

[Global Aspects of Food Production]

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CHAPTER 15

The Significance of Desertification

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INTRODUCTION

DESERTIFICATION CONSTITUTES A serious potential threat to the future of world food production – but in a rather more complex way than is represented in most of the arguments and figures published so far. The circumstances of the discovery of desertification led to a particular structuring of the campaign to combat it. From the beginning the campaign held the seeds of conflict in the form of political imbalance. The data that were gathered to further the campaign have served to fuel the conflict. Not only is the conflict not yet resolved: it has received little open discussion. Meanwhile, the campaign languishes.

This chapter seeks to disentangle some of the complexity in the desertification debate, in order to bring the problem into better perspective, so that its future significance can be realistically assessed. The presentation falls into four sections. The first reviews the background to the campaign. The second discusses the organisation of activities and of information, giving special attention to the inherent conflicts of interest that have (it is suggested) been responsible for the difficulties encountered in formulating and implementing practical measures to combat desertification. The third looks at the concept of desertification, as it has developed and continues to develop, as a rationalisation of the ideas generated in the campaign. The final section outlines the prospect for dealing with desertification insofar as it may affect food production at the global level, and formulates an approach to it that may be not only more acceptable politically but more comprehensive scientifically.

BACKGROUND

The modern consciousness of ecological degradation can be traced back at least to the nineteenth century; the conviction that degradation cannot be allowed to continue began to appear only in the 1950's when the international development effort got under way and the limits of the world's capacity to produce enough food to satisfy anticipated levels of demand seemed to come within sight. That development effort was based on the assumption, very simply, that increased production and improved health and well-being (and reduced population growth) could be induced by the injection of investment and the transfer of technology into existing low-growth systems of production. In the 1960's, as it became clear that results were falling considerably short of expectations, this assumption began to be questioned. At the same time ecological degradation was diagnosed by specialists as endangering the overall success of the effort. Implicit in this diagnosis was the related assumption that such degradation was not only increasing and intensifying but was caused by the traditional systems that development was designed to transform. The situation was particularly grave in areas subject to either continuous or regular annual water deficit – the world's drylands.

Initially the Sahelian drought, which lasted from 1968 to 1973 and had particularly severe effects in many areas that had recently been the scene of intensive development efforts, can now be seen to have dealt the deciding blow to the paradigm of development that was based on those assumptions – although at the level of implementation the change has been slow, largely because of the difficulties of operationalising and mobilising the concepts that have begun to take their place. The effects of drought also led to the formal establishment, at the official level, of the term “desertification,” when at the end of 1974 the United Nations General Assembly passed a resolution calling for an international conference on desertification (UNCOD), to be held in 1977.

Since the case for a campaign against desertification is *prima facie* ecological and is argued in ecological terms, while the case for development is economic and social and is argued in economic, social and political terms, it tends not to be recognised that both spring from different orientations towards the same historical process – the struggle of increasing numbers of people for an optimum distribution of available resources.

The difference in orientation reflects a difference in social background and social identity. Failure to see the intimate relationship between desertification and development is not surprising since the two concepts derive from different orientations towards various aspects of the global food supply problem. To put it simply, desertification implies that people must change their ways to fit nature; development implies that the use of resources must be rearranged with the aid of newly available technologies to fit policy requirements. Neither gives sufficient attention to the often intractable nature of social or cultural factors. The effects of the Sahelian drought were so startling that for a time the ecological emphasis implied in the concept of desertification eclipsed the development orientation. A chronological survey of the

literature since the early 1970's shows that enormous progress has been made towards resynthesising the two orientations, but we have still not brought the problem of desertification fully into perspective. The United Nations Organisation has played the major organising role in the desertification-development debate. (It has possibly been able to do this only because of the pervasive, but mistaken, sense – especially early on – that desertification is an ecological and not a political problem. As the political dimensions of the problem have become clearer the coherence and cohesion of the United Nations' organising role have dissipated).

The resolution of the United Nations General Assembly specified that "a world map should be developed showing areas vulnerable to desertification, all available information on desertification and its consequences for development should be gathered and assessed, and a plan of action to combat desertification should be prepared with emphasis on the development of indigenous science and technology" (UNCOD 1977a). Between early 1975 and the summer of 1977 the UNCOD Secretariat, aided by various United Nations agencies and a number of interested governments, accumulated and synthesised an impressive amount of information on the nature of desertification, the rate of its advance and the seriousness of its effects (although they were not able to do much on indigenous science and technology, since the apparatus for gathering and organising this information was not available to them, and in fact barely exists), and compiled a draft Plan of Action which if passed by the Conference would provide the basis of corrective action at the national, regional, and international levels. This draft was discussed and modified at five regional meetings and again at the Conference itself, where it arrived at its final form. Unanimous approval of it (in a form significantly modified to accord with political considerations) constituted the culmination of the Conference. So far efforts to implement this Plan of Action have been disappointing.

At the present time it would seem that everyone – all governments – acknowledge that desertification is a serious global problem, but similar unanimity is lacking on the analysis of its component processes and on how it is related to other problems that are also considered serious. As a result there is significant disagreement about how the problem should be dealt with. The Plan of Action states *what* should be done, but not *how* it should be done. More exactly it states what should be done politically and economically to combat desertification, but it does not (and could not, even if the compilers and the delegates were conscious of them) attack the political and economic conditions that are an integral component of desertification processes. It is symptomatic of this situation that neither the Desertification Unit, set up in Nairobi to co-ordinate the Plan, nor the intergovernmental Consultative Group, which includes representatives of both prospective donor and recipient countries, and which met twice in May 1978 and March 1980 to facilitate the organisation and especially the funding of the measures agreed on in the Plan, have produced tangible results. It appears that governments generally do not perceive desertification (as it is presently defined), to be among the most pressing of their problems, whether it is viewed in local or in global perspective.

