, T. (1990) "Development and the politics of knowledge: a critical interpretation of the social role of modernization theories in the development of the Third World," in Marglin, F. and Marglin, S. (eds) *Dominating Knowledge: Development Culture and Resistance*, Oxford: Clarendon.

Barnes, B., Bloor, D., and Henry, J. (eds) (1996) *Scientific Knowledge: a Sociological Analysis*, London: Athlone Press.

Barr, J. and Birke, L. (1998) *Common Science: Women, Science and Knowledge*, Bloomington and Indianapolis, IN: Indiana University Press.

Barraclough, S. and Ghimire, K. (1996) "Deforestation in Tanzania: beyond simplistic generalizations," *The Ecologist* 26: 3, 104–107.

Bass, T. (1990) *Camping with the Prince, and Other Tales of Science in Africa*, Cambridge: Latterworth Press.

Bassett, T. and Zuéli, K. (2000) "Environmental discourses and the Ivorian Savanna," *Annals of the Association of American Geographers* 90: 1, 67–95.

Batterbury, S. (1996) "Planners or performers? Reflections on indigenous dryland farming in northern Burkina Faso," *Agricultural and Human Values* 13: 3, 12–22.

Batterbury, S. (2001) "Landscapes of diversity: a local political ecology of livelihood diversification in south-western Niger," *Ecumene* 8: 4, 438–464.

Batterbnry, S. and Bebbington, A. (eds) (1999) "Environmental histories, access to resources and landscape change: an introduction," Special edition of *Land Degradation and Development* 10: 4, 279–288.

Batterbury, S. and Forsyth, T. (1999) "Fighting back: human adaptations in marginal environments," *Environment* 41: 6, 6–11, 25–29.

Batterbury, S., Forsyth, T., and Thomson, K. (1997) "Environmental transformations in developing countries: hybrid research and democratic policy," *Geographical Journal* 163: 2, 126–132.

Batterbnry, S. and Warren, A. (eds) (2001) "The African Sahel 25 years after the great drought: assessing progress and moving towards new agendas and approaches," Special edition of *Global Environmental Change* 11: 1, 1–8.

Bebbington, A. (1997) "Social capital and rural intensification: local organizations and islands of sustainability in the rural Andes," *Geographical Journal* 163: 2.

Bebbington, A. (1999) "Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty," *World Development* 27: 12, 2021–2044.

Bebbington, A. and Batterbury, S. (2001) "Transnational livelihoods and landscapes: political ecologies of globalization," *Ecumene* 8: 4, 369–380.

Beck, U. (1992) *Risk Society: Towards a New Modernity*, Cambridge: Polity.

Beck, U. (1995) *Ecological Politics in an Age of Risk*, Cambridge: Polity.

Benedick, R. (1991) *Ozone Diplomacy: New Directions in Safeguarding the Planet*, Cambridge, MA: Harvard University Press.

Benhabib, S. (ed.) (1996) *Democracy and Difference: Contesting the Boundaries of the Political*, Princeton, NJ: Princeton University Press.

Benjaminsen, T. (2001) "The population–environment nexus in the Malian cotton zone," *Global Environmental Change* 11: 4, 283–295.

Benton, T. (1996) "Marxism and natural limits: an ecological critique and reconstruction," in Benton, T. (ed.) *The Greening of Marxism*, New York: Guilford Press, pp. 157–186.

Berger, P. (1987) *The Capitalist Revolution*, Aldershot: Wildwood House.

Berkes, F., Folke, C., and Colding, J. (eds) (1998) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Cambridge: Cambridge University Press.

Bernstein, H. and Woodhouse, P. (2001) "Telling environmental change like it is? Reflections on a study in Sub-Saharan Africa," *Journal of Agrarian Change* 1: 2, 283–324.

Berry, S. (1989) "Social institutions and access to resources," *Africa* 59: 1, 41–55.

Bhaskar, R. (1975) *A Realist Theory of Science*, Leeds: Leeds Books.

Bhaskar, R. (1986) *Scientific Realism and Human Emancipation*, London: Macmillan.

Bhaskar, R. (1991) *Philosophy and the Idea of Freedom*, Oxford: Blackwell.

Biot, Y. (1995) *Rethinking Research on Land Degradation in Developing Countries*, Washington, DC: World Bank.

Blaikie, P. (1985) *The Political Economy of Soil Erosion in Developing Countries*, London: Longman Development Series.

Blaikie, P. (1995) "Understanding environmental issues," in Morse, S. and Stocking, M. (eds) *People and Environment*, London: University College London Press, pp. 1–30.

Blaikie, P. and Brookfield, H.C. (ed.) (1987) *Land Degradation and Society*, London: Methuen.

Blaikie, P., Cannon, T., Davis, I., and Wisner, B. (1994) *At Risk: Natural Hazards, People's Vulnerability and Disasters*, London: Routledge.

Blowers, A. (1997) "Environmental policy: ecological modernization or the risk society?" *Urban Studies* 34: 5/6.

Boehmer-Christiansen, S. (1994) "Global climate protection policy: the limits of scientific advice part II," *Global Environmental Change* 4: 3, 845–871.

Botkin, D. (1990) *Discordant Harmonies: A New Ecology for the Twenty-First Century*, New York: Oxford University Press.

Braun, B. and Castree, N. (eds) (1998) *Remaking Reality: Nature at the Millennium*, London: Routledge.

Brechin, S. (1997) *Planting Trees in the Developing World: A Sociology of International Organizations*, Baltimore, MD: Johns Hopkins University.

Brookfield, H., Potter, L., and Byron, Y. (1995) *In Place of the Forest: Environmental and Socio-Economic Transformation in Borneo and the Eastern Malay Peninsula*, Tokyo, Paris, New York: United Nations University Press.

Brown, L. (2001) *Eco-economy: Building an Economy for the Earth*, London and Washington, DC: Earthscan and Earth Policy Institute.

Brown, R. (1998) *Toward a Democratic Science: Scientific Narration and Civic Communication*, New Haven, CT: Yale University Press.

Brulle, R. (2000) *Agency, Democracy, and Nature: The US Environmental Movement from a Critical Theory Perspective*, Cambridge, MA: MIT Press.

Bryant, R. (1992) "Political ecology: an emerging research agenda in Third-World studies," *Political Geography* 11: 1, 12–36.

Bryant, R. (1997a) *The Political Ecology of Forestry in Burma 1824–1994*, London: Hurst.

Bryant, R. (1997b) "Beyond the impasse: the power of political ecology in Third World environmental research," *Area* 29: 1–15.

Bryant, R. (1998) "Power, knowledge and political ecology in the Third World: a review," *Progress in Physical Geography* 22: 1, 79–94.

Bryant, R. and Bailey, S. (1997) *Third-World Political Ecology*, London: Routledge.

Bunge, M. (1991) "What is science? Does it matter to distinguish from pseudoscience? A reply to my commentators," *New Ideas in Psychology* 9: 2, 245–283.

Bunker, S. (1985) *Underdeveloping the Amazon: Extraction, Unequal Exchange and the Failure of the Modern State*, Chicago, IL: University of Illinois Press.

Button, M. and Madson, K. (1999) "Deliberative democracy in practice: challenges and prospects for civic deliberation," *Polity* 31: 4, 609–637.

Calder, I. (1999) *The Blue Revolution: Land Use and Integrated Water Resources*, London: Earthscan.

Calder, I. and Aylward, B. (2002) *Forests and Floods: Perspectives on Watershed Management and Integrated Flood Management*, Rome: FAO, and Newcastle, University of Newcastle.

Calhoun, C. (ed.) (1992) *Habermas and the Public Spheré*, Cambridge, MA: MIT Press.

Callon, M. (1986) "Some elements of a sociology of translation: domestication of the scallops and the fishermen of Saint Brieuc Bay," in Law, J. (ed.) *Power, Action and Belief: A New Sociology of Knowledge? Sociological Review Monograph*, Volume 32, London: Routledge and Kegan Paul, pp. 196–233.

Callon, M. (1995) "Four models for the dynamics of science," in Jasanoff, S., Markle, G., Petersen, J., and Pinch, T. (eds) *Handbook of Science and Technology Studies*, Thousand Oaks, CA: Sage, pp. 29–63.

Carnegie Commissions on Science, Technology, and Government (1992) *Enabling the Future: Linking Science and Technology to Societal Goals*, New York: Carnegie Commission.

Carney, D. (1998) *Sustainable Rural Livelihoods: What Contribution Can We Make?* London: Department for International Development.

Carson, R. (1962) *Silent Spring*, Boston, MA: Houghton Mifflin.

Cartwright, N. (1983) *How the Laws of Physics Lie*, Oxford: Clarendon.

Cartwright, N. (1999) *The Dappled World: a Study of the Boundaries of Science*, Cambridge: Cambridge University Press.

Cash, D. and Clark, W. (2001) "From science to policy: assessing the assessment process," *John F. Kennedy School of Government, Harvard University, Faculty Research Working Paper Services, RWP01–045*, Cambridge, MA: Kennedy School of Government.

Casman, E. and Dowlatabadi, H. (eds) (2002) *Contextual Determinants of Malaria*, Washington, DC: RFF Press.

Castree, N. (1995) "The nature of produced nature: materiality and knowledge construction in Marxism," *Antipode* 27: 1, 12–48.

Castree, N. (ed.) (2001) *Social Nature*, Oxford: Blackwell.

Castree, N. and Braun, B. (1998) "The construction of nature and the nature of construction: analytical and political tools for building survivable futures," in Braun, B. and Castree, N. (eds) *Remaking Reality: Nature at the Millennium*, London: Routledge, pp. 3–42.

Chambers, R. (1997) *Whose Reality Counts? Putting the First Last*, London: IT Books.

Chambers, R. and Conway, G. (1992) *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*, IDS Discussion Paper 296: Brighton, UK: IDS.

Chapman, G. and Thompson, M. (eds) (1995) *Water and the Quest for Sustainable Development in the Ganges Valley*, London: Cassell.

Chomitz, K. and Kumari, K. (1996) "The domestic benefits of tropical forests: a critical review emphasizing hydrological functions," *World Bank Policy Research Working Paper 160,* World Bank, Policy Research Department, Washington, DC.

Clark, W. (1985) "Scales of climate impacts," *Climatic Change* 7: 5–27.

Cleaver, F. (2001) "Institutional bricolage, conflict and cooperation in Usangu, Tanzania," *IDS Bulletin* 32: 4, 26–35.

Cline-Cole, R. and Madge, C. (eds) (2000) *Contesting Forestry in West Africa*, Aldershot: Ashgate.

Cobb, R. and Elder, C. (1972) *Participation in American Politics: the Dynamics of Agenda Building*, Baltimore, MA: Johns Hopkins University Press.

Cockburn, A. and Ridgeway, J. (eds) (1979) *Political Ecology: an Activist's Reader on Energy, Land, Food, Technology, Health, and the Economics and Politics of Social Change*, New York: Times Books.

Cohen, E. (1989) "'Primitive and remote': hill tribe trekking in Thailand," *Annals of Tourism Research* 16: 1, 30–61.

Collier, A. (1989) *Scientific Realism and Socialist Thought*, Hemel Hempstead: Harvester Wheatsheaf.

Collier, A. (1994) *Critical Realism: The Work of Roy Bhaskar*, London: Verso.

Collingridge, D. and Reeve, C. (1986) *Science Speaks to Power: the Role of Experts in Policy Making*, London: Pinter.

Conklin, H. (1954) "An ethnoecological approach to shifting agriculture," *Transactions of the New York Academy of Sciences* 77: 133–142.

Conley, A. (1996) *Ecopolitics: the Environment in Poststructuralist Thought*, London: Routledge.

Corbridge, S. (1986) *Capitalist World Development: a Critique of Radical Development Geography*, Basingstoke: Macmillan.

Correll, E. (1999) *The Negotiable Desert: Expert Knowledge in the Negotiations of the Convention to Combat Desertification*, Linköping Studies in Arts and Science, no. 191, Department of Water and Environmental Studies, Sweden: Linköping University.

Costanza, R., Kemp, M., and Boynton, W. (1995) "Scale and biodiversity in estuarine ecosystems," in Perrings, C., Mäler, K., Holling, C., and Jansson, B. (eds) *Biodiversity Loss: Economic and Sociological Issues*, Cambridge: Cambridge University Press, pp. 84–125.

