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# THE NATURE, CAUSES AND CONSEQUENCES OF DESERTIFICATION IN THE DRYLANDS OF AFRICA

M. B. K. DARKOH

*Department of Environmental Science, University of Botswana, Gaborone*

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## ABSTRACT

The dryland environment of Africa poses formidable problems for sustainable development. Among these are unpredictable and severe drought, desiccation or aridification due to persistent drought and dryland degradation or desertification. Because these problems overlap in their effects on the ground, often those who seek sustainable development for these drylands tend to view the problems as one and the same. Yet to facilitate the development of appropriate and effective mitigating measures it is important that the differences and interrelationships be clearly understood. This article starts by outlining the differences and interlinkages between desertification, drought, desiccation and climate change and their causal factors. The central theme is the human causes and consequences of desertification in the drylands of Africa. An attempt has been made to unravel the changing views on the human causes, this is followed by a brief outline of the intervening plans and actions to stem the problem. A significant drawback in combating desertification and drought is the failure of African governments to devolve power to the people who are affected, and to link environmental degradation to economic policy. Consequently, many programmes lack local support or are undermined by conflicting trade and agricultural policies pursued by governments. It is contended that, for sustainable development strategies to work, policies should put the welfare of the people in these drylands at the centre of the development agenda and give them the rights and the power to determine their future. They should empower the people to sustain adaptive strategies towards sustainable livelihoods. Also the threats posed to environment and sustainable development by protectionism and overconsumption in the north and structural adjustment programmes (SAPs), call for the removal of distortions created by the import barriers of developed country, the curbing of overconsumption and a fundamental revision in the structure of SAPs to help alleviate poverty and protect the environment in these African countries. It is in the interest of the global community that the environment in Africa is protected. © 1998 John Wiley & Sons, Ltd.

**KEY WORDS** desertification; drought; desiccation; drylands; adaptive strategies; sustainable development

## INTRODUCTION

The term 'desertification' was coined in 1949 by the French forester Aubreville. He used it to describe a general process of degradation starting with deforestation – not necessarily in drylands – and ending in land turned into desert (Aubreville, 1949). He was working in the subhumid parts of West Africa. Unfortunately, the term includes the word 'desert', so people assume it refers to productive land being covered by sand dunes. This popular image of sand-dune encroachment is only a minor part of the problem. Sometimes desertification is taking place thousands of kilometres away from the margins of the Sahara, Gobi, Atacama and other so-called 'true' deserts. The situation has been likened to a skin disease in which existing eruptions worsen and coalesce with new outbreaks of the disease (Tolba, 1984). According to UNEP (1992a), the idea of shifting sand dunes or desert encroachment has distracted scientific and public attention from the real issue. The process of desertification is not shifting sand dunes, but rather 'patches of increasingly unproductive land breaking out and spreading over hundreds of square kilometres' (UNEP, 1992a). Odingo (1990) has reviewed the different definitions of desertification and their programmatic consequences for UNEP and the international community. Until UNCED, UNEP itself had attempted to allay confusion by

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defining desertification as 'land degradation in drylands resulting from adverse human impact' (Dregne, *et al*., 1991).

Most current definitions include some mention of land degradation, the loss of productivity, the combined roles of climate and human activity, and the fact that desertification is restricted to drylands. But these definitions are too general for estimating the actual extent and degree of desertification in a particular area. Most in common use are criticized for their vagueness on key issues (Is it a process or a state? Are processes like deforestation and salinization causes or symptoms? What exactly is the role of drought?).

The latest and most widely accepted definition is the internationally negotiated one which defines desertification as 'land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities' (UNCED, 1992). In the context of this new definition, as in previous definitions proposed by UNEP and others (see Odingo, 1990), 'land' is taken to mean the terrestrial bioproductive system that comprises soils, vegetation, other biota and the ecological and hydrological processes that operate within the system.

'Degradation' implies diminution or destruction of the biological potential (resource potential) by one or a combination of processes acting on the land. The concept of land degradation is broader than soil degradation, because it deals with the whole ecosystem in which soil is just one of the components. The processes of land degradation include water erosion, wind erosion and sedimentation by these agents, long-term destruction of vegetation and diminution of many plants and animal populations, or decreases of crop yields where relevant, and salinization or sodication of soils. The 1994 UN International Convention to Combat Desertification described land degradation as the reduction or loss of the biological or economic productivity and complexity of the land (INCD, 1994). 'Human activities' include overcultivation, overgrazing, deforestation, poor irrigation practices and any other inappropriate land-use practices.