In the context of this volume these governmental perceptions demand a careful reconsideration of the campaign to combat desertification. The hypothesis that

underlies the reconsideration that follows is that desertification must be reconceptualised – if anything is to be gained from its discovery. The original conceptualisation, insofar as it was ever expressed in a generally accepted definition, was partial and inadequate as a result of stunned reaction to the efficient cause, which was the natural disaster in the Sahel. With the lapse of time a more balanced definition should be possible, that would take into account the intimate interrelation of desertification and development.

THE ORGANISATION

The desertification debate has been dominated by UNCOD and the bureaucratic processes leading up to it and deriving from it. The nature of the problem can be seen in some of the conflicts that developed at the Conference itself.¹ The delegates were presented with a comprehensive synthesis of existing knowledge, examples from twelve countries of experience in specific projects, and six feasibility studies demonstrating practical ways to achieve supranational co-operation (that is, co-operation at the level of ecological and regional rather than national and political units) to combat desertification.² On the basis of this material they were told that they should accept existing knowledge as adequate for the immediate purpose of establishing an international Plan to combat desertification. They should therefore devote their attention during the Conference to the problem of organising the successful application of this knowledge. They were told that their task lay in the organisation of programmes and resources in order to make possible (in the words of the Plan of Action) "the immediate adaptation and application of existing knowledge." For, "Desertification can be halted and ravaged land reclaimed in terms of what is known now. All that remains is the political will and determination to do it" (UNCOD 1977a). Like all U.N. conferences, therefore, UNCOD was – implicitly at least – a political conference, in that it was concerned primarily with organisation.

Organisation on this scale transcends the province of ecology where desertification was diagnosed. Answers to the problems of ecological management inevitably beg questions of management of the political economy. As often happens in such international forums, the discussions were conducted on two levels. While ostensibly the delegates were discussing means and guidelines for the organisation of programmes in which they would co-operate to mobilise resources and combat desertification,

1. The argument of this section appears also in Spooner and Mann 1982.

2. These transnational Projects, of which there were six – two ecological monitoring projects in Southwest Asia and South America, two greenbelt projects in the North African and Sahelian countries, a livestock stratification project in the Sahel and a ground water conservation project in Northeast Africa and the Arabian peninsula – although they survived the Conference, began soon after to disintegrate. In an attempt to save some of them the Desertification Unit (which succeeded the UNCOD Secretariat, Nairobi) redefined them as sets of interrelated national projects. The twelve "Case Studies" were from Australia, Chile, China, India, Iran, Iraq, Israel, Niger, Pakistan, Tunisia, United States, USSR. Four "component reviews" were prepared on desertification and climate, ecological change, society, and technology. There were also a number of country reports and other minor documents.

many were using the discussion to bargain about relations between the parties to the Conference. Most delegates saw the solution to desertification in the mobilisation of resources, but many also blamed the incentives for exploitation of people and resources that they considered to be inherent in the present system, and saw the solution in the reorganisation of the world economic order. While all the delegates accepted the ecological explanations of desertification and the technical solutions, many were more concerned with causation at another level: that of the economic and political conditions that generate land use decisions. The organisers of the Conference pursued a strategy designed to keep deliberations at the former level, but the "political will and determination" that they sought to stimulate were more abundant at the latter level – though more difficult to harness.

These two levels of discussion are evident in other arenas of the anti-desertification debate. They are inherent in the political process, and it is unrealistic to hope to keep them entirely separate. The campaign to organise for the purpose of conserving resources can never entirely free itself from the campaign to reorganise the distribution of resources. The consequent dialectic between overt discussion of how to organise in the existing system and the underlying theme of how to reorganise the system is particularly noticeable in two other arenas. Most obviously, it arises in the relations between populations which are at risk or suffering from desertification and the planners and implementers of management programmes designed to combat desertification. But perhaps most significantly, it characterises the relations between natural scientists concerned with the viability of physical and biological systems and social scientists concerned with the viability of social and cultural systems.

For example, management programmes designed by range scientists to address the long term ecological balance in the relationship between animals and carrying capacity in the arid and semi-arid rangelands of the world are based on values and perceptions different from those of pastoralists. Coming from a different cultural environment and a different social class and trained in different land use systems, the ecologists are led to define the universe of the problem differently and to place a different emphasis in the aims that they pursue in relation to it. The ecologist is primarily concerned with the long term productivity of the resource; the pastoralist is primarily concerned with survival – first in the short term and then in the long term, and survival is for him not only his own personal survival but survival of his socio-cultural unit, which is based on the productivity of the herds. It is obvious that these concerns overlap – but they are centred on different priorities, which are in turn based on different values. In the interaction between the ecologist and the pastoralist over the implementation of a management programme that would redress the balance in the ecological system of which the pastoral population is a component, the explicit bargaining concerns specific elements of the management programme; implicitly the values of the ecologist are pitted against the values of the pastoralist – a conflict that will be resolved eventually in the larger political process.

In the study of ecosystems where the productivity of natural resources is reduced as the consequence of activities in the human use system that incorporated them, the ecologist's reaction has commonly been to focus on the degraded resource, and attribute the degradation to the immediate cause in the form of the social group exploit-

ing it, as in many cases of traditional pastoralists and degraded rangelands. Desertification, then, is caused by social factors, but solutions are generally designed by focusing on the natural symptoms of the problem (for example, reduction in the quantity and quality of vegetation) and by attempting to rearrange the social factors in relation to them. Judging by the record, this approach commonly fails to lead to a satisfactory solution, and besides often brings about new adverse social factors which may accelerate desertification. Cause is translated easily into fault, and central authorities with large urban constituencies are indulged in their prejudices against marginal rural populations. Cultural discrimination of urban against rural increases; the population concerned suffers further reduction in its range of economic options and tends to become an increased burden on its immediate natural resources. The ecologist focuses on natural processes and sees the fault in the behaviour of the human population which failed to reorganise its activities in the way prescribed. The social scientist is invited to devise ways to encourage the people to confine their activities within boundaries prescribed by the ecologist. As with the UNCOD delegates some social scientists are happy to accept these terms of reference and seek to apply their expertise as a service in the ecologists' programme; others seek to redefine the terms of reference: they seek to redefine the situation in terms of the interests of the human population and to develop an ecologically feasible strategy that will serve those interests. In dealing with desertification the social scientist tends to look for the ultimate social cause, which is likely to be outside the affected area.