Covey, J. (1995) "Accountability and effectiveness in NGO policy alliances," in Edwards, M. and Hulme, D. (eds) *Non-Governmental Organisations – Performance and Accountability: Beyond the Magic Bullet*, London: Earthscan, pp. 167–182.

Crapper, P. (1962) *Land Requirements for the Papua New Guinea Population*, Internal Report, CSIRO Land Research Series no. 1, Melbourne.

Cronin, E. (1979) *The Arun: A Natural History of the World's Deepest Valley*, Boston, MA: Houghton Mifflin.

Cronon, W. (1991) *Nature's Metropolis: Chicago and the Great West*, New York: Norton.

Cronon, W. (1992) "A place for stories: nature, history and narrative," *Journal of American History* 78: 1347–1376.

Cronon, W. (1996) "The trouble with wilderness: a response," *Environmental History* 1: 1, 47–55.

Cullet, P. and Kameri-Mbote, P. (1998) "Joint implementation and forestry projects: conceptual and operational fallacies," *International Affairs* 74: 2, 393–408.

Custodio, E. (2000) *The Complex Concept of Overexploited Aquifer*, Papeles del Proyecto Aguas Subterráneas, Serie A: Uso intensiob del las agues subterráneas, aspectos ecológicos, tecnolólogicos y éticos, Madrid: Fundación Marcelino Botín.

Cutajar, M.Z. (2001) "Notes for closing session," *Global Change Open Science Conference* (IGBP–IHDP–WCRP), Amsterdam, 10–13 July 2001, Bonn: International Human Dimensions Program on Global Environmental Change.

Cutter, S. (1995) "The forgotten casualties: women, children and environmental change," *Global Environmental Change* 5: 3, 181–194.

Dahlberg, A. and Blaikie, P. (1999) "Changes in landscape or in interpretation? Reflections based on the environmental and socio-economic history of a village in northeast Botswana," *Environment and History* 5: 2, 127–174.

Daly, J. (1991) "Does a constructivist view require epistemological relativism? A response to Turnbull," *Social Studies of Science* 21: 3, 568–571.

Davies, B. and Harré, R. (1990) "Positioning: the discursive production of selves," *Journal for the Theory of Social Behavior* 20: 1, 43–63.

de Jong (1999) "Institutionalized criticism: the demonopolization of scientific advising," *Science and Public Policy* 26: 3, 193–199.

DeHart, J. and Soulé, P. (2000) "Does I = PAT work in local places?" *Professional Geographer* 52: 1, 1–10.

Demeritt, D. (1994) "The nature of metaphors in cultural geography and environmental history," *Progress in Human Geography* 18: 2, 163–185.

Demeritt, D. (1998) "Science, social constructivism and nature," in Braun, B. and Castree, N. (eds) *Remaking Reality: Nature at the Millennium*, London: Routledge, pp. 173–193.

Demeritt, D. (2001) "The construction of global warming and the politics of science," *Annals of the Association of American Geographers* 91: 2, 307–337.

Denevan, W. (1989) "The fragile lands of Latin America," in Browder, J. (ed.) *The Fragile Lands of Latin America: Strategies for Sustainable Development*, Boulder, CO: Westview Press, pp. 3–25.

DFID (Department for International Development, Great Britain) (2002) *Poverty and Environment*, information booklet, March, London: DFID.

Dickens, P. (1996) *Reconstructing Nature: Alienation, Emancipation and the Division of Labour*, London: Routledge.

Dierkes, M. and van Grote, C. (2000) (eds) *Between Understanding and Trust: the Public, Science and Technology*, Amsterdam: Harwood.

Dietz, T. and Rosa, E. (1994) "Rethinking the environmental impacts of population, affluence and technology," *Human Ecology Review* 1: 2, 277–300.

Donovan, D. (1981) "Fuelwood: how much do we need?' *Newsletter* (DGD 14), Hanover, NH: Institute of Current World Affairs.

Dougill, A., Thomas, D., and Heathwaite, A. (1999) "Environmental change in the Kalahari: integrated land degradation studies for nonequilibrium dryland environments," *Annals of the Association of American Geographers* 89: 3, 420–442.

Douglas, M. (1978) *Purity and Danger*, London and New York: Routledge.

Douglas, M. (1985) *Risk Acceptability According to the Social Sciences*, London: Routledge and Kegan Paul.

Douglas, M. (1987) *How Institutions Think*, London and New York: Routledge and Kegan Paul.

Douglas, M. (1993) "The depoliticization of risk," in Ellis, R. and Thompson, M. (eds) *Culture Matters: Essays in Honor of Aaron Wildavsky*, Boulder, CO: Westview Press, pp. 121–132.

Dove, M. (1992) "Foresters' belief about farmers: a priority for social science research in social forestry," *Agroforestry Systems* 17: 13–41.

Dowlatabadi, H. (1997) "Assessing the health impacts of climate change: an editorial essay," *Climatic Change* 35: 2, 137–144.

Dregne, H. (1985) "Aridity and land degradation," *Environment* 27: 8, 16–20, 28–33.

Drèze, J. and Sen, A. (1990) *The Political Economy of Hunger: Vol. 1, Entitlement and Well-Being*, Oxford: Clarendon.

Driver, T. (1999) "Anti-erosion policies in the mountain areas of Lesotho: The South African connection," *Environment and History* 5: 1, 1–25.

Dryzek, J. (1990) *Discursive Democracy: Politics, Policy and Political Science*, Cambridge: Cambridge University Press.

Dryzek, J. (1997) *The Politics of the Earth*, Oxford: Oxford University Press.

Dryzek, J. (1998 [1995]) "Political and ecological communication," in Dryzek, J. and Schlosberg, D. (eds) *Debating the Earth: The Environmental Politics Reader*, Oxford: Oxford University Press, pp. 584–598.

Dubos, R. (1964) "Environmental biology," *Bioscience* 14: 1, 11–14.

Dummett, M. (1978) *Truth and Other Enigmas*, London: Duckworth.

Dunne, T. and Black, R. (1970) "Partial area contributions to storm runoff in a small New England watershed," *Water Resources Research* 6: 5, 1296–1311.

Dunne, T. and Leopold, L. (1978) *Water in Environmental Planning*, San Francisco, CA: W.H. Freeman and Company.

Durant, J. (1999) "Participatory technology assessment and the democratic model of the public understanding of science," *Science and Public Policy* 25: 5, 313–319.

Dürrenberger, G., Kastenholz, H., and Behringer, J. (1999) "Integrated assessment focus groups: bridging the gap between science and policy?' *Science and Public Policy* 25: 5, 341–349.

Dye, C. and Reiter, P. (2000) "Temperatures without fevers?' *Science* 289: 1697–1698.

Eckersley, R. (1992) *Environmentalism and Political Theory: Towards an Ecocentric Approach*, London: University College London Press.

Eckholm, E. (1976) *Losing Ground: Environmental Stress and Food Problems*, New York: W.W. Norton.

Eckley, N. (2001) "Designing effective assessments: the role of participation, science and governance, and focus," *European Environment Agency Environmental Issue Report no. 26*, Copenhagen: Office for Official Publications for the European Communities.

Economist, The (1996) "Science and technology: the science of sexual discrimination," June, 22: 97–99.

Eder, K. (1996) "The institutionalization of environmentalism: ecological discourse and the second transformation of the public sphere," in Lash, S., Szersynski, B., and Wynne, B. (eds) *Risk, Environment and Modernity*, London: Sage, pp. 203–223.

Edwards, A. (1999) "Scientific expertise and policy-making: the intermediary role of the pubic sphere," *Science and Public Policy* 26: 3, 163–170.

Edwards, P. and Schneider, S. (2001) "Self governance and peer review in science for policy: the case of the IPCC Second Assessment Report," in Miller, C. and Edwards, P. (eds) *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, Cambridge, MA: MIT Press, pp. 219–246.

Ehrlich, P. and Ehrlich, A. (1991) *Healing the Planet: Strategies for Resolving the Environmental Crisis*, Cambridge, MA: Perseus.

Ehrlich, P. and Ehrlich, A. (1996) *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens our Future*, Washington, DC and Covelo, CA: Island Books.

Ehrlich, P. and Holdren, J. (1974) "The impact of population growth," *Science* 171: 1212–1217.

Enzensberger, H. (1974) "A critique of political ecology," *New Left Review* 84: 3–31.

Epstein, S. (1996) *Impure Science: AIDS Activism and the Politics of Knowledge*, Los Angeles, CA: UCLA Press.

Escobar, A. (1996) "Constructing nature: elements for a poststructural political ecology," in Peet, R. and Watts, M. (eds) *Liberation Ecologies: Environment, Development, Social Movements*, London: Routledge, pp. 46–68.

Escobar, A. (1998) "Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements," *Journal of Political Ecology* 5: 53–82.

Escobar, A. (1999) "Steps to an antiessentialist political ecology," *Current Anthropology* 40: 1, 1–30.

Escobar, E. (1995) *Encountering Development: the Making and Unmaking of the Third World*, Princeton, NJ: Princeton University Press.

Eyerman, R. and Jamison, A. (1991) *Social Movements: A Cognitive Approach*, Cambridge: Polity.

Ezrahi, Y. (1990) *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*, Cambridge, MA: Harvard University Press.

Fairhead, J. and Leach, M. (1996) *Misreading the African Landscape: Society and Ecology in a Forest–Savanna Mosaic*, Cambridge: Cambridge University Press.

Fairhead, J. and Leach, M. (1998) *Reframing Deforestation: Global Analysis and Local Realities: Studies in West Africa*, London: Routledge.

Farrell, A., VanDeveer, S., and Jäger, J. (2001) "Environmental assessments: four

under-appreciated elements of design," *Global Environmental Change* 11: 4, 311–333.
Ferguson, J. (1990) *The Anti-Politics Machine: "Development," Depoliticization and Bureaucratic Power in Lesotho*, Minneapolis, MN and London: University of Minnesota Press.
Fetzer, J. and Almeder, R. (1993) *Glossary of Epistemology/Philosophy of Science*, New York: Paragon House.
Fischer, F. (1999) "Technological deliberation in a democratic society: the case for participatory inquiry," *Science and Public Policy* 25: 5, 294–302.
Fischer, F. (2000) *Citizens, Experts and the Environment: the Politics of Local Knowledge*, Durham and London: Duke University Press.
Fogel, C. (2001) "From invisibility to...? Indigenous peoples, traditional ecological knowledge, and the Kyoto Protocol," Paper presented at the workshop, *Localizing and Globalizing: Knowledge Cultures of Environment and Development*, Kennedy School of Government, Harvard University, April 5–7.
Fogel, C. (2002). "Perspectives on 'carbon sinks': the construction of knowledge and policy to abate global climate change, 1980–2001." Ph.D. Dissertation, University of California at Santa Cruz.
Forsyth, T. (1994) "Shut up or shut down: how a Thai health agency was forced to close when it challenged a major foreign investor," *Asia, Inc.* 3: 4, April, 30–37.
Forsyth, T. (1996) "Science, myth and knowledge: testing Himalayan environmental degradation in Thailand," *Geoforum* 27: 3, 375–392.
Forsyth, T. (1998a) "Mountain myths revisited: integrating natural and social environmental science," *Mountain Research and Development* 18: 2, 126–139.
Forsyth, T. (1998b) "The politics of environmental health: suspected industrial poisoning in Thailand," in Hirsch, P. and Warren, C. (eds) *The Politics of Environment in Southeast Asia: Resources and Resistance*, Routledge, London, pp. 210–226.
Forsyth, T. (1999a) *International Investment and Climate Change: Energy Technologies for Developing Countries*, London: Earthscan and the Royal Institute of International Affairs.
Forsyth, T. (1999b) "Flexible mechanisms of climate technology transfer," *Journal of Environment and Development* 8: 3, 238–257.
Forsyth, T. (1999c) "Environmental activism and the construction of risk: implications for NGO alliances," *Journal of International Development* 11: 5, 687–700.
Forsyth, T. (2001a) "Environmental social movements in Thailand: how important is class?" *Asian Journal of Social Sciences* 29: 1, 35–51.
Forsyth, T. (2001b) "Political ecology and critical realism," in Stainer, A. and Lopez, G. (eds) *After Postmodernism: Critical Realism?* London: Athlone Press, pp. 146–154.
Forsyth, T. (2002) "What happened on *The Beach*? Social movements and governance of tourism in Thailand," *International Journal of Sustainable Development* 5: 3, 325–336.
Forsyth, T., Leach, M., and Scoones, I. (1998) *Poverty and Environment: Research and Policy Priorities*, UNDP and European Commission.
Foster, J. Bellamy (2000) *Marx's Ecology: Materialism and Nature*, New York: Monthly Review Press.
Foucault, M. (1980) "Two Lectures," in *Power/Knowledge. Selected Interviews and Other Writings 1972–1977* (ed. C. Gordon), London: Harvester, pp. 78–102.
Fox J., Dao Minh Truong, Rambo, A., Nghiem Phuong Tuyen, Le Trong Cuc, and Stephen Leisz (2000) "Shifting cultivation: a new old paradigm for managing tropical forests," *BioScience* 50: 6, 521–528.