Desertification is often confused with drought or desiccation. 'Drought' refers to the naturally occurring short-term (1–2 years) phenomenon when precipitation is significantly below normal recorded levels. Usually such temporary deficits in rainfall can generally be accommodated by existing ecological, technical and social strategies. Drought is generally a dry period from which an ecosystem recovers rapidly after the rains return. 'Desiccation' refers to longer-term (decadal order) deficits in rainfall which seriously disrupt ecological and social patterns and require national and global responses. Recovery after desiccation is much slower, for trees may have died and vegetation may then take years to recover. Responses include management of population movements and the development of alternative livelihood systems.

However, it does not, necessarily follow that drought or desiccation *per se* will give rise to or cause desertification in dryland areas. Much depends on the resource management in these areas. When human misuse or mismanagement of land weakens the natural system, drought and desiccation often lead to desertification. While the latter should not be confused with drought and desiccation, the definition provided by UNCED (1992) cites climate variation as a direct causal factor and implicitly links desertification with climatic variation or climate change. 'Climatic variation' or 'climate change' refers to short-term climate variability and longer-term climatic trends or shifts caused by natural mechanisms or by human activity (Kelly and Hulme, 1993). Climate change does cause global warming often through greenhouse gas emissions. Natural climate change, which typically operates at a slow pace, is not a problem. Climate has been changing constantly for hundreds of millennia. As a result of the slow advance of natural processes, the planet has warmed and cooled, passing from ice ages to warm, interglacial periods. These gradual transitions, often spanning thousands of years, have allowed life on earth to adjust relatively smoothly to each new climatic equilibrium. None the less, during these transitions, the boundaries of ecological communities have shifted, the associated human cultures have flourished and, occasionally, disappeared.

However, something important has changed recently. During the last two centuries, the natural greenhouse effect (see Box) has become the 'greenhouse problem'. In the foreseeable future, rising concentrations of greenhouse gases (GHGs) threaten to induce rapid shifts in global and regional climate regimes, disrupting economic systems and inflicting significant economic damage on the affected societies.

 

The United Nations Global Environmental Facility (GEF, 1993, 1994) identifies two sources of greenhouse gases that affect the climate. First are the GHGs that have a direct effect on climate. Such gases are $CO_2$, methane ($CH_4$), nitrogen dioxide ($NO_2$), and the chlorofluorocarbons (CFCs), hydroCFCs (HFCs), hydrofluorocarbons (HFCs) and other chlorine compounds. The first three of these compounds, $CO_2$, $CH_4$ and $NO_2$, have important natural as well as anthropogenic sources. Most of the chlorine compounds that have greenhouse effects are of anthropogenic origin and their sources are well established (GEF, 1994).

The second group comprises emissions of gases that have a negligible direct greenhouse effect, but are indirectly affecting the climate through their impact on chemical and physical processes in the atmosphere and thereby on the GHGs that are affected by chemistry. Source gases that belong to this group are nitrous oxide ($NO_x$), carbon monoxide (CO), and hydrocarbons. Greenhouse gases that may be affected by emissions of these gases are methane and ozone. Ozone ($O_3$) is not emitted, but is formed in the atmosphere. It affects climate through interaction with both long-wave radiation and solar (short-wave) radiation. Emissions of sulfur dioxide ($SO_2$) may also affect climate through the formation of sulfate aerosols. These aerosols reflect solar radiation and may also affect the radiation budget through changes in the optical properties of clouds. The climate impact of this second group of anthropogenic gases cannot be assessed with satisfactory accuracy at present as too little is known about their impact on GHGs and the aerosols in the atmosphere (GEF, 1994). Nevertheless, it is believed that the indirect climatic impact of such gases can be important.

Since the beginning of the Industrial Revolution in the nineteenth century GHG emissions from human activities have grown steadily. Because the rates of emissions of these gases have exceeded the ability of natural processes to remove them from the atmosphere, their atmospheric concentrations have increased thus enhancing the natural greenhouse effect. The build-up of the gases creates the problem and, if the current trends continue, the planet may warm up at an unprecedented rate (GEF, 1994).

*The Greenhouse Effect*

The 'greenhouse effect' is the name given to a biogeographical process that has been essential to the evolution of life on earth. For two billion years, natural background concentrations of certain gaseous compounds have trapped heat close to the earth's surface, warming the planet. These gases, principally water vapour, ozone, and carbon dioxide, are transparent to incoming sunlight in the short-wave portion of the electromagnetic spectrum, but they absorb and remit some of the outbound, long-wave, infrared radiation from the earth's surface. Part of this infrared radiation is re-emitted upwards towards outer space; the remainder is re-emitted downwards towards the Earth's surface.