Where an ecologist is studying an ecosystem without a human component, or where his research interests allow him to ignore the role in the ecosystem of other members of his own species, he implicitly determines relative values for the various species in his study. For example, in an open steppe ecosystem the survival interests of grasses and forbs, shrubs, herbivores and predators are obviously in conflict. The ecologist stands outside the system but bases his research design implicitly on certain inter-related assumptions such as 1) the system should not run down, 2) the number of species should not decrease, and so on. However objective his research design, the ecologist is led by his assumptions to discriminate in favour of the survival of the system. The survival of the system may, of course, be in the long term best interests of all the component species. It is not, however, in the best interests of all living individuals in the system, some of whom will, for example, fall prey to predators. A reduction in the number of predators would, therefore, be in the best interests of some at least of the living herbivores and a reduction in the number of herbivores would be in the best interests of many living plants. If a gazelle or a shrub could produce a study of the same ecosystem, therefore, we might expect their results to differ from those of the ecologist inasmuch as they would, as a matter of course, be based on different assumptions. The ecologist can argue in terms of the survival of species and of the system, because survival on that level suits his own socially determined values best. A member of the system, such as the gazelle, whose personal interests are at stake will argue for his own survival first. Both arguments may be equally objective and scientific, but differ on grounds of morals and personal interests, which are socially relative. The conflict between them is resolved politically as a result of the difference in power of the populations in question. This reduction of the relationship

between the ecologist and his subject matter to questions of morals and politics is exaggerated, and in the case of plants may seem absurd, but by bringing out the fact that the ecologist's argument is based on the attribution of a value to the survival of a species or a system which might conflict with the values of individuals, it serves to focus attention on the moral and political aspects of the problems that develop between scientists and local populations in the treatment of declining ecosystems, especially in the cause of desertification. It is worth noting that this problem arises in all the applied sciences – social, biological, and physical. It has effectively paralysed the theoretical development of applied social science; in the physical and biological sciences it has generally been possible to ignore it.

When the ecologist includes a human population in the system he is studying, his recommendations for treatment and management are likely to conflict with the perceptions and values of that local population. These conflicts can be presented as differences between scientific understanding and uneducated superstition and self interest, but it may be more realistic to minimise the difference between science and lore to see them as differences between socially-derived perceptions based on an interest in the long term survival of a total ecosystem and its usefulness to human populations on the one hand and perceptions based on less long term interests in individual economic and group cultural survival on the other. Pragmatically, there has to be a compromise between such differing perceptions. Such compromise is the essence of any national political process. The ecologist's case is commonly reinforced by the central authority, which often shares his assumptions. However, the government depends on the political process and, ultimately therefore, on the various interest groups which achieve participation in it. The population involved in a process of desertification may or may not have a voice in the political process. In any case, to the degree to which the populations using the resources that are at risk of desertification are represented in the larger political process, they are divided into different interest groups. Any proposal to manage the threatened resources according to the scientist's values unavoidably benefits some interest groups at the expense of others. Since the final arbiter is the political process and relative power (in which the claim to be on the side of absolute values is an important but not a determining factor), it may not in the long term be a realistic ecological management policy to allow the terms of reference for the solution of desertification problems to be defined exclusively according to those supposedly absolute values.

The campaign to combat desertification, as it has been organised – logistically and intellectually – so far, has implied an adversary relationship between those who (consciously) fought it and those who (perhaps unconsciously) caused it. The adversary relationship has often also had the nature of a class conflict. But the question of who stands to gain or lose in particular situations has seldom been carefully investigated. Without such investigation the social dimensions of the concept cannot be understood. Throughout the preparations for the Conference, and since, there has been no general agreement on a definition of desertification – even without the social dimensions (cf. UNCOD 1977b). The concept has evolved and continues to evolve as the progressive rationalisation of the logistical structuring the the campaign. The following section discusses this continuing process of rationalisation.

THE CONCEPT

Desertification does indubitably occur. In popular usage its meaning seems obvious. But determination of the details that should be included or excluded from even a working definition for use outside particular disciplinary forums in conservation or planning has proved difficult.

Desertification is detrimental to settlement, health, recreation – but most importantly to food production. But what are the chances that it will significantly affect the quantity or quality of world food production in the foreseeable future? Are its effects most likely to be direct, in reduction in acreage or productivity? or indirect, in problems caused by the resulting redistribution of population and increased pressure on distribution networks, in the organisation of labour, of investment, or of society generally? Will it be a serious problem at the international level? Finally, what might be done to counteract or, failing that, to reduce its severity. Agreement on answers to these questions depends on more careful investigation of the conceptualisation implicit in the campaign. Despite the enormous outpouring of literature on the subject of desertification that occurred between 1975 and 1978 as direct and indirect results of the Conference, there is still room for another appraisal of the problem – partly because now that eight years have elapsed since the Conference some of the dust raised in the logistical, emotional and political flurry of organising the Conference has settled, and partly because as time has passed more information has arrived and some earlier perspectives on the phenomenon will now bear modification or revision.