Frankfurt, H. (1978) *On the Importance of What We Care About*, Cambridge: Cambridge University Press.
Fuller, S. (1993) *Philosophy, Rhetoric and the End of Knowledge: the Coming of Science and Technology Studies*, Madison, WI: University of Wisconsin Press.
Fuller, S. (2000) *The Governance of Science*, Buckingham and Philadelphia, PA: Open University Press.
Funtowicz, S. and Ravetz, J. (1985) "Three types of risk assessment: a methodological analysis," in Whipple, C. and Covello, V. (eds) *Risk Analysis in the Private Sector*, New York: Plenum.
Funtowicz, S. and Ravetz, J. (1992) "Three types of risk assessment and the emergence of post normal science," in Krimsky, S. and Golding, D. (eds) *Social Theories of Risk*, Westport, CT: Praeger.
Funtowicz, S. and Ravetz, J. (1993) "Science for the post-normal age," *Futures* 26: September, 739–756.
Gandy, M. (1997) "Ecology, modernity and the intellectual legacy of the Frankfurt School," in Light, A. and Smith, J. (eds) *Space, Place and Environmental Ethics: Philosophy and Geography I*, London: Rowman and Littlefield, pp. 231–254.
Geertz, C. (1963) *Agricultural Involution: the Processes of Ecological Change in Indonesia*, Berkeley, CA: The University of California Press.
Gelbspan, R. (1997) *The Heat is On: The High Stakes Battle over Earth's Threatened Climate*, New York: Addison-Wesley.
Giddens, A. (1973) *The Class Structure of the Advanced Societies*, London: Hutchinson University Library, New York: Harper and Row.
Giddens, A. (1990) *Consequences of Modernity*, London: Polity Press.
Giddens, A. (1994) *Beyond Left and Right: the Future of Radical Politics*, Cambridge: Polity.
Gieryn, T. (1999) *Cultural Boundaries of Science: Credibility on the Line*, Chicago, IL: University of Chicago Press.
Goldman, M. (2001) "The birth of a discipline: producing authoritative green knowledge, World Bank style," *Ethnography* 2: 2, 191–217.
Gore, A. (1992) *Earth in the Balance: Forging a New Common Purpose*, revised edn, London: Earthscan.
Gorz, A. (1983 [1975]) *Ecology as Politics*, London: Pluto Press.
Gorz, A. (1994 [1991]) *Capitalism, Socialism, Ecology*, London: Verso.
Goudie, A. (1990) *The Human Impact on the Natural Environment*, 3rd edn, Oxford: Blackwell.
Grainger, A. (1990) *The Threatening Desert: Controlling Desertification*, London: Earthscan.
Greenberg, J. and Park, T. (1994) "Political ecology," *Journal of Political Ecology* 1: 1–12.
Grimes, P. (1999) "The horsemen and the killing fields: the final contradiction of capitalism," in Goldfrank, W., Goodman, D., and Szasz, A. (eds) *Ecology and the World System*, Westport, CT: Greenwood Press, pp. 13–42.
Gross, P. and Levitt, N. (1994) *Higher Superstition: the Academic Left and its Quarrels With Science*, Baltimore, MA: Johns Hopkins Press.
Grossman, L. (1998) *The Political Ecology of Bananas: Contract Farming, Peasants and Agrarian Change in the Eastern Caribbean*, London and Chapel Hill: University of North Carolina Press.

Grove, R. (1995) *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1660–1860*, Cambridge: Cambridge University Press.

Grove-White, R. (1999) "Afterword: On 'sound science,' the environment, and political authority," *Environmental Values* 8: 277–282.

Grove-White, R., Macnaghten, P., Mayer, S., and Wynne, B. (1997) *Uncertain World: Genetically Modified Organisms, Food and Public Attitudes in Britain*, Lancaster: Centre for Study of Environmental Change, Lancaster University.

Grubb, M., Brack, D., and Vrolijk, C. (1999) *The Kyoto Protocol, a Guide and Assessment*, London: Earthscan and the Royal Institute of International Affairs.

Grubb, M., Koch, M., Munson, A., Sullivan, F., and Thomson, K. (1993) *The Earth Summit Agreements: a Guide and Assessment*, London: Earthscan and RIIA.

Guha, R. and Martinez-Allier, J. (1997) *Varieties of Environmentalism*, London: Earthscan.

Gupta, J. (1997). *The Climate Change Convention and Developing Countries: from Conflict to Consensus?* London, Dordrecht, Boston: Kluwer.

Guston, D. (2001) "Boundary organizations in environmental policy and science: an introduction," *Science, Technology and Human Values* 26: 4, 399–408.

Gyawali, D. (2000) *Water in Nepal*, Kathmandu: Himal Books.

Haas, P. (1992) "Introduction: epistemic communities and international policy coordination," *International Organization* 46: 1, 1–35.

Habermas, J. (1974) *Theory and Practice*, translated by John Viertel, Boston, MA: Beacon Press.

Habermas, J. (1981) "New social movements," *Telos* 49: 33–37.

Habermas, J. (1987 [1985]) *The Theory of Communicative Action, Vol. 2*, translated by Thomas McCarthy, Boston, MA: Beacon Press.

Hagel, Chuck, Senator (2001) Testimony to Senate Committee on Commerce, Science and Transportation, in *Notes from Senate Committee on Commerce, Science and Transportation hearing on Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report, May 1*, Washington, DC: NOAA Office of Legislative Affairs.

Hajer, M. (1993) "The politics of environmental discourse: a study of the acid rain controversy in Great Britain and the Netherlands." Unpublished Ph.D. thesis, University of Oxford.

Hajer, M. (1995) *The Politics of Environmental Discourse*, Oxford: Clarendon.

Hallsworth, E. (1987) *Anatomy, Physiology and Psychology of Erosion*, Chichester: Wiley.

Hamilton, L. (1987) "What are the impacts of deforestation in the Himalayas on the Ganges–Brahmaputra lowlands and delta? Relations between assumptions and facts," *Mountain Research and Development* 7: 256–263.

Hamilton, L. (1988) "Forestry and watershed management," in Ives, J. and Pitt, D. (eds) *Deforestation: Social Dynamics in Watershed and Mountain Ecosystems*, London, New York: Routledge, pp. 99–131.

Hamilton, L. and Pearce, A. (1988) "Soil and water impacts of deforestation," in Ives, J. and Pitt, D. (eds) *Deforestation: Social Dynamics in Watershed and Mountain Ecosystems*, London: Routledge, pp. 75–98.

Hammond, A., Rodenburg, E., and Moomaw, W. (1991) "Calculating national accountability for climate change," *Environment* 33: 1, 11–15, 33–35.

Hanbury-Tenison, R. (2001) "The Greens must not be allowed to ruin our planet," *The Daily Telegraph*, July 19, 26.

Hannah, M. (1999) "Skeptical realism: from either/or to both-and," *Environment and Planning D: Society and Space* 17: 17–34.

Haraway, D. (1991) *Simians, Cyborgs, and Women: the Reinvention of Nature*, London: Routledge.

Hardin, G. (1968) "The tragedy of the commons," *Science* 162: 1243–1248.

Harding, S. (1986) *The Science Question in Feminism*, Ithaca, NY: Cornell University Press.

Hardoy, J., Mitlin, D., and Satterthwaite, D. (2001) *Environmental Problems in an Urbanizing World*, London: Earthscan.

Harré, R. (1986) *Varieties of Realism*, Oxford: Blackwell.

Harré, R. (1993) *Laws of Nature*, London: Duckworth.

Harré, R., Brockmeier, J., and Mühlhäusler, P. (1999) *Greenspeak: a Study of Environmental Discourse*, Thousand Oaks, CA: Sage.

Harré, R. and Krausz, M. (1996) *Varieties of Relativism*, Oxford: Blackwell.

Harris, D. (ed.) (1980) *Human Ecology in Savanna Environments*, London, New York: Academic Press.

Harrison, M. (1996) "'The tender frame of man': disease, climate, and racial difference in India and the West Indies, 1760–1860," *Bulletin of the History of Medicine* 70: 68–93.

Harvey, D. (1996) *Justice, Nature, and the Geography of Difference*, Oxford: Blackwell.

Hecht, S. and Cockburn, A. (1989) *The Fate of the Forest: Developers, Destroyers and Defenders of the Amazon*, London: Verso.

Hess, D. (1997) *Science Studies: an Advanced Introduction*, New York and London: New York University Press.

Hewitt, K. (ed.) (1983) *Interpretations of Calamity: from the Viewpoint of Human Ecology*, Boston, MA: Allen and Unwin.

Hicks, E. and van Rossum, W. (eds) (1991) Policy development and big science, special edition of *Verhandelingen der Koninklijke Nederlandse*, vol. 147.

Hoben, A. (1995) "Paradigms and politics: the cultural construction of environmental policy in Ethiopia," *World Development* 23: 6, 1007–1021.

Höfer, T. (1993) "Himalayan deforestation, changing river discharge, and increasing floods: myth or reality?" *Mountain Research and Development* 13: 3, 213–233.

Hohenemser, C., Kasperson, R., and Kates, R. (1985) "Causal structure," in Kates, R., Hohenemser, C., and Kasperson, J. (eds) *Perilous Progress: Managing the Hazards of Technology*, Boulder, CO: Westview Press, pp. 43–66.

Holden, C. (1996) "Social science: researchers find feminization a two-edged sword," *Science* 271: 5257, 1919–1920.

Holling, C. (1973) "Resilience and stability of ecological systems," *Annual Review of Ecology and Systematics* 4: 1–23.

Holling, C. (1979) "Myths of ecological stability: resilience and the problem of failure," in Smart, G. and Standbury, W. (eds) *Studies on Crisis Management*, Montreal: Butterworth, pp. 93–106.

Holling, C., Schindler, D., Walker, B., and Roughgarden, J. (1995) "Biodiversity in the functioning of ecosystems: an ecological synthesis," in Perrings, C., Mäler, K., Holling, C., and Jansson, B. (eds) *Biodiversity Loss: Economic and Sociological Issues*, Cambridge: Cambridge University Press, pp. 44–83.

Holmes, T. and Scoones, I. (2000) *Participatory Environmental Policy Processes: Experiences from North and South*, IDS Working Paper 113, Falmer: Institute of Development Studies.

Holton, G. (1993) *Science and Anti-Science*, Cambridge, MA: Harvard University Press.

Hörning, G. (1999) "Citizens' panels as a form of deliberative technology assessment," *Science and Public Policy* 26: 5, 351–359.

Howartb, J. (1995) "Ecology: modern hero or post-modern villain: from scientific trees to phenomenological wood," *Biodiversity and Conservation* 4: 786–797.

Hutchings, J. (2001) "Kaitiaki," *Genetics Forum*, May/June 2001 (http://www.geneticsforum.org.uk/).

Huxley, A. (1963) *The Politics of Ecology: the Question of Survival*, occasional paper of the Free Society, Center for the Study of Democratic Institutions, Santa Barbara, CA.

Huxley, J. (1947) *Conservation of Nature in England and Wales*, Cmd. 7122, London: HMSO.

Hynes, H. (1993) *Taking Population Out of the Equation: Reformulating I = PAT*, North Amherst, MA: Institute on Women and Technology.

ICRAF (International Ceuter for Agroforestry Research) (1999) *ICRAF in Southeast Asia*, publicity brochure, Bogor: ICRAF.

IPCC (Intergovernmental Panel on Climate Change) (1996) *Second Assessment Report* Watson, R., Zinyowera, M., and Moss, R. (eds). New York: Cambridge University Press.