For millennia, the effect of this downward re-emission has been to raise the average temperature at the surface by about 33°C (59°F) above what it would otherwise have been. Without this natural greenhouse effect, the average temperature on Earth would have been −18°C, and water would have been present only as ice. As it is, the effect has allowed liquid water to remain stable over most of the earth's surface, providing the fundamental substrate for biological activity as we know it (GEF, 1993).

In tropical areas, land-use practices that might have impacts on regional or even global climate include large-scale clearing of rainforests, the burning of biomass, paddy-field cultivation, cattle breeding and overgrazing of semiarid pasture grounds (Jacobeit, 1991). These practices, modify climatic parameters such as land surface evapotranspiration, concentration of atmospheric trace gases and aerosol particles, albedo (coefficient of reflectivity) and roughness of the earth's surface. Many effects appear to be small scale and sometimes compensate each other. However, a variety of GHGs released from tropical areas under land use seem increasingly to enhance the earth's warming.

In arid and semiarid lands, human activities like overgrazing, coupled with the degradation of the natural vegetation can lead to changes in particular climatic parameters. Initially, surface albedo could rise by

 

roughly 5 per cent increasing by 10–15 per cent under conditions of desertification (Jacobeit, 1991). Reduced vegetation cover and increased surface albedo may, however, result from naturally occurring periods of drought. Reduced vegetation cover also increases dust emission in arid and semiarid lands due to intensified deflation and thus contribute to the anthropogenic particle emission, one-third of which is due to land-use deflation (Jacobeit, 1991). However, because arid and semiarid lands are climatically determined, any changes in climate which result in an expansion or contraction will alter the extent of the area in which desertification can be expected to occur, but deciding its precise contribution is problematic.

## CAUSES AND LINKAGES OF DESERTIFICATION

Desertification is, first and foremost, the outcome of resource management failure (Kelly and Hulme, 1993). Its anthropogenic processes include overcultivation, overgrazing, deforestation, and poor irrigation practices (UNEP, 1992a, b and c). These processes are the result of excessive pressures on resource ecosystems, which are fueled by *local forces* (Figure 1), such as increases in human numbers and the escalation of their needs, poverty, land shortages and landlessness, civil strife, wars, and poorly conceived national policies that put a premium on export production as opposed to increased food-crop production for local consumption. They may also be exacerbated by *external forces*, such as the state of the global economy, commodity prices, the debt burden, the brain drain, terms of trade, and protectionism and import barriers in developed countries which make alleviation of poverty more difficult for exporting countries and which may cause them to accelerate rates of natural resource exploitation by preventing diversification.

The process may be aggravated by climate change (Kelly and Hulme, 1993): in particular, by prolonged drought and desiccation (Figure 1). Desiccation itself could be the result of natural mechanisms with the climate system such as the influence of ocean temperature patterns (Kelly and Hulme, 1993). Desiccation may also be caused by desertification through surface–atmosphere interaction, or it may possibly be the result of global warming, which can be defined as climate change resulting from GHG emissions discussed already. Finally, dryland degradation can contribute to global warming through its effect on the sources and sinks of GHGs (Kelly and Hulme, 1993). The relative importance of all the above factors may change with sustained degradation or decreased rainfall. Balling (1992), Hulme and Kelly (1993), and Williams and Balling (1996) have provided an extensive discussion on the interactions of desertification and climate, with a fairly comprehensive review of the existing literature on climate and human impact on dryland environments.

That climate change does occur is now an established fact. In the African Sahel, as Nicholson (1978) Kelly and Hulme (1993), and Hulme and Kelly (1993) have amply demonstrated, annual rainfall during the most

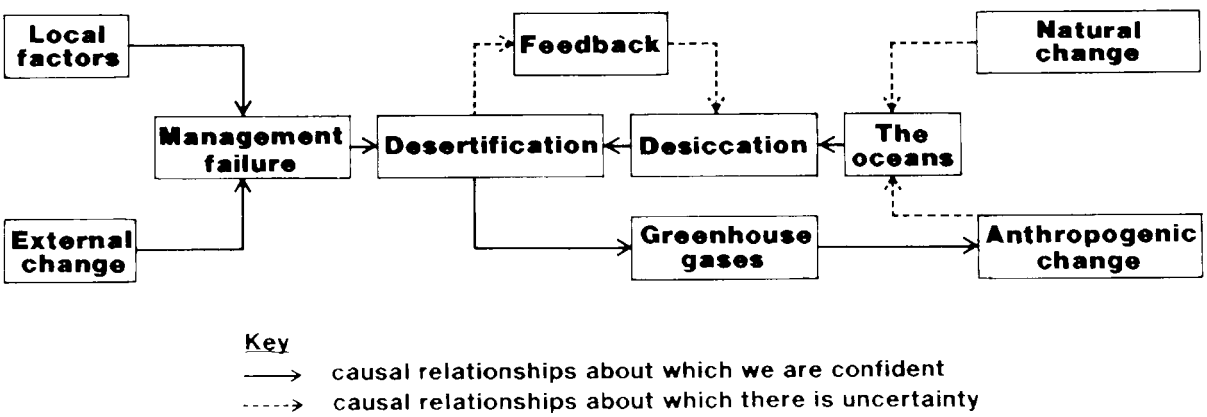


Figure 1. Desertification and its linkages (*Source*: Kelly and Hulme, 1993).