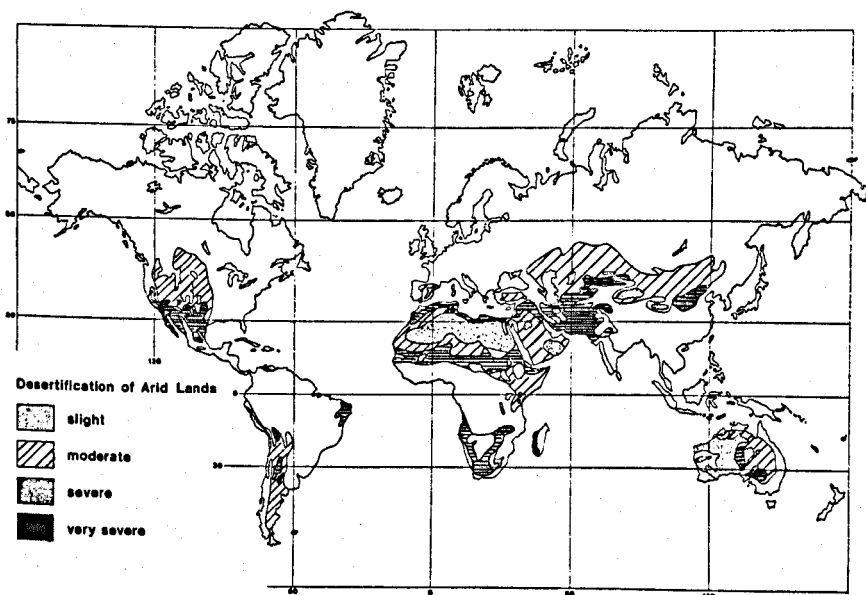
Despite considerable efforts on the part of the Secretariat to cost out all the implications of desertification, there has been a tendency all along simply to define desertification as a type of ecological decline which is *per se* evil. This tendency alone may explain the relative political failure of the global campaign to combat it. In general it has not been made entirely clear just who is suffering or stands to lose by specific cases of desertification. The disadvantages of desertification are commonly left as self evident. It is well, therefore, at the outset to make it clear that – at least at the political level – they are self evident only given the assumption that the resources which are thereby degraded are irreplaceable for the population that currently depends on them. Outside certain intellectual circles the argument that future generations will suffer carries little weight. Most governments, because of the exigencies of the individual politician's career and the recurrence of elections, have perspectives of less than five years. Here we are not limited by such a perspective, but in order to understand the concept of desertification it is necessary to understand the variation in perspectives on it and the basis of that variation. This aspect of the problem was only implicit at the Conference and has received little open discussion. The following discussion cannot be comprehensive but attempts to include at least some indication of all the significant questions.

In developing the concept of desertification in relation to future food production it is necessary to ask, first: what are the factors relevant to the prediction and planning of food production? They are population (sc. size, structure, spatial distribution

and organisation of labour), culture (tastes, values and expectations), technology, climate (temperature, wind and precipitation), and the condition of productivity of natural resources (especially soil and vegetation), to which must be added national and international factors of political economy that affect choice of crop, investment patterns, terms of trade and distribution networks. Prediction or planning of food production involves predicting or planning what is going to happen to each of these variables. Desertification, as it is usually defined, constitutes only one of these variables – resources – and then only in certain environments, though it is of course intimately interrelated with all the others. It is possible to see, therefore, that however dangerous the threat of desertification may be other threats may with some justification attract more political attention.

Secondly, what is the case for giving desertification high priority? It is now conventional wisdom that desertification is “the impoverishment of arid, semiarid and sub-humid ecosystems by the combined impact of man’s activities and drought. It is the process of change in these ecosystems that can be measured by reduced productivity of desirable plants, alteration in the biomass and the diversity of the micro and macro fauna and flora, accelerated soil deterioration, and increased hazards for human occupancy” (Dregne, 1977). Defined in this way desertification is generally understood to be affecting large areas of every continent, especially Africa, and to be increasing. Potentially productive but threatened lands have been estimated at 45 million square kilometres or 30% of the land surface of the world, distributed through two thirds of the world’s 150 nations. The rate of desertification is said to be increasing and “some experts have suggested that it has reached at least 50,000 km² per year” (UNCOD, 1977a 6–7).

Figure 15.1.



The accompanying map (Figure 15.1) shows four classes of desertification: slight, moderate, severe, and very severe. The last category is defined as "economically irreversible" (Dregne, 1977). However, "there just are not many large areas where economically irreversible desertification has occurred" (Dregne, 1977). This judgement was "shared by all persons contacted – thus far – who have helped improve the first draft" (*ibid.* note) of his article. Professor Mikhail Petrov suggested to Dregne that "very severe desertification might be limited to small areas up to 20 km wide around oases" (Dregne, 1977). If this is true, it suggests not only (as Dregne concluded) that "therefore the true extent of the very severely affected areas will not be shown on small scale continental or world maps" but that true or irreversible desertification – as distinct from reversible reduction in productivity – may be a function of settlement rather than (as is generally assumed) the over-intensive practice of particular food production technologies (cf. Spooner *et al.*, 1980).

Whether or not desertification is irreversible, it threatens reduction in productivity over vast areas which are already relatively low in productivity and poor in economy. However, because of their vast extent the total productivity of these areas is of great consequence for world totals – the more so because they are as yet relatively undeveloped and their potential for increased productivity may therefore be relatively high. As yet also their production is relatively unintegrated into larger economic systems. The actual figures, therefore, as marshalled for UNCOD, that one third of the land surface of the world containing (in 1976) 15% of world population, or 630 million, of whom already 8% or 50 million are threatened by desertification's productivity losses (see Hare *et al.*, 1977) may be a misleading understatement, because desertification is threatening the as yet unrealised and unknown potential of as much as one third of the world's land.

Desertification in its most widespread forms is generally represented as the immediate result of one or another of three practices: over-grazing, "over"-cultivation, or over-irrigation – in increasing order of investment required and of potential productivity per hectare, and decreasing order of area at risk.