IPCC (Intergovernmental Panel on Climate Change) (2000) *IPCC Special Report on Land Use, Land-Use Change and Forestry*, Bonn: IPCC (http://www.grida.no/climate/ipcc/land_use/index.htm).

IPCC (Intergovernmental Panel on Climate Change) (2001) *Third Assessment Report of the IPCC: Summary for Policymakers: Climate Change 2001: Impacts, Adaptation and Vulnerability* (http: //www.ipcc.ch).

Irwin, A. (1995) *Citizen Science: a Study of People, Expertise, and Sustainable Development*, London: Routledge.

Irwin, A., Simmons, P., and Walker, G. (1999) "Faulty environments and risk reasoning: the local understanding of industrial hazards," *Environment and Planning A* 31: 1311–1326.

Irwin, A. and Wynne, B. (eds) (1996) *Misunderstanding Science*, Cambridge: Cambridge University Press.

Ives, J. and Messerli, B. (1989) *The Himalayan Dilemma: Reconciling Conservation and Development*, London: Routledge/UNU.

Ives, J. and Pitt, D. (eds) (1988) *Deforestation: Social Dynamics in Watershed and Mountain Ecosystems*, London, New York: Routledge.

Jackson, C. (1995) "Radical environmental myths: a gender perspective," *New Left Review* 210: 124–140.

Jackson, C. (1997) "Women in critical realist environmentalism: subaltern to the species?' *Economy and Society* 26: 1, 62–80.

Jamison, A. (1996) "The shaping of the global environmental agenda: the role of non-governmental organisations," in Lash, S., Szerszynski, B., and Wynne, B. (eds) *Risk, Environment and Modernity*, London: Sage, pp. 224–245.

Jasanoff, S. (1987) "Contested boundaries in policy-relevant science," *Social Studies of Science* 17: 195–230.

Jasanoff, S. (1990) *The Fifth Branch: Science Advisers as Policymakers*, Cambridge, MA: Harvard University Press.

Jasanoff, S. (1996a) "Science and norms in global environmental regimes," in Hampson, F. and Reppy, J. (eds) *Earthly Goods: Environmental Change and Social Justice*, Ithaca, NY and London: Cornell University Press, pp. 173–197.

Jasanoff, S. (1996b) "Beyond epistemology: relativism and engagement in the politics of science," *Social Studies of Science* 26: 2, 393–418.

Jasanoff, S. (1998) "The political science of risk perception," *Reliability Engineering and System Safety* 59: 91–99.

Jasanoff, S. (1999) "The songlines of risk," *Environmental Values* 8: 2, 135–152.

Jasanoff, S. (2000) "The "Science Wars" and American politics," in Dierkes, M. and van Grote, C. (eds) *Between Understanding and Trust: the Public, Science and Technology*, Amsterdam: Harwood, pp. 39–60.

Jasanoff, S. (2001) "Image and imagination: the formation of global environmental consciousness," in Miller, C. and Edwards, P. (eds) *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, Cambridge, MA: MIT Press, pp. 309–338.

Jasanoff, S., Markle, C., Petersen, J., and Pinch, T. (eds) (1995) *Handbook of Science and Technology Studies*, Thousand Oaks, CA: Sage.

Jasanoff, S. and Wynne, B. (1998) "Science and decisionmaking," in Rayner, S. and Malone, E. (eds) *Human Choice and Climate Change*, Columbus, OH: Battelle Press, pp. 1–87.

Jewitt, S. (1995) "Europe's 'others'? Forestry policy and practices in colonial and postcolonial India," *Environment and Planning D: Society and Space* 13: 67–90.

Jewitt, S. (2000) "Unequal knowledges in Jharkhand, India: de-romanticizing women's agroecological expertise," *Development and Change* 31: 961–985.

Joerges, B. (1999) "Do politics have artefacts?' *Social Studies of Science* 29: 3, 411–431.

Johnson, C. and Forsyth, T. (2002) "In the eyes of the state: negotiating a 'rights-based approach' to forest conservation in Thailand," *World Development* 30: 9, 1591–1605.

Johnson, M. (ed.) (1992) *Lore: Capturing Traditional Environmental Knowledge*, Dene Cultural Institute, Canada; International Development Research Center.

Joss, S. (1999) "Public participation in science and technology policy- and decision-making – ephemeral phenomenon or lasting change?" *Science and Public Policy* 25: 5, 290–293.

Kaiser, J. (2000) "Ecosystem assessment: ecologists hope to avoid the mistakes of previous assessment," *Science* 289: 5485, 1676–1677.

Kasperson, J. and Kasperson, R. (eds) (2001) *Global Environmental Risk*, London: Earthscan.

Kasperson, J., Kasperson, R., and Turner, B.L. (1995) *Regions at Risk: Comparisons of Threatened Environments*, Tokyo, New York, and Paris: United Nations University Press.

Kates, R. (2000a) "Population and consumption: what we know, what we need to know," *Environment* 42: 3, 10–19.

Kates, R. (2000b) "Cautionary tales: adaptation and the global poor," in Kanes, S. and Yohe, G. (eds) *Societal Adaptation to Climate Variability and Change*, Dordrecht: Kluwer, pp. 5–17.

Kates, R. and Clark, W. (1996) "Environmental surprise: expecting the unexpected," *Environment* 38: 6–11, 28–34.

Katyal, J. and Vlek, P. (2000) *Desertification – Concept, Causes and Amelioration*, Bonn: Zentrum für Entwicklungsforschung, Universität Bonn.

Kearns, G. (1998) "The virtuous circle of facts and values in the New Western History," *Annals of the Association of American Geographers* 88: 3, 377–387.

Keck, M. and Sikkink, K. (1998) *Activists Beyond Borders: Advocacy Networks in International Politics*, Ithaca, NY and London: Cornell University Press.

Keller, E. Fox (1995) "The origin, history, and politics of the subject called 'gender and science': a first person account," in Jasanoff, S., Markle, C., Petersen, J., and Pinch, T. (eds) *Handbook of Science and Technology Studies*, Thousand Oaks, CA: Sage, pp. 80–94.

Kelly, P. and Adger, W. (1999) *Assessing Vulnerability to Climate Change and Facilitating Adaptation*, CSERGE Working Paper GEC 99–07, CESERGE: University of East Anglia, Norwich.

Khor, M. (1997) "Is globalization undermining the prospects for sustainable development?" Fifth Annual Hopper Lecture presented at the University of Guelph, 21 October, and the University of Prince Edward Island, 23 October.

Kienholz, H., Schneider, G., Bichsel, M., Grunder, M., and Mool, P. (1984) "Mapping of mountain hazards and slope stability," *Mountain Research and Development* 4: 3, 247–266.

Kingdon, J. (1984) *Agendas, Alternatives, and Public Policies*, Boston, MA: Little, Brown.

Klooster, D. (2002) "Toward adaptive community forestry management: integrating local forest knowledge with scientific forestry," *Economic Geography* 78: 1, 43–70.

Knorr-Cetina, K. and Mulkay, M. (eds) (1983) *Science Observed: Perspectives on the Social Study of Science*, London: Sage.

Knowledge Center, The (2000) "Threat that never was" (http://www.biotech-knowledge.monsanto.com).

Koertge, N. (ed.) (1998) *A House Built on Sand: Exposing Postmodernist Myths about Science*, New York and Oxford: Oxford University Press.

Kuhn, T. (1962) *The Structure of Scientific Revolutions*, Chicago, IL: University of Chicago Press.

Kukla, A. (1993) "Epistemic boundedness," *International Studies in the Philosophy of Science* 7: 2, 121–126.

Kull, C. (2000) "Deforestation, erosion, and fire: degradation myths in the environmental history of Madagascar," *Environment and History* 6: 423–450.

Kurian, P. (2000) *Engendering the Environment? Gender in the World Bank's Environmental Policies*, Aldershot: Ashgate.

Kwa, C. (1987) "Representations of nature modeling between ecology and science policy: the case of the International Biological program," *Social Studies of Science* 17: 413–442.

Kwa, C. (2001) "The steering of the International Geosphere–Biosphere Programme (IGBP)," Draft BCSIA Discussion Paper, Environment and Natural Resources Program, Kennedy School of Government, Harvard University.

Lahsen, M. (1999) "The detection and attribution of conspiracies: the controversy over Chapter 8," in Marcus, G. (ed.) *Paranoia Within Reason: A Case Book on Conspiracy and Explanation*, Chicago, IL: Chicago University Press.

Lakatos, I. (1978) *The Methodology of Scientific Research Programs*, Worrall, J. and Currie, G. (eds), Cambridge: Cambridge University Press.

Lambin, E.F., Turner, B.L., Geist, H.J., *et al.* (2001) "The causes of land-use and land-cover change: moving beyond the myths," *Global Environmental Change* 11: 4, 261–269.

Lamprey, H. (1988 [1975]) "Report on the desert encroachment reconnaissance in northern Sudan, 21 October to 10 November, 1975," *Desertification Control Bulletin* 17: 1–7.

Landy, M. (1995) "The new politics of environmental policy," in Landy, M. and Levin, M. (eds) *The New Politics of Public Policy*, Baltimore, MA: Johns Hopkins Press, pp. 207–227.

Landy, M., Roberts, M., and Thomas, S. (1994) *The Environmental Protection Agency: Asking the Wrong Questions*, New York: Oxford University Press.

Lankester, E. (1914) "Nature reserves," *Nature* 93: 2315, 33–35.

Latour, B. (1983) "Give me a laboratory and I shall raise the world," in Knorr-Cetina, K. and Mulkay, M. (eds) *Science Observed*, London: Sage, pp. 141–170.

Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers Through Society*, Cambridge, MA: Harvard University Press.

Latour, B. (1988) *The Pasteurization of France*, Cambridge, MA: Harvard University Press.

Latour, B. (1993 [1991]) *We Have Never Been Modern*, Hemel Hempstead: Harvester Wheatsheaf.

Latour, B. and Woolgar, S., with Salk, J. (1979) *Laboratory Life: the Social Construction of Scientific Facts*, Beverly Hills, CA: Sage.

Laudan, L. (1977) *Progress and its Problems*, London: Sage.

Laudan, L. (1990) *Science and Relativism: Some Key Controversies in the Philosophy of Science*, Chicago, IL: University of Chicago Press.

Law, J. (ed.) (1991) *A Sociology of Networks: Essays on Power, Technology and Domination*, London: Routledge.

Law, J. and Hassard, J. (eds) (1999) *Actor Network Theory and After*, Oxford: Blackwell and The Sociological Review.

Layne, L. (1990) "Motherhood lost: cultural dimensions of miscarriage and stillbirth in America," *Women and Health* 16: 3, 75–104.

Layne, L. (1997) "Breaking the silence: an agenda for a feminist discourse of pregnancy loss," Special edition of *Feminist Studies* 23: 2, 289–315.

Layne, L. (2001) "In search of community: tales of pregnancy loss in three toxically assaulted US communities," *Women's Studies Quarterly* 29: 1, 2, 25–50.

Leach, G. and Mearns, R. (1988) *Beyond the Fuelwood Crisis*, London: Earthscan.

Leach, M., Fairhead, J., and Amanor, K. (eds) (2002) "Science and the policy process: perspectives from the forest," Special edition of *IDS Bulletin* 33: 1.

Leach, M. and Mearns, R. (1991) *Poverty and Environment in Developing Countries, an Overview Study*, report presented to the Economic and Social Research Council and the Overseas Development Administration, Brighton: Institute of Development Studies.

Leach, M. and Mearns, R. (eds) (1996) *The Lie of the Land: Challenging Received Wisdom on the African Environment*, Oxford: James Currey.

Leach, M., Mearns, R., and Scoones, I. (1999) "Environmental entitlements: dynamics and institutions in community-based natural resource management," *World Development* 27: 2, 225–247.

Leach, M., Mearns, R., and Scoones, I. (eds) (1997) "Community-based sustainable development: consensus or conflict?' Special edition *IDS Bulletin* 28: 4.

Lederman, M. and Bartsch, I. (eds) (2001) *The Gender and Science Reader*, London and New York: Routledge.

Lee, N. and Hassard, J. (1999) "Organization unbound: actor-network theory, research strategy and institutional flexibility," *Organization* 6: 3, 391–404.

Leff, E. (1995) *Green Production: Toward an Environmental Rationality*, New York, London: Guilford.