Natural rangelands sustain pastoralism up to a certain threshold beyond which grazing and browsing are likely to eliminate not only individual plants but entire species and so cause modification in community composition as well as reduction in percentage cover throughout the range. Although less vulnerable species may take the place of those eliminated, they are always less palatable and so less useful to pastoralism (or any other form of food production) and invariably provide less protection against soil erosion. This threshold varies seasonally and annually with the variation in precipitation that is typical of arid and semi-arid climates. Population growth or loss of territory in many pastoral societies has led to increases in animal population per hectare to the point where that threshold is often and even continuously exceeded. Because of social and cultural factors pastoralists seldom adapt simply and directly to the ecological situation by reducing their herd size in tune with the reduced carrying capacity of the range (cf. Sandford, 1982. Their technological adaptability to recurrent conditions of reduced carrying capacity has also in some cases been prejudiced or impaired by the effects of nationally and internationally sponsored projects to increase their productivity and integrate it into the larger economy, especially

by making new watering points available which facilitate greater exploitation in good years and lead to herd growth (cf. Bernus, 1977). As ranges become more heavily overgrazed they first lose their more palatable species, then gradually overall cover is reduced leading to reduced absorption of precipitation, increased run off and erosion. The conventional cure is reduction of the animal population to the point where the vegetation may recover, but this measure does not always produce a simple reversal of the process. Undesirable species may invade and take over the range before the earlier vegetation (which may have lost its seed base) can reestablish itself (cf. Conant, 1982).

In the case of rainfed cultivation, the main hazard arises from the extension of the system on to marginal soils that will not support it. Opportunistic ploughing of such soils, which may produce a few good harvests in the short term, in the longer term leads to erosion. The wild vegetation produced by such soils often constitutes the better rangeland of traditional pastoralists. As a result of erosion the land is lost to both agriculture and pastoralism, and the pastoralists are thereby pushed back in denser numbers on to less productive rangeland which becomes further impoverished as a result. In addition to – or instead of – being extended, cultivation is sometimes intensified by the reduction of fallow periods – which similarly leads to the impoverishment and loss of soil and to long term reduction in productivity. These forms of “over-”cultivation have been encouraged not only by population growth but by increased economic demand and opportunity resulting from integration into a larger, cash economy, and also by the increasing availability of mechanical aids to labour such as tractors, which allow a much faster rate of growth in acreage than would be possible given simply the rate of population growth. A further important factor in over-cultivation is the reduction in the farmer’s dependence on his land that often accompanies his incorporation into the cash economy. This shift and its implications in the historical study of the relationship between natural processes and human activities have been appropriately termed “the ecological transition” (Bennett, 1976). The farmer begins to worry what will happen to him when his land is farmed out: he sees the economic opportunities of the urban or industrial economy which may even appear more attractive than farming. In this way the socio-economic reorganization that goes with development may bring in its train reduced ecological sensitivity in local populations. It is worth noting, however, that the social security of these populations may at the same time be increased.

Over-irrigation, as a form of desertification, occurs in the land use system which is not only the most intensive and productive (though admittedly with the least – actual and potential – extent) but it is in a sense the most directly caused by industrialisation. Unlike most other desertification processes over-irrigation is scarcely affected by local levels of population: it is a function of the large scale engineering of irrigation, in which the local operators do not control their own operation, did not develop it themselves and therefore have a less detailed “folk” understanding of the ecology of it. The investors, developers or organisers, whether in late prehistoric and early historical Mesopotamia or in the Punjab under the British in the nineteenth century approached it as an economic enterprise, and now that the ecology is understood by the organisers it remains to work out ways to arrange the efficient operation of the

system. In short, the limiting factor in agricultural production in many arid areas is water. Many arid areas can be transformed into agricultural miracles by the controlled application of water – which is possible, especially in large river basins, given large scale organisation, engineering and above all industrial construction. But in order to be ecologically successful over a long period the flow of irrigation water must be engineered in such a way that it reaches the root zones in optimum quantities for the needs of the specific crops. Excess water that seeps out of the channels before reaching the crops, or sinks below the root zone of the crops, unless it can somehow be drained out of the basin, sooner or later causes trouble. However deep the original water table, excess irrigation water gradually builds it up until it approaches close enough to the surface to cause first salinisation (since it invariably has a high mineral content) through capillary action, and finally waterlogging. The result is serious decline in yields and, in severe cases, total loss of productivity for indefinite periods.

Since this type of land use system is basically modern and industrial, generated by national or international investment, and integrated into the larger economy, loss of its production due to desertification is of more immediate economic significance than in the case of over-grazing or over-cultivation which are often unintegrated so that the potential value of their production in the larger economic context is difficult to determine. In the case of over-irrigation, therefore, figures are both more available and more meaningful. The following depict what is perhaps the most serious example.

In Pakistan before the development of the irrigation system in the Punjab, water table depths over most of the area now irrigated were about 24 to 28 metres. Of the 123 billion cubic metres of Indus water diverted annually into the irrigation system, only about 71.5 billion cubic metres are available at the heads of watercourses: the rest is lost through seepage. It has been estimated that from 2 per cent to as much as 27 per cent per kilometer is lost in the watercourses. Altogether, less than 30 per cent of the water diverted from the rivers is stored in root zones for crop use. Historical data show that the water table has risen an average of 15 to 35 cm per year since modern irrigation was introduced. Further, in an area where the underground water has a salinity of 1,000 parts per million, which is acceptable for virtually all crops, evaporation at a rate of 60 cm per year, which is a typical value where the water table is only a few feet deep, will raise the salt content of the top three feet of soil to about 1 per cent in 20 years. This level is too high for even the hardiest crops. Not only, therefore, are environmental problems causing loss of cultivable land – the irrigation system is working at only 30 per cent efficiency and this inefficiency is responsible for the loss. These processes are exacerbated by inefficiencies in actual irrigation and cultivation, that is, in application of water to crops. In the 1960's it was estimated that up to 40,000 additional hectares were being affected each year and, in the worst districts, 40 per cent to 50 per cent of the cultivated land was already severely damaged.³

A certain amount can be done to correct this situation by more engineering. Fields may be levelled, canals may be partially or wholly lined to reduce or prevent seepage; drains may be dug. Tube wells may be installed to pump the ground water back up to the surface for recycling where the mineral content is low enough. But these mea-

3. This section on Panjab (Pakistan) is based on Michel, 1967 and Spooner 1979 and Hasan, 1976.

sure all increase both the capital cost and the running cost of the operation and reduce its profitability without increasing its efficiency. The basic aim – to provide the root zone homogeneously with just the right amount of water – remains elusive and can probably be solved only at the level of the individual operator or some social grouping of operators. There have been moves to approach the problem at this level (Merrey, 1982), but little practical success so far; partly perhaps because so much rethinking of the relationship between government, official, engineer, and local operator or farmer is required.

Desertification, then, as conventionally defined, is a function of the complex interaction of a series of factors, which includes: topography, soil, vegetation, groundwater, wind, temperature, precipitation, and the nature and intensity of human activity. It is not new. It is not peculiar to any particular land use system, area of the world or culture. In fact it can accompany any land use system and has probably accompanied all land use systems to some extent at least in some periods. It is not qualitatively different from ecological change as a result of human activity in more humid areas. It has only recently been perceived as a problem – partly because the rate of global population growth has for the first time brought us to the point where it is not only conceivable that we shall run out of resources, but we have felt threatened by imminent failure to feed ourselves. It is important to note that the present consciousness of this threat derives at least partly from intellectual developments that have generated a new perception of the environment. But however infallible this perception may appear among planners and ecologists, it is not universal. Even where the problem is perceived to be immediate the perceptions are not all uniform, and there are legitimate differences of opinion about the analysis of particular situations. It will be useful here to discuss the causes of desertification, bearing in mind that any causal analysis is likely to reflect a particular perception of the problem, and although one analysis may seem more persuasive than another, in the last resort what will determine the acceptance of one or another analysis in any campaign to combat desertification will be the political process of interaction between the various agencies, governments and social groups concerned. The most useful aim of the intellectual level of this volume is to seek to inform that political process by making available to the various parties to it the maximum amount of relevant information in its most digestible form.

What then are the causes of desertification? Arguments about ecological deterioration have been usefully grouped as:

“(a) *Structural* arguments. These lay the main blame on social and economic structures and relations (patterns of ownership, rights of use and control over resources).

(b) *Natural events* arguments. These see largely uncontrollable events, such as droughts or outbreaks of disease, as the prime causes of deterioration. We can also include in this category political developments whose origins lie outside the context of pastoralists and rangelands, and which are, therefore, similar.

(c) *Human fallibility* arguments. These lay the blame on the stupidity, ignorance, or short-sightedness and perversity of pastoralists, of governments, and of do-gooders.

(d) *Population* arguments. These see the main cause of the deterioration in the rapid growth of human and livestock populations.”

(Sandford 1976)

In the terms of the conventional wisdom there has been a tendency always to assume

implicitly that the immediate human cause of any particular symptom of desertification, such as over-grazing, was the significant cause, to look no further to pursue the reconstruction of a chain of causation, but to prescribe simple remedies in the form of management regimes and expect them to be easily and efficiently implemented. This tendency derives from the fact that the consciousness of desertification arose among specialists in the study of natural phenomena, who naturally sought to solve it in those terms. They were able to communicate their concern fairly readily to the community of the agricultural sciences, but they had less success with the communities of economics and the social sciences, whose first priorities were the efficient use of labour and social well-being respectively rather than the conservation of renewable natural resources. Although the dangers of desertification could have been presented in economic or social terms, the ecologists did not make a very convincing case in such terms. For this reason, and because of the underlying problem of the sectoral fragmentation of science there has been little interdisciplinary synthesis of desertification or transdisciplinary co-operation to develop recipes for solutions. The communication, or lack of it, between the disciplines or professions, with regard to desertification, has been exacerbated by the conviction of the ecologists, who discovered it, of the urgency of the situation – that something had to be done immediately in order to save a significant proportion of the world's resources not only for posterity but for the future wellbeing of the present generation, and especially for the good of the affected people themselves. This element of panic is reminiscent of other similar campaigns also having to do with the global ratio of people to resources that have hit us since the mid-sixties. The first was population; then came food; more recently it has been energy. No time could be lost working out the ideal way of dealing with the situation. Early faint protestations from social scientists that simple imposition of management solutions based on experience in other areas which may well be ecologically comparable, but whose populations are socially and culturally non-comparable, were met with accusations of callous detachment. Invariably, however, though they often seemed feasible at the time, we now see that Western-devised management solutions for non-Western situations of desertification, or for that matter of "under-development", have not been successful, and we can now see that this lack of success should not surprise us. These management solutions are a form of technological change. It is now generally accepted that technological change does not occur in isolation from, and cannot be induced in isolation from, economic change and general social change. The development campaign generally has not fulfilled expectations because it has been technology-led, formulated in terms of technology and investment (and management) with the implicit assumption that the social relations that constitute the society in question will rearrange or re-form themselves in adaptation to the new exogenous techno-environmental conditions. It is now possible for the social scientist to join in the development effort – and therefore also the effort to combat desertification – because it has now become clear that in order to induce change successfully in any social system it is necessary first to investigate the dynamics of the existing system. It is unscientific to expect to change particular social practices without first ascertaining what generates the social formation underlying those practices.