Leggett, J. (ed.) (1990) *Global Warming: The Greenpeace Report*, Oxford: Oxford University Press.

Leiss, W. (1972) "Technological rationality: Marcuse and his critics," *Philosophy of the Social Sciences* 2: 34–35.

Leopold, A. (1933) *Game Management*, New York and London: C. Scribner's and Sons.

Leplin, J. (1984) "Truth and scientific progress," in Leplin, J. (ed.) *Scientific Realism*, Berkeley, CA, Los Angeles, CA, London: University of California Press, pp. 193–217.

Levidow, L. and Carr, S. (1997) "How biotechnology regulation sets a risk/ethics boundary," *Agriculture and Human Values* 14: 29–43.

Levin, M. (1984) "What kind of explanation is truth?" in Leplin, J. (ed.) *Scientific Realism*, Berkeley, CA, Los Angeles, CA, London: University of California Press, pp. 124–139.

Levitt, N. (1999) *Prometheus Bedeviled: Science and the Contradictions of Contemporary Culture*, New Brunswick, NJ: Rutgers University Press.

Lewis, J. (1990) "The vulnerability of small island states to sea level rise: the need for holistic strategies," *Disasters* 14: 3, 241–249.

Lewis, P. (1996) "Metaphor and critical realism," *Review of Social Economy* 54: 4, 487–506.

Light, A. and Katz, E. (eds) (1996) *Environmental Pragmatism*, London: Routledge.

Limerick, P. (1991) "What on earth is the new western history?" in Limerick, P., Milner, C., and Rankin, E. (eds) *Trails: Toward a New Western History*, Lawrence, KS: University of Kansas Press, pp. 81–88.

Lipietz, A. (1992) *Towards a New Economic Order: Postfordism, Ecology and Democracy,* translated by Malcolm Slater, Cambridge: Polity.

Lipietz, A. (2000) "Political ecology and the future of Marxism," *Capitalism, Nature, Socialism* 11: 1, 69–85.

List, M. and Rittberger, V. (1992) "Regime theory and international environmental management," in Hurrell, A. and Kingsbury, B. (eds) *The International Politics of the Environment*, Oxford: Clarendon, pp. 85–109.

Litfin, K. (1994) *Ozone Discourses: Science and Politics in Global Environmental Cooperation*, New York: Columbia University Press.

Little, C. (1995) *The Dying of the Trees: The Pandemic in America's Forests*, New York: Penguin.

Liverman, D. (1999) "Vulnerability and adaptation to drought in Mexico," *Natural Resources Journal* 39: 1, 99–115.

Lohmann, L. (1993) "Resisting green globalism," in Sachs, W. (ed.) *Global Ecology: a New Arena of Political Conflict*, London, Zed, Halifax, Novia Scotia: Fernwood, pp. 157–169.

Lohmann, L. (1995) "No rules of engagement: interest groups, centralization and the creative politics of 'environment' in Thailand," in Rigg, J. (ed.) *Counting the Costs: Economic Growth and Environmental Change in Thailand*, Singapore: ISEAS, pp. 211–234.

Lohmann, L. (1998) *Whose Voice is Speaking? How Opinion Polling and Cost–Benefit Analysis Synthesize New Publics*, Briefing Paper number 7, The Corner House, Sturminster Newton, UK (http://cornerhouse.icaap.org/).

Lohmann, L. (1999) *The Dyson Effect: Carbon "Offset" Forestry and the Privatisation of the Atmosphere*, Briefing number 15, The Corner House, Sturminster Newton, UK (http://cornerhouse.icaap.org/).

Lohmann, L. (2001) *Democracy or Carbocracy? Intellectual Corruption and the Future of the Climate Debate*, Briefing number 24, The Corner House, Sturminster Newton, UK (http://cornerhouse.icaap.org/).

Lomborg, B. (2001) *The Skeptical Environmentalist: Measuring the Real State of the World*, Cambridge: Cambridge University Press.

Long, N. and Long, A. (eds) (1992) *Battlefields of Knowledge: the Interlocking of Theory and Practice in Social Research and Development*, London: Routledge.

Longino, H. (1990) *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*, Princeton, NJ: Princeton University Press.

Lookingbill, B. (2001) *Dust Bowl, USA: Depression America and the Ecological Imagination, 1929–1941*, Athens, OH: Ohio University Press.

Losey, J., Raynor, L., and Carter, M. (1999) "Transgenic pollen harms monarch larvae," *Nature* 399: 214.

Low, N. and Gleeson, B. (1998) *Justice, Society and Nature: an Exploration of Political Ecology*, London: Routledge.

Lowe, P. and Rüdig, W. (1986) "Political ecology and the social sciences: the state of the art," *British Journal of Political Science* 16: 513–550.

Luhmann, N. (1989) *Ecological Communication*, Chicago, IL: University of Chicago Press.

Luke, T. (1999) *Capitalism, Democracy and Ecology: Departing from Marx*, Chicago and Urbana, IL: University of Illinois Press.

Luzzarder-Beach, S. and MacFarlane, A. (2000) "The environment of gender and science: status and perspectives of women and men in physical geography," *Professional Geographer* 52: 3, 407–424.

Lynch, M. and Woolgar, S. (eds) (1990) *Representation in Scientific Practice*, Cambridge, MA: MIT Press.

McComas, K. and Shanahan, J. (1999) "Telling stories about global climate change: measuring the impact of narratives on issue cycles," *Communication Research* 26: 1, 30–57.

McHenry, H. (2000) "Wild flowers in the wrong field are weeds! Examining farmers' constructions of conservation," *Environment and Planning A* 30: 1039–1053.

MacKenzie, D. (1990) *Inventing Accuracy: a Historical Sociology of Nuclear Missile Guidance*, Cambridge, MA: MIT Press.

McManus, P. (1999) "Histories of forestries: ideas, networks and silences," *Environment and History* 5: 2, 185–208.

McNaughton, P. and Urry, J. (1998) *Contested Natures*, London and Thousand Oaks, CA: Sage.

Malin, J. (1946) "Dust storms 1850–1900," *Kansas History Quarterly* 14: 129–144, 265–296.

Marcuse, H. (1964) *One Dimensional Man*, Boston, MA: Beacon Press.

Marcuse, H. (1969) *An Essay on Liberation*, Boston, MA: Beacon Press.

Marsh, G.P. (1864) *Man and Nature, or, Physical Geography as Modified by Human Action*, New York: Scribner.

Marshall, B. (1999) "Globalization, environmental degradation and Ulrich Beck's Risk Society," *Environmental Values* 8: 253–275.

Martens, P. (2000) "Malaria and global warming in perspective?" *Journal of Infectious Diseases* 6: 3, 313–314.

Martin, B. (1991) *Scientific Knowledge in Controversy: the Social Dynamics of the Fluoridation Debate*, Albany, NY: State University of New York Press.
Mason, M. (1999) *Environmental Democracy*, London: Earthscan.
Massey, D. (1999) "Space–time, 'science' and the relationship between physical geography and human geography," *Transactions of the Institute of British Geographers* NS 24: 261–276.
Mather, A. (1992) "The forest transition," *Area* 24: 367–379.
Mather, A. and Needle, C. (2000) "The relationships of population and forest trends," *The Geographical Journal* 166: 1, 2–13.
Matthews, J. and Ho, Mae-Wan (2001) "The new thought police," *Genetics Forum* September/October (http: //www.geneticsforum.org.uk/).
Maunder, W. (1992) *Dictionary of Global Climate Change*, London: UCL Press.
May, R. (1974) "Biological populations with non-overlapping generations: stable points, stable cycles and chaos," *Science* 186: 645–647.
Mayer, S. (2000) "Genetic engineering in agriculture," in Huxham, M. and Sumner, D. (eds) *Science and Environmental Decision Making*, Harlow: Prentice Hall, pp. 94–117.
Meadows, D., Meadows, D., Randers, J., and Behrens III, W. (1972) *The Limits to Growth: a Report for the Club of Rome's Project on the Predicament of Mankind*, New York: University Books.
Mehta, L. (2001) "The World Bank and its emerging knowledge empire," *Human Organisation* 60: 2, 189–196.
Mehta, L., Leach, M., Newell, P., Scoones, I., Sivaramakrishnan, K., and Way, S. (1999) *Exploring Understandings of Institutions and Uncertainty: New Directions in Natural Resource Management*, IDS Discussion Paper 372, Falmer: Institute of Development Studies.
Mehta, L., Leach, M., and Scoones, I. (eds) (2001) *Environmental governance in an uncertain world*, Special edition of *IDS Bulletin*, 32: 4.
Merchant, C. (1980) *The Death of Nature: Women, Ecology and the Scientific Revolution*, San Francisco, CA: Harper and Row.
Merton, R.K. (1973 [1942]) "The normative structure of science," in Merton, R.K., *The Sociology of Science*, Storer, N. (ed.), Chicago, IL: University of Chicago Press, pp. 267–278.
Metz, J. (1989) "Himalayan political economy: more myths in the closet?" *Mountain Research and Development* 9: 2, 175–181.
Metz, J. (1991) "A reassessment of the causes and severity of Nepal's environmental crisis," *World Development* 19: 7, 805–820.
Midgley, M. (1992) *Science as Salvation: a Modern Myth and its Meaning*, London: Routledge.
Miller, A. (1978) *A Planet to Choose: Value Studies in Political Ecology*, New York: Pilgrim Press.
Miller, C. (2001) "Hybrid management: boundary organizations, science policy, and environmental governance in the climate regime," *Science, Technology and Human Values* 26: 4, 478–500.
Millington, A. (1986) "Environmental degradation, soil conservation and agricnltural policies in Sierra Leone, 1895–1984," in Anderson, D. and Grove, R. (eds) *Conservation in Africa*, Cambridge: Cambridge University Press, pp. 229–248.
Mol, A. (1996) "Ecological modernization and institutional reflexivity: environmental reform in the late modern age," *Environmental Politics* 5: 2, 302–323.

Mol, A. and Law, J. (1994) "Regions, networks and fluids: anaemia and social topology," *Social Studies of Science* 24: 641–671.
Monbiot, G. (2002) "Corporate phantoms: the web of deceit over GM food has now drawn in the PM's speechwriters," the *Guardian*, Wednesday 29 May.
Morgan, R. (1986) *Soil Erosion and Conservation*, Harlow: Longman Scientific and Technical Series.
Morris, A. and Mneller, C. (eds) (1992) *Frontiers in Social Movement Theory*, New Haven, CT: Yale University Press.
Morris, J. (1995) *The Political Economy of Land Degradation: Pressure Groups, Foreign Aid and the Myth of Man-Made Deserts*, London: Institute of Economic Affairs.
Morrow, R. (1994) *Critical Theory and Methodology* (Contemporary Social Theory, vol. 3), Thousand Oaks, CA, London, Delhi: Sage.
Morse, S. and Stocking, M. (eds) (1995) *People and Environment*, London: UCL Press.
Mortimore, M. and Adams, W. (1999) *Working the Sahel: Environment and Society in Northern Nigeria*, London: Routledge.
Mukta, P. and Hardiman, D. (2000) "The political ecology of nostalgia," *Capitalism, Nature, Socialism* 11: 1, 113–133.
Multinational Monitor (periodical) http: //www.essential.org/monitor/monitor.html.
Murdoch, J. (1997) "Inhuman/nonhuman/human: actor-network theory and the prospects for a nondualistic and symmetrical perspective on nature and society," *Environment and Planning D: Society and Space* 15: 6, 731–756.
Murdoch, J. and Clark, J. (1994) "Sustainable knowledge," *Geoforum* 25: 2, 115–132.
Murphy, R. (1994) *Rationality and Nature: a Sociological Inquiry into a Changing Relationship*, Bonlder, CO: Westview Press.
Murphy, R. (1995) "Sociology as if nature did not matter: an ecological critique," *British Journal of Sociology* 46: 4, 688–707.
Murton, J. (1999) "Population growth and poverty in Machakos, Kenya," *Geographical Journal* 165: 1, 37–46.
Myers, N. (1984) *The Primary Source: Tropical Forests and our Future*, New York: Norton.
Myers, N. (1990) "Tropical Forests," in Leggett, J. (ed.) *Global Warming: The Greenpeace Report*, Oxford: Oxford University Press, pp. 372–399.
Nader, L. (ed.) (1996) *Naked Science: Anthropological Inquiry into Boundaries, Power, and Knowledge*, London: Routledge.
Naka, K., Hammett, A., and Stuart, W. (2000) "Forest certification: stakeholders, constraints and effects," *Local Environment* 5: 4, 475–481.
Nash, R. (1973) *Wilderness and the American Mind*, New Haven, CT: Yale University Press.
Netting, R. (1993) *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*, Stanford, CA: Stanford University Press.
Neumann, R. (1996) "Dukes, earls and ersatz Edens: aristocratic nature preservationists in colonial Africa," *Environment and Planning D: Society and Space* 14: 79–98.
Neumann, R. (1998) *Imposing Wilderness: Struggles over Livelihood and Nature Preservation in Africa*, Los Angeles and Berkeley, CA: University of California Press.
Nietzsche, F. (1979 [1873]) "On truth and lies in a non-moral sense," in Breazeale,

D. (ed.) *Philosophy and Truth: Selection from Nietzsche's Notebooks of the Early 1970s*, Sussex, Harvester Press, New Jersey: Humaniti :s Press, pp. 79–80.
Nietzsche, F. (1967 [1901]) *The Will to Power*, translated by W. Kaufmann, edited by R. Hollingdale, New York: Vintage Books.
Norberg-Bohm, V., Clark, W., Bakshi, B., *et al.* (2001) "Inter: ational comparisons of environmental hazards," in Kasperson, J. and Kaspers(n, R. (2001) *Global Environmental Risk*, London: Earthscan, pp. 55–147.
Norris, C. (1995) "Truth, science and the growth of knowledg :," *New Left Review* 210: 105–123.
Nowotny, H. (1979) "Science and its critics: reflections on anti-science," in Nowotny, H. and Rose, H. (eds) *Counter Movements in th Sciences: the Sociology of the Alternatives to Big Science*, Dordrecht, Boston, MA, London: Reidel, pp. 1–26.
Nowotny, H. and Rose, H. (eds) (1979) *Counter Movement in the Sciences: the Sociology of the Alternatives to Big Science*, Dordrecht, B ston, MA, London: Reidel, pp. 1–26.
NRC (National Research Council, Board on Sustainable Development Policy Division) (1999) *Our Common Journey: A Transition To vards Sustainability*, Washington, DC: NRC.
O'Connor, J. (1996) "The second contradiction of capitalism,' in Benton, T. (ed.) *The Greening of Marxism*, New York: Guilford Press, pp. 187–196.
O'Riordan, T. and Jordan, A. (1999) "Institutions, climate change and cultural theory: towards a common analytical framework," *Gl bal Environmental Change* 9: 81–93.
Oba, G., Stenseth, N., and Lusigi, W. (2000) "New perspe tives on sustainable grazing management in arid zones of sub-Saharan Africa," *BioScience* 50: 35–51.
Odum, E. (1964) "The new ecology," *Bioscience* 14: 7, 14–16.
Odum, E. (1969) "The strategy of ecosystem development," *S ience* 164: 262.
Offe, C. (1985) "New social movements: challenging the bour laries of institutional politics," *Social Research* 52: 4, 817–868.
Olsson, L. and Ardö, J. (2002) "Soil carbon sequestration ir degraded semi-arid ecosystems: perils and potentials," *Ambio* 31: 6, 471–477.
Openshaw, K. (1974) "Woodfuels in the developing worlc," *New Scientist* 31: 271–272.
Ortony, A. (1993) *Metaphor and Thought*, 2nd edn, Cambridge: Cambridge University Press.
Ostrom, E. (1990) *Governing the Commons: the Evolution of Institutions for Collective Action*, Cambridge: Cambridge University Press.
Pasuk Phongpaichit and Baker, C. (1995) *Thailand: Economy and Politics*, Oxford: Oxford University Press.
Patz, J., McGeehin, M., Bernard, S., *et al.* (2000) "The potential health impacts of climate variability and change for the United States: executive summary of the report of the health sector of the U.S. National Assessment," *Environmental Health Perspectives* 108: 367–376.
Peet, R. and Watts, M. (eds) (1996) *Liberation Ecologies: Environment, Development, Social Movements*, London: Routledge.
Pereira, H. (1989) *Policy and Practice in the Management of Tropical Watersheds*, Boulder, CO: Westview Press.
PERG (Political Ecology Research Group) (1979) *A First Report of the Work of the Political Ecology Research Group*, Oxford: PERG.

Perlman, M. (1994) *The Power of Trees: the Reforesting of the Soul*, Dallas, TX: Spring Publications.
Pickering, A. (1995) *The Mangle of Practice*, Chicago, IL: University of Chicago Press.
Pickett, S. and White, P. (1985) *The Ecology of Natural Disturbance and Patch Dynamics*, New York: Academic Press.
Pielke, R. (1999) "Nine fallacies of floods," *Climatic Change* 42: 2, 413–438.
Pirandello, L. (1998 [1922]) *Naked: a New Version by Nicholas Wright*, London: Nick Hern Books.
Plumwood, V. (1993) *Feminism and the Mastery of Nature*, London: Routledge.
Poincaré, H. (1958) *The Value of Science*, London: Dover.
Polanyi, M. (1962) "The republic of science: its political and economic theory," *Minerva* 1: 1, 54–73.
Popper, K. (1945) *The Open Society and its Enemies*, London: Routledge.
Popper, K. (1962) *Conjectures and Refutations: the Growth of Scientific Knowledge*, New York: Basic Books.
Popper, K. (1994) *The Myth of the Framework: in Defense of Science and Rationality*, edited by M.A. Notturno, New York: Routledge.
Porritt, J. (2000) *Playing Safe: Science and the Environment*, London: Thames and Hudson.
Postel, S. (1993) "Facing water scarcity," in Starke, L. (ed.) *State of the World 1993*, New York: W.W. Norton and Co., pp. 22–41.
Preston, D., Macklin, M., and Warburton, J. (1997) "Fewer people, less erosion: the twentieth century in southern Bolivia," *The Geographical Journal* 163: 2, 198–205.
Price, D. (1965) *The Scientific Estate*, Cambridge, MA: Harvard University Press.
Price, D. (1986) *Little Science, Big Science ... and Beyond*, New York: Columbia University Press.
Price, M. and Thompson, M. (1997) "The complex life: human land uses in mountain ecosystems," *Global Ecology and Biogeography Letters* 6: 77–90.
Princen, T., Finger, M., and Manro, J. (1994) "Translational linkages," in Princen, T. and Finger, M. *Environmental NGOs in World Politics: Linking the Local and the Global*, London: Routledge, pp. 217–236.
Proctor, J. (1998) "The social construction of nature: relativist accusations, pragmatist and critical realist responses," *Annals of Association of American Geographers* 88: 3, 352–376.
Psillos, S. (1999) *Scientific Realism: How Science Tracks Truth*, London: Routledge.
Radder, H. (1998) "The Politics of STS," *Social Studies of Science* 28: 2, 328–332.
Rangan, H. (2000) *Of Myths and Movements: Rewriting Chipko into Himalayan History*, London: Verso.
Rappaport, R. (1968) *Pigs for the Ancestors*, New Haven, CT: Yale University Press.
Rasmussen, D. (ed.) (1996) *The Handbook of Critical Theory*, Oxford: Blackwell.
Rasmussen, K., Fog, B., and Madsen, J.E. (2001) "Desertification in reverse? Observations from northern Burkina Faso," *Global Environmental Change* 11: 4, 271–282.
Raustilia, K. and Victor, D. (1996) "Biodiversity since Rio: the future of Convention on Biological Diversity," *Environment* 38: 4, 17–20, 37–45.
Reich, R. (1990) *Public Management in a Democratic Society*, Englewood Cliffs, NJ: Prentice Hall.

Reid, W. (1997) "Strategies for conserving biodiversity," *Environment* 39: 7, 16–20.
Reij, C., Scoones, I., and Toulmin, C. (ed.) (1996) *Sustaining the Soil: Indigenous Soil and Water Conservation in Africa*, London: Earthscan.
Reiter, P. (1998) "Global warming and vector-borne disease," *Lancet* 351: 1738.
Reiter, P. (2000) "Malaria and global warming in perspective?' *Journal of Infectious Diseases* 6: 4, 438.
Revenga, C., Murray, S., Abramovitz, J., and Hammond, A. (1998) *Watersheds of the World: Ecological Value and Vulnerability*, Washington, DC: World Resources Institute, and Worldwatch Institute.
Ribot, J., Magalhaes, A., and Panagides, S. (eds) (1996) *Climate Variability, Climate Change and Social Vulnerability in the Semi-arid Tropics*, Cambridge: Cambridge University Press.
Rich, B. (1994) *Mortgaging the Earth: the World Bank, Environmental Impoverishment and the Crisis of Development*, London: Earthscan and Boston, MA: Beacon Press.
Richards, P. (1952) *The Tropical Rain Forest*, Cambridge: Cambridge University Press.
Richards, P., Slikkerveer, L., and Phillips, A. (1989) *Indigenous Knowledge Systems for Agriculture and Rural Development: The CIKARD inaugural lectures*, Studies in technology and social change no. 13, Technical and social change program, Iowa State University, Adams, IA.
Robbins, P. (1998) "Paper forests: imagining and deploying exogenous ecologies in arid India," *Geoforum* 29: 1, 69–86.
Robbins, P. (2000) "The practical politics of knowing: state environmental knowledge and local political economy," *Economic Geography* 76: 2, 126–144.
Robertson, R. (1992) *Globalization: Social Theory and Global Culture*, Thousand Oaks, CA: Sage.
Rocheleau, D. (1995) "Maps, numbers, text, and context: mixing methods in feminist political ecology," *Professional Geographer* 47: 4, 458–466.
Rocheleau, D. and Edmunds, D. (1997) "Women, men and trees: gender, power and property in forest and agrarian landscapes," *World Development* 25: 8, 1351–1371.
Rocheleau, D. and Ross, L. (1995) "Trees as tools, trees as text: struggles over resources in Zamhrana-Chacney, Dominican Republic," *Antipode* 27: 4, 407–428.
Rocheleau, D., Ross, L., Morrobel, J., Malaret, L., Hernandez, R., and Kominiak, T. (2001) "Complex communities and emergent ecologies in the regional agroforest of Zambrana-Chacuey, Dominican Republic," *Ecumene* 8: 4, 465–492.
Rocheleau, D., Thomas-Slayter, B., and Wangari, E. (eds) (1996) *Feminist Political Ecology: Global Issues and Local Experiences*, London: Routledge.
Roe, E. (1991) "'Development narratives' or making the best of blueprint development," *World Development* 19: 4, 287–300.
Roe, E. (1994) *Narrative Policy Analysis: Theory and Practice*, Chapel Hill, NC: Duke University Press.
Roe, E. (1995) "Except Africa: postscript to a special section on development narratives," *World Development* 23: 6, 1065–1069.
Roquelpo, P. (1995) "Scientific expertise among political powers, administrations and public opinion," *Science and Public Policy* 22: 3, 175–182.
Rorty, R. (1989a) *Contingency, Irony, and Solidarity*, Cambridge: Cambridge University Press.