The question then arises whether the plan to induce the change can be morally justified – especially when it is often based implicitly on assumptions about the interests of future populations. This is too large a question to be dealt with fully in this chapter, but its existence and importance must be acknowledged. For the time being we can assume that in the case of desertification many will argue that the attempt to induce change is morally justified by the prediction of ecological consequences based on the assessment of current ecological trends. However, there is still a moral problem insofar as the over-grazing or other practice that is the immediate cause may be a response not to local factors such as inefficient management of resources but to external factors such as market opportunities and the terms of trade for pastoral products. In this case do moral principles dictate a solution to the problem by imposition of a pastoral management regime (which is likely after all to be distasteful, if not a cause of serious hardship, to the local pastoral population)? or, for example, by administrative changes in tax structure that would alter the relationship between the pastoralists and the larger economy in which they are encapsulated, and possibly reverse the desertification trend by imposing some degree of hardship on other sectors of the population that use pastoral products and were benefitting from it?

In many cases of desertification the production system, for example pastoralism, may constitute a less significant pressure on the vegetation than the demand for fuel and for construction materials. Apart from forage the vegetation often has to satisfy the need for fuel for heating, cooking and in some cases also for processing milk into yoghurt and other products, and for roofing and the construction of animal pens. In an area of arid rangeland in northeastern Iran the average domestic consumption of firewood has been estimated at 5.3 metric tons per year per family plus as much as an additional 7-10 tons for milk processing (Horne, 1980). Historically the same area has also produced charcoal for urban markets. In other Middle Eastern rangelands, where no ligneous vegetation survives to satisfy even local fuel demands, animal dung is also collected for fuel purposes. Perhaps the most surprising point is that there are still whole cities with cold winters, such as Kabul, in which wood serves as a major fuel for heating. The distribution of fuel and construction materials is even more obviously a matter for central economic planning and political decision-making, and the "fault" therefore lies at the national level, not at the level of the user. It has to be generally accepted that desertification demands a "no-fault" approach, in which the interests of existing populations should not easily be set aside in favour of future generations, especially when the burden could be spread.

These simple examples enlarge the perspective on desertification by suggesting the moral, political, economic, as well as social and ecological, dimensions of any process that involves the interaction of human activities and natural processes in the modern world. If the problem of desertification is to be approached realistically, all these dimensions must be taken into account. Conceived in this way, the problem of desertification can be resolved only in the political process, but the political decisions necessary to resolve it are unlikely to be made for purely ecological reasons. We are likely, therefore, to have to live with increasing desertification for some time to come. Meanwhile, the goal of science should be to synthesise research on these various dimensions of the problem as conceived above, and seek to feed information from

that synthesis into the political process.

In fact, however, there is little or no evidence either that current trends (where they are bad) are long term trends, or that direct intervention is likely to reverse them, and not enough notice is taken of contrary indications. For example, in at least two arid areas – northern Nigeria in the vicinity of Kano, and Rajasthan in northwestern India – population densities have exceeded 150 per square kilometre, and although there is definitely evidence of desertification, living standards are not deteriorating and disaster is not imminent (Hare *et al.*, 1977).

Some diagnoses of desertification are questionable. For example, erosion may not necessarily be disadvantageous. "In northern Libya many small dams were built specifically to trap the eroded sediment and to create deep, well-watered soils for agriculture. Roman agriculture could have expanded in a short period of favorable rainfall, much as agriculture expanded into the northern Sahel in the early 1960's. The Romans, like the Hausa, may have had to retreat in the face of a drought and what was, in effect, only a marginal increase in erosion" (Hare *et al.*, 1977; Vita-Finzi, 1969). The use of a natural factor, such as soil, as a yardstick of desertification, may disguise the assumption that a particular set of human social interests had priority – those that valued the present state of soil distribution over those that were happy to see it changed. The following example merits quotation in full:

In the Valley of Nochixtlan in southern Mexico, many side slopes "are ravaged by active gullies which remove the surface wholesale and leave the slopes bare of vegetation, fields or houses. Since the Spanish Conquest, an average depth of 5 m has been stripped from the entire surface area, producing one of the highest rates of erosion recorded in the world.⁴ Set between the forested uplands and the agricultural valley floor, the area seems a wasteland which only drastic soil conservation measures could reverse.

Government experts share this view and have instituted conservation measures including the construction of low earth ridges to slow down soil movement. Few scientifically trained experts would disagree with their general perception of the gullying as a problem but the view from inside the valley is different. Gullies are seen not as a hazard but as a resource. By directing the flow of the eroded material, Mixtec farmers can annually feed their fields with fertile soil and can, with greater effort, extend their agricultural land by building new fields over a few years.

Over the past 1000 years, Mixtec cultivators have managed to use gully erosion to double the width of the main valley floors from about 1.5 km to 3 km; and to infill the narrow tributary valley floors with flights of terraces several kilometres long. Judicious use of gullying has enabled them to convert poor hill-top fields into rich alluvial farmland below, using the gullies to transport the soil. Thus before large-scale gullying began, the agricultural productivity of the valley area was less than it is today.

The difference between the "outside expert" view and the inside Mixtec one rests on the farmers' greater experience and knowledge of the local situation. Their experience of the highly fertile and erodible local deposits, and their familiarity with the technical and social bases of controlling soil movement, are too particular to the Valley of Nochixtlan to be readily translated to other areas. Thus the concept "gullies are good" is not part of the outside expert's portfolio. Nor could he be expected to know that intermarriage between the hill-top and valley bottom communities enables families to "move with their soil" downvalley.

The Valley of Nochixtlan is an unusual case; usually different groups agree that soil erosion is a problem but disagree about how to solve it. This example is intended, however, to illustrate the importance of understanding local perceptions of the environment in the context of local resource use and social structure. But this is only the first, important step. In

the example of Nochixtlan – as almost everywhere – both perceptions of the environment are valid, within their own contexts. For the farmers in Nochixtlan, gullies are an important agricultural resource. For the government authorities concerned with the area as a whole, gullies are also a problem – not for those farms whose owners remain, but for the farms abandoned by their urban-migrating owners and no longer receiving replenishment and protection from the gullies. Thus, the national “problem” is that of urban migration and rural depopulation, which is the higher-order one, and which is outside the scope of agricultural authorities and local communities.” (Whyte, 1977).