Rorty, R. (1989b) "Solidarity or objectivity?" in Krausz, M. (ed.) *Relativism*, Notre Dame, IN: University of Notre Dame Press, pp. 35–50.
Rose, H. (1990) "Toward pragmatic realism in human geography," *Cahiers de Géographie du Québec* 34: 92, 161–179.
Ross, A. (1996) *Strange Weather: Culture, Science and Technology in the Age of Limits*, London: Verso.
Rosswall, T., Woodmansee, R., and Risser, P. (1988) *Scales and Global Change: Spatial and Temporal Variability in Biospheric and Geospheric Processes*, New York: John Wiley.
Rostand, E. (1985) *Cyrano de Bergerac*, translated and adapted by Anthony Burgess, London: Hutchinson.
Rouse, J. (1987) *Knowledge and Power: Toward a Political Philosophy of Science*, Ithaca, NY: Cornell University Press.
Royal Society (1992) *Risk: Analysis, Perception and Management*, London: The Royal Society.
Ruether, R. (1972) *Liberation Theology: Human Hope Confronts Christian History and American Power*, New York: Paulist Press.
Rundle, B. (1993) *Facts*, London: Duckworth.
Russell, B. (1940) *An Inquiry into Meaning and Truth*, London: Allen and Unwin.
Russett, B. (1967) *International Regions and the International System: a Study in Political Ecology*, Chicago, IL: Rand McNally.
Sabatier, P. (1987) "Knowledge, policy oriented learning and policy change," *Knowledge: Creation, Diffusion, Utilization* 8: 4, 649–662.
Sabatier, P. and Jenkins-Smith, H. (eds) (1993) *Policy Change and Learning: an Advocacy Coalition Approach*, Boulder, CO: Westview Press.
Saberwal, V. (1997) "Science and the desiccationist discourse of the 20th Century," *Environment and History* 3: 309–343.
Sachs, W. (ed.) (1993) *Global Ecology: a New Arena of Political Conflict*, London: Zed, Halifax, Novia Scotia: Fernwood.
Satterthwaite, D. (1997) "Environmental transformations in cities as they get larger, wealthier and better managed," *The Geographical Journal* 163: 2, 216–224.
Sayer, A. (1997) "Essentialism, social constructivism, and beyond," *Sociological Review* 45: 453–477.
Sayer, A. (2000) *Realism and Social Science*, Thousand Oaks, CA: Sage.
Schaefer, W. (ed.) (1983) *Finalization in Science*, Dordrecht: Reidel.
Schiebinger, L. (1993) *Nature's Body: Gender in the Making of Modern Science*, Boston, MA: Beacon Press.
Schmidt-Vogt, D. (1998) "Defining degradation: the impacts of swidden on forests in northern Thailand," *Mountain Research and Development*, 18: 2, 135–149.
Schön, D. and Rein, M. (1994) *Frame Reflection: Towards the Resolution of Intractable Policy Controversies*, New York: Basic Books.
Schumm, S. (1991) *To Interpret the Earth: Ten Ways to be Wrong*, Cambridge: Cambridge University Press.
Schuurman, F. (1993) "Introduction: development theory in the 1990s," in Schuurman, F. (ed.) *Beyond the Impasse: New Directions in Development Theory*, London: Zed, pp. 1–18.
Schwarz, M. and Thompson, M. (1990) *Divided We Stand: Redefining Politics, Technology and Social Choice*, Hemel Hempstead: Harvester Wheatsheaf.
Scoones, I. (1994) *Living with Uncertainty: New Directions in Pastoral Development in Africa*, London: Intermediate Technology Publications.

Scoones, I. (1998) *Sustainable Rural Livelihoods: a Framework for Analysis*, IDS Working Paper 72, Brighton, UK: IDS.

Scoones, I. and Thompson, J. (eds) (1994) *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice*, London: Intermediate Technology Publications.

Scott, J. (1985) *Weapons of the Weak: Everyday Forms of Peasant Resistance*, New Haven, CT: Yale University Press.

Scott, J. (1998) *Seeing Like a State: How Certain Schemes to Improve the Human Condition have Failed*, New Haven, CT: Yale University Press.

Searle, J. (1995) *The Construction of Social Reality*, New York: Free Press.

Sears, P. (1959 [1935]) *Deserts on the March*, Norman, OK: University of Oklahoma Press.

Sears, P. (1964) "Ecology – a subversive subject," *Bioscience* 14: 7, 11–13.

Segerstråle, U. (ed.) (2000) *Beyond the Science Wars: the Missing Discourse About Science and Society*, Albany, NY: State University of New York Press.

Seligman, A. (1997) *The Problem of Trust*, Princeton, NJ: Princeton University Press.

Sen, A. (1981) *Poverty and Famines: an Essay on Entitlement and Deprivation*, Oxford: Clarendon Press.

Shackley, S. (1997) "The IPCC: consensual knowledge and global politics," *Global Environmental Change* 7: 1, 77–79.

Shackley, S. and Wynne, B. (1995) "Global climate change: the mutual construction of an emergent science–policy domain," *Science and Public Policy* 22: 218–230.

Shackley, S. and Wynne, B. (1996) "Representing uncertainty in global climate change science and policy: boundary-ordering devices and authority," *Science, Technology and Human Values* 21: 3, 275–302.

Shah, M. and Banerji, D. (2001) "India needs vigilance against discredited technologies: GM crops and the world market" *The Hindu*, Thursday, 20 December.

Shapin, S. (1994) *A Social History of Truth: Civility and Science in Seventeenth-Century England*, Chicago, IL: University of Chicago Press.

Shapin, S. (2001) "Proverbial economies: how an understanding of some linguistic and social features of common sense can throw light on more prestigious bodies of knowledge, science for example," *Social Studies of Science* 31: 5, 731–769.

Shapin, S. and Schaffer, S. (1985) *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life*, Princeton, NJ: Princeton University Press.

Shepard, P. and McKinley, D. (eds) (1969) *The Subversive Science: Essays Toward an Ecology of Man*, Boston, MA: Houghton Mifflin.

Shiva, V. (1993) "The greening of the global reach," in Sachs, W. (ed.) *Global Ecology: a New Arena of Political Conflict*, London: Zed, Halifax, Novia Scotia: Fernwood, pp. 149–156.

Shiva, V. (1999) "The global campaign against biopiracy and changing the paradigm of agriculture," speech made to the *International Forum on Globalization*, Seattle IFG Teach-In, 26 November 1999 (http: //gos.sbc.edu/s/shiva3.html).

Shrader-Frechette, K. and McCoy, E. (1994) "How the tail wags the dog: how value judgments determine ecological science," *Environmental Values* 3: 107–120.

Shrum, W., Chompalov, I., and Genuth, J. (2001) "Trust, conflict and performance in scientific collaborations," *Social Studies of Science* 31: 5, 681–730.

Sillitoe, P. (1993) "Losing ground? Soil loss and erosion in the highlands of Papua New Guinea," *Land Degradation and Rehabilitation* 5: 3, 179–190.

Sillitoe, P. (1998) "It's all in the mound: fertility management under stationary shifting cultivation in the Papua New Guinea highlands," *Mountain Research and Development* 18: 2, 123–134.

Silverman, D. (1993) *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*, London: Sage.

Simon, J. and Kahn, H. (eds) (1984) *The Resourceful Earth: a Response to Global 2000*, Oxford: Blackwell.

Simpson, A. (1998) "Can democracy cope with biotechnology?" *Genetics Forum* December 1998/January 1999 (http: //www.geneticsforum.org.uk/).

Simpson, G. (1960) "The world into which Darwin led us," *Science* 131: 966–974.

Sismondo, S. (1996) *Science Without Myth: On Constructions, Reality, and Social Knowledge*, Albany, NY: State University of New York Press.

Sivraramakrishnan, K. (2000) "State sciences and development histories: encoding local forest knowledge in Bengal," *Development and Change* 31: 61–89.

Sluijs, J. van der, Eijndhoven, J. van, Shackley, S., and Wynne, B. (1998) "Anchoring devices for science in policy: the case of consensus around climate sensitivity," *Social Studies of Science* 28: 2, 291–323.

Smith, P. (1988) *Discerning the Subject*, Minneapolis, MN: University of Minnesota Press.

Smith, R. (1996) "Sustainability and the rationalization of the environment," *Environmental Politics* 5: 1, 25–47.

Snow, C.P. (1961) *Science and Government*, Cambridge, MA: Harvard University Press.

Social Learning Group (2000a) *Learning to Manage Global Environmental Risks: vol. 1, A Comparative History of Social Responses to Climate Change, Ozone Depletion, and Acid Rain*, Cambridge, MA: MIT Press.

Social Learning Group (2000b) *Learning to Manage Global Environmental Risks: vol. 2, A Functional Analysis of Social Responses to Climate Change, Ozone Depletion, and Acid Rain*, Cambridge, MA: MIT Press.

Sokal, A. (1996) "Transgressing the boundaries: toward a transformative hermeneutics of quantum gravity," *Social Text* 46/47, 217–252.

Solbrig, O. (1993) "Ecological constraints to savanna land use," in Young, M. and Solbrig, O. (eds) *The World's Savannas: Economic Driving Forces, Ecological Constraints, and Policy Options for Sustainable Land Use*, Man and the Biosphere Series 12, Paris: UNESCO.

Soper, K. (1995) *What is Nature?* Oxford: Blackwell.

Soulé, M. (1995) "The social siege of nature," in Soulé, M. and Lease, G. (eds) *Reinventing Nature? Responses to Postmodern Deconstruction*, Washington, DC: Island Press, pp. 137–170.

Soulé, M. and Lease, G. (eds) (1995) *Reinventing Nature? Responses to Postmodern Deconstruction*, Washington, DC: Island Press.

Spaagaren, G. and Mol, A. (1992) "Sociology, environment and modernity," *Society and Natural Resources* 5: 4, 323–344.

Spivak, G.C. (1988) "Can the subaltern speak?," in Nelson, C. and Grossberg, L. (eds) *Marxism and the Interpretation of Culture*, London: Macmillan, pp. 271–313.

Star, S. and Griesemer, J. (1989) "Institutional ecology, 'translations,' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–1939," *Social Studies of Science* 19: 3, 387–420.

Stebbing, E. (1937) "The threat of the Sahara," *Journal of the Royal African Society* 36: 1–35.
Stehr, N. (1994) *Knowledge Societies*, Thousand Oaks, CA: Sage.
Steinbeck, J. (1983 [1939]) *The Grapes of Wrath*, London: Landmark Heinemann.
Stocking, M. (1996) "Soil erosion: breaking new ground," in Leach, M. and Mearns, R. (eds) *The Lie of the Land: Challenging Received Wisdom on the African Environment*, Oxford: Currey, pp. 140–154.
Stott, P. (1999) *Tropical Rain Forest: a Political Ecology of Hegemonic Mythmaking*, London: Institute of Economic Affairs.
Stott, P. and Sullivan, S. (eds) (2000) *Political Ecology: Science, Myth and Power*, London: Arnold.
Swyngedouw, E. (1999) "Modernity and hybridity: nature, *regeneracionismo*, and the production of the Spanish Waterscape, 1890–1930," *Annals of the Association of American Geographers* 89: 3, 443–465.
Szerszynski, B., Lash, S., and Wynne, B. (1996) "Introduction: ecology, realism and the social sciences," in Lash, S., Szerszynski, B., and Wynne, B. (eds) *Risk, Environment and Modernity: Towards a New Ecology*, London: Sage, pp. 1–26.
Tandon, Y. (1995) "Grassroots resistance to dominant land-use patterns in Southern Africa," in Taylor, B. (ed.) *Ecological Resistance Movements: the Global Emergence of Radical and Popular Environmentalism*, New York: State University Press, pp. 161–176.
Taylor, B. (ed.) (1995) *Ecological Resistance Movements: the Global Emergence of Radical and Popular Environmentalism*, New York: State University Press.
Taylor, P. and Buttel, F. (1992) "How do we know we have Global Environmental Problems? Science and the globalization of environmental discourse," *Geoforum* 23: 3, 405–416.
Taylor, P. and Garcia-Barrios, R. (1995) "The social analysis of ecological change: from systems to intersecting processes," *Social Science Information* 35: 5–30.
Tennant, N. (1997) *The Taming of the True*, Oxford: Clarendon.
Tesh, S. (2000) *Uncertain Hazards: Environmental Activists and Scientific Proof*, Ithaca, NY and London: Cornell University Press.
Tewdwr-Jones, M. and Allmendinger, P. (1998) "Deconstructing communicative rationality: a critique of Habermasian collaborative planning," *Environment and Planning A* 30: 11, 1975–1989.
Thomas, D. and Middleton, N. (1994) *Desertification: Exploding the Myth*, Chichester: Wiley.
Thompson, G. (1985) "New faces, new opportunities: the environment movement goes to business school," *Environment* 27: 4, 6–11, 30.
Thompson, M. (1989) "Commentary: from myths as falsehoods to myths as repositories of experience and wisdom," *Mountain Research and Development* 9: 2, 182–186.
Thompson, M. (1993) "Good science for public policy," *Journal of International Development* 5: 6, 669–679.
Thompson, M. (2000) "Understanding the impacts of global networks on local social, political and cultural values," vol. 42 of Engel, C. and Keller, K. (eds) *First Symposium of the German American Academic Council's Project: "Global Networks and Local Values," Dresden, 18–20 February 1999*, Baden-Baden: Nomos Verlagsgesellschaft.
Thompson, M., Ellis, R., and Wildavsky, A. (1990) *Cultural Theory*, Boulder, CO: Westview Press.

Thompson, M. and Rayner, S. (1998a) "Risk and governance part 1: the discourses of climate change," *Government and Opposition* 33: 2, 139–166.
Thompson, M. and Rayner, S. (1998b) "Risk and governance part 2: the discourses of climate change," *Government and Opposition* 33: 3, 330–354.
Thompson, M., Warburton, M., and Hatley, T. (1986) *Uncertainty on a Himalayan Scale: an Institutional Theory of Environmental Perception and a Strategic Framework for the Sustainable Development of the Himalayas*, London: Ethnographica, Milton Ash Publications.
Tiffen, M. and Mortimore, M., with Gichuki, F. (1994) *More People, Less Erosion? Environmental Recovery in Kenya*, Chichester: John Wiley.
Tol, R. and Dowlatabadi, H. (2001) "Vector-borne diseases, development and climate change," *Integrated Assessment* 2: 171–183.
Touraine, A. (1981) *The Voice and the Eye*, Cambridge: Cambridge University Press.
Trimble, S. (1983) "A sediment budget for Coon Creek basin in the Driftless area, Wisconsin 1853–1977," *American Journal of Science* 283: 454–474.
Trudgill, S. and Richards, K. (1997) "Environmental science and policy: generalizations and context sensitivity," *Transactions of the Institute of British Geographers* NS 22: 5–12.
Turnbull, D. (1991) "Local knowledge and 'absolute standards': A reply to Daly," *Social Studies of Science* 21: 3, 571–573.
Turner, B.L. II (2002) "Contested identities: human–environment geography and disciplinary implications in a restructuring academy," *Annals of the Association of American Geographers* 92: 1, 52–74.
Turner, B.L. II, Clark, W., Kates, R., Richards, J., Mathews, J., and Meyer, W. (eds) (1990) *The Earth Transformed by Human Action: Global and Regional Changes in the Biosphere over the Past 300 Years*, Cambridge: Cambridge University Press.
Turner, M. (1993) "Overstocking the range: a critical analysis of the environmental science of Sahelian pastoralism," *Economic Geography* 69: 4, 402–421.
Turner, S. (2001) "What is the problem with experts?" *Social Studies of Science* 31: 1, 123–149.
UNCED (United Nations Conference on Environment and Development) (1992) *Agenda 21 and the UNCED proceedings*, edited by Robinson, N.A. with Hassan, P. and Burhenne-Guikmin, F., under the auspices of The Commission on Environmental Law of the World Conservation Union – The International Union for the Conservation of Nature and Natural Resources (IUCN), Third Series, International Protection of the Environment, New York, London and Rome: Oceania Publications (in six volumes).
UNEP (United Nations Environment Program) (2001) *Cultural and Spiritual Values of Biodiversity: a Complementary Contribution to the Global Biodiversity Assessment*, edited by Posey, D. and the Oxford Centre for the Environment, Ethics and Society, Oxford University, Nairobi: UNEP.
UNFCCC/SBSTA (2000) (United Nations Framework Convention on Climate Change/Subsidiary Body on Scientific and Technological Advice), *Methodological Issues: Land Use, Land Cover Change, and Forestry: Draft Conclusions by the Chairman of the Subsidiary Body on Scientific and Technological Advice*, UNFCCC/SBSTA/2000/CRP.11, The Hague, November.
USCEQ (United States Council on Environmental Quality) (1980) *The Global 2000 Report to the President: Entering the Twenty-first Century.* A report pre-

pared by the Council on Environmental Quality and the Department of State: Washington, DC: Department of State.
USCSP (1999) *Climate Change: Mitigation, Vulnerability, and Adaptation in Developing and Transition Countries*, Washington, DC: USCSP.
USDA (US Department of Agricultural Research Service) (1961) *A Universal Equation for Predicting Rainfall-Erosion Losses,* USDA-ARS special report, pp. 22–26.
van Zwanenberg, P. and Millstone, E. (2000) "Beyond skeptical relativism: evaluating the social constructions of expert risk assessments," *Science, Technology and Human Values* 25: 3, 259–282.
Vayda, A. (1996) *Methods and Explanations in the Study of Human Actions and their Environmental Effects*, CIFOR/WWF Special Publication, Jakarta: World Wide Fund for Nature (Indonesia).
Vayda, A. and Walters, B. (1999) "Against political ecology," *Human Ecology* 27: 1, 167–179.
Vogel, S. (1996) *Against Nature: the Concept of Nature in Critical Theory*, Albany, NY: State University of New York Press.
Wade, W. (1997) "Greening the Bank: the struggle over the environment, 1970–1995," in Kapur, D., Lewis, J., and Webb, R. (eds), *The World Bank: its First Half Century*, vol. 2, Washington, DC: Brookings Institution, pp. 611–734.
Walker, P. (1962) "Terrace chronology and soil formation on the south coast of New South Wales," *Journal of Soil Science* 13: 178.
Wallerstein, I. (1999) "Ecology and capitalist costs of production: no exit," in Goldfrank, W., Goodman, D., and Szasz, A. (eds) *Ecology and the World System*, Westport, CT: Greenwood Press, pp. 3–12.
Wallner, H., Naraodoslawsky, M., and Moser, F. (1996) "Islands of sustainability: a bottom-up approach towards sustainable development," *Environment and Planning A* 28: 1763–1778.
Walters, B. (2001) "Event ecology in the Philippines: explaining mangrove planting and its environmental effects," paper presented at the 97th Annual Meeting of the American Association of Geographers, New York City, New York, 27 February–3 March.
Wapner, P. (1995) "Politics beyond the state: environmental activism and world civic politics," *World Politics* 47: 311–340.
Ward, B. and Dubos, R. (1972) *Only One Earth,* New York: Deutsch.
Ward, S. (1996) *Reconfiguring Truth: Postmodernism, Science Studies, and the Search for a New Model of Knowledge*, Lanham, BO, New York, London: Rowman and Littlefield.
Warren, A. and Agnew, C. (1988) *An Assessment of Desertification and Land Degradation in Arid and Semi-Arid Areas*, London: IIED and University College, London.
Watts, M. (1983) *Silent Violence: Food, Famine and Peasantry in Northern Nigeria*, Berkeley, CA: University of California Press.
Watts, M. and McCarthy, J. (1997) "Nature as artifice, nature as artefact: development, environment and modernity in the late twentieth century," in Lee, R. and Wills, J. (eds) *Geographies of Economies,* London: Arnold, pp. 71–86.
WCED (World Commission on Environment and Development) (1987) *Our Common Future,* New York: Oxford University Press.
Weinberg, A. (1963) "Criteria for scientific choice," *Minerva* 1: 159.
Weinberg, A. (1972) "Science and trans-science," *Minerva* X: 2, 209–222.

Weingart, P. (1999) "Scientific expertise and political accountability: paradoxes of science in politics," *Science and Public Policy* 26: 3, 151–161.
Wells, D. and Lynch, T. (2000) *The Political Ecologist*, Aldershot: Ashgate.
Westra, L. and Lawson, B. (2001) *Faces of Environmental Racism: Confronting Issues of Global Justice*, 2nd edn, Lanham, MD: Rowman and Littlefield.
White, R. (1980) *Land Use, Environment, and Social Change: the Shaping of Island Country, Washington*, Seattle, WA: University of Washington Press.
Whitmore, T. (1984) *Tropical Rain Forests of the Far East,* 2nd edn, Oxford: Clarendon Press.
Wiens, J. (1977) "On competition and variable environments," *American Scientist* 65: 590–597.
Wiesenthal, H. (1993) *Realism in Green Politics: Social Movements and Ecological Reform in Germany*, edited by J. Ferris, Manchester: Manchester University Press.
Wilbanks, T. and Kates, R. (1999) "Global change in local places: how scale matters," *Climatic Change* 43: 3, 601–628.
Wildavsky, A. (1995) *But Is It True? A Citizen's Guide to Environmental Health and Safety Issues*, Cambridge, MA: Harvard University Press.
Williams, J. (2001) *The Rise and Decline of Public Interest in Global Warming: Toward a Pragmatic Conception of Environmental Problems*, Huntingdon, NY: Nova.
Williams, W. (1958) "Conservation: is it important?" *Journal of the Institute of Biology* 5: 4, 86–88.
Wilson, A.N. (2000) "Sermons on science from a royal soaphox," *The Sunday Telegraph* 12 November, p. 42.
Wilson, W. (1896) "A commemorative address delivered on October 21, 1896," in Wilson, W. (1992) *Papers of Woodrow Wilson 1896–1898*, Princeton, NJ: Princeton University Press.
Wittfogel, K. (1956) "The hydraulic civilizations," in Thomas, W. (ed.) *Man's Role in Changing the Face of the Earth*, Chicago, IL: University of Chicago Press, pp. 152–164.
Wolf, E. (1972) "Ownership and political ecology," *Anthropological Quarterly* 45: 3, 201–205.
Woodgate, G. and Redclift, M. (1994) "Sociology and the environment: discordant discourse?" in Redclift, M. and Benton, T. (eds) *Social Theory and the Global Environment*, London: Routledge, pp. 51–66.
Woodgate, G. and Redclift, M. (1998) "From a 'sociology of nature' to environmental sociology: beyond social constructivism," *Environmental Values* 7: 3–24.
Worster, D. (1977) *Nature's Economy: a History of Ecological Ideas*, Cambridge: Cambridge University Press.
Worster, D. (1979) *Dust Bowl: the Southern Plains in the 1930s*, Oxford: Oxford University Press.
WRI (World Resources Institute) (1990) *A Guide to the Global Environment*, New York: Oxford University Press.
WRM (World Rainforest Movement) (2000) "Sinks that stink," *WRM Bulletin*, June.
Wu, J. and Loucks, O. (1995) "From balance of nature to hierarchical patch dynamics: a paradigm shift in ecology," *The Quarterly Review of Biology* 70: 4, 439–466.
Wynne, B. (1992a) "Misunderstood misunderstanding: social identities and public uptake of science," *Public Understanding of Science* 1: 3, 231–304.

Wynne, B. (1992b) "Uncertainty and environmental learning: reconceiving science and policy in the preventive paradigm," *Global Environmental Change* 2: 111–127.

Wynne, B. (1994) "Scientific knowledge and the global environment," in Redclift, M. and Benton, T. (eds) *Social Theory and the Global Environment*, London: Routledge, pp. 169–189.

Wynne, B. (1996a) "May the sheep safely graze? A reflexive view of the expert–lay knowledge divide," in Lash, S., Szerszynski, B., and Wynne, B. (eds) *Risk, Environment and Modernity*, London: Sage, pp. 44–83.

Wynne, B. (1996b) "SSK's identity parade: signing-up, off-and-on," *Social Studies of Science* 26: 2, 357–391.

Wynne, B. (1998) "Reply to Radder," *Social Studies of Science* 28: 2, 339–342.

Wynne, B. (2001) "Creating public alienation: expert cultures or risk and ethics on GMOs," *Science as Culture* 10: 4, 445–481.

Yearley, S. (1992) "Green ambivalence about science: legal–rational authority and the scientific legitimization of a social movement," *The British Journal of Sociology* 43: 4, 511–532.

Yearley, S. (1994) "Social movements and environmental change," in Redclift, M. and Benton, T. (eds) *Social Theory and the Global Environment*, London: Routledge, pp. 150–168.

Yearley, S. (1996) *Sociology, Environmentalism, Globalization*, London: Sage.

Zimmerer, K. (1994) "Human geography and the 'new ecology': the prospect and promise of integration," *Annals of the Association of American Geographers* 84: 1, 108–125.

Zimmerer, K. (1996a) "Discourses on soil loss in Bolivia," in Peet, R. and Watts, M. (eds) *Liberation Ecologies: Environment, Development, Social Movements*, London: Routledge, pp. 110–124.

Zimmerer, K. (1996b) "Ecology as cornerstone and chimera in human geography," in Earle, C., Mathewson, K., and Kenzer, M. (eds) *Concepts in Human Geography*, Lanham, MD: Rowman and Littlefield, pp. 161–188.

Zimmerer, K. (2000) "The reworking of conservation geographies: nonequilibrium landscape and nature–society hybrids," *Annals of the Association of American Geographers* 90: 2, 356–369.

Zimmerer, K. and Young, K. (eds) (1998) *Nature's Geography: New Lessons for Conservation in Developing Countries*, Madison, WI: University of Wisconsin Press.

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