The average erosion rate over the whole surface was in the order of 10 km per year over the last 500 years for a drainage basin of area 0.4 km² (M Kirkby, 1972).

Analogous examples have been documented in the history of the Negev (Lamprey, 1976) and of parts of Iran (Dennell, 1982).

Any process of ecological change is likely to be perceived differently by different social groups. Desertification studies so far focus on ecological change resulting from human activity. If progress is to be made in the campaign to combat desertification, their focus must be shifted to the relationship between population and resources. But it will still be necessary to develop a yardstick to measure desertification in those terms. “Flexibility” may serve this purpose. A major factor in the social tragedy that followed the Sahelian drought was the recent loss of flexibility in resource use. In arid and semi arid lands where precipitation is often more irregular and unreliable than insufficient, flexibility is the most important aspect of any land use system. Nomadism has survived for so many millennia in many such areas because it is a strategy that gives first priority to flexibility. The value of this strategy is still not fully appreciated (see Bernus 1977). Flexibility is often lost as a result of modernisation and the introduction of new technologies, but it could be safeguarded as a matter of public policy – though such an objective would require a major reorientation in development planning and in government intervention in land tenure generally.

Over the last decade a few attempts have been made to develop research programmes that would illustrate the interaction of social and natural factors in desertification and provide better understanding of its dynamics in different cultural contexts. The switch away from a focus on natural processes irrespective of their social referents is slow, and data from these programmes are still in the process of publication but examples may be found in Lamprey (1978), Mann (1982) Spooner *et al.* (1980), and Novikoff *et al.* (1973–1976.)

THE PROSPECT

Desertification is real, but more complex and less well understood than even UNCOD documentation suggests. However, for the most part, it is probably not irreversible and therefore not as critical as we thought. As a slogan, an organising concept, it is part of the international history of the late twentieth century, taking its place alongside population, food and energy. But in the final analysis it seems not to

have the same force as the others. Many of the figures used to maximise its force appear to have been exaggerated, unrepresentative, in some cases misunderstood or mistaken (see Simon, 1980). The danger now is that its credibility will decline further.

It is important that the campaign to combat desertification should not lose force, but in order to maintain it, desertification must be put over in such a way that the implications for counter measures appear politically fair and advantageous to a much larger proportion of the people who may be affected. To achieve this end a great deal more rethinking is necessary than has been achieved so far. We need a yardstick and a set of indicators that will be applicable in different political and cultural contexts.

The first essential step in this direction is to discontinue the exclusive use of ecosystems as units of analysis. For example, if Rajasthan is providing meat and dairy products to the population of Delhi (UNCOD, 1977a) it would be unrealistic both politically and ecologically to seek to combat desertification in Rajasthan simply by rearranging pastoral activities in Rajasthan. Central governments are responsible for the formulation and implementation of policy, and therefore also for the measures that influence the distribution of economic activity, developing some areas and marginalising others. It is at this level of organisation and planning that desertification can serve as an important concept to minimise the ecological degradation of drylands.

An historical perspective suggests that a certain degree of desertification (as conventionally defined) is the inevitable consequence of human activity. It should probably, therefore, be approached more positively as one aspect of an unavoidable compromise with population growth, bearing in mind that another aspect of that compromise can be (and in some cases has definitely been) improved social productivity. The reality of social factors cannot be overemphasised; they have their own dynamics and we have little scientific understanding of their interaction with natural processes such as desertification. The concept of adaptation which is borrowed from evolutionary biology to facilitate discussion of this interaction as yet has no theoretical content in this usage. It is possible that systemic relationships generally cause social factors to intervene before desertification becomes severe – except in cases of critical external intervention. In any case ecological degradation can be accounted an evil only in relation to society – not in its own right (cf. Passmore, 1974). In the Sahel there is evidence that social disruption had set in before the drought (Bernus, 1977). For this reason, if for no other, it is important to develop traditional systems rather than seek to replace them.

To attack desertification is to select one symptom arbitrarily from a range of symptoms generated by a pervasive disease. The disease lies in the relationship between society and natural resources on a global scale. Desertification has come into vogue only since that relationship has been perceived on a global scale. We are not prepared to deal with it on that scale because of the political and other divisions in society. We have a fair view of the natural resources on that scale and we must keep this ecological knowledge in mind as we search for social and political answers. In so doing we shall develop a new approach to development generally – a new approach that will be both scientifically more comprehensive and politically more acceptable.

The significance of desertification for the foreseeable future as far as food produc-

tion is concerned (as distinct from, for example, the quality of life in new urban and industrial communities in areas like the Southwest of the United States) depends on the political process and is a relatively insignificant aspect of it. Despite a number of excellent scientific papers on the biological and physical processes involved (for example, Le Houerou (1977 and 1978), there is no hard evidence that overall food production is likely to decrease as a result of it. But the overall political process could be helped and smoothed if the information deriving from the campaign against desertification so far, and from now on, is fed into it more efficiently. There is no need for a special fund, as recommended (less than unanimously) at UNCOD. The campaign will have served its purpose, if it has led to a situation wherein from now on ecological consultation will be built into the development process. Though undeniable, desertification is not only insignificant relative to the overall socio-political problems of organising production and distribution (while raising living standards and freedom) but is integral to that effort and unbeatable except as part of that effort.

To summarise, desertification may reduce the productivity of natural resources seriously in the foreseeable future, but it is unlikely that a frontal attack on the problem, which attempts to rearrange human activities in direct management solutions, will have much impact. Desertification is intimately related to development and represents one aspect of the inadequacy of the development effort so far. The development effort is undergoing a process of re-thinking, in which the emphasis is shifting from purely economic criteria to criteria of social welfare and broader public participation. The campaign to combat desertification can be effective only as a component of this general development effort.

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