 

recent decades (1961–90) has been between 20 and 40 per cent less than it was from 1931–60. Within contiguous Africa, Kelly and Hulme (1993) have shown that there has been a net shift toward aridity, especially toward hyperaridity, and a consequent net loss of semiarid and dry subhumid land.

However, as we have noted, determining the precise contribution of climate change to the problem of desertification is not an easy matter. One can generalize in the light of recent research findings that there is a causal link between the two. While the relative contribution of climate change is difficult to determine, there is little doubt, that it can aggravate the problem, especially where resource management failure has occurred or where, as a result of natural or anthropogenic disturbances, prevailing management systems of land use in arid and semiarid lands reach their resilience thresholds.

As the case histories of four different regions – the Sahel, the Euphrates–Tigris basin, the Aral Sea region and the Dustbowl of the USA – which are undergoing or have undergone desertification show (Darkoh, 1995), a common structure underlies the desertification process. In arid and semiarid areas, systems formed by man and natural resources evolve to cope with the maximum possible ranges of local climate variability (Puigdefabregas, 1995). Eventually such systems may be disturbed by a factor that produces a sudden increase in resource availability or resource consumption, as, for example, a humid climate anomaly as occurred in the Sahel, or a technological change allowing access to new resources as in the irrigation development in the Euphrates–Tigris basin (the 'Garden of Eden') and in the Aral Sea region of the former Soviet Union, or a change in the market condition as in the Dustbowl of the USA. The result of such disturbances is a burst in the exploitation rate, followed by the inflow of population from the outside, as in the case of the Sahel and the Dustbowl, or by increase in per capita ability to exploit resources as in the Garden of Eden and the Aral Sea region. Figure 2 illustrates the process outlined above.

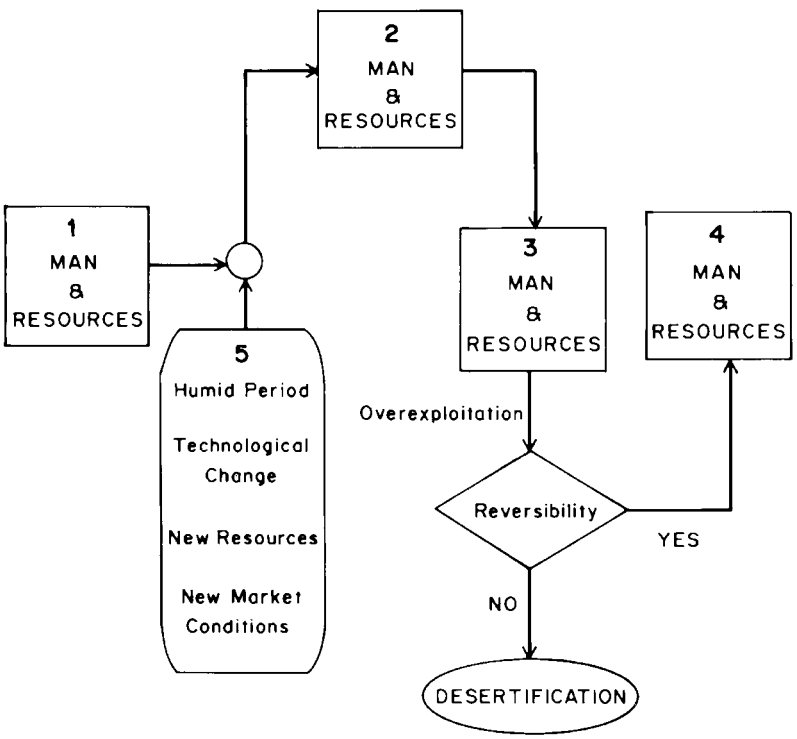


Figure 2. Outline of the desertification process. Square boxes represent the system formed by man and local resources. Boxes 1 and 4 represent the systems in equilibrium with the normal long-term variability of the resources in the area. Box 2 represents the system stressed by the occurrence of a disturbance embodied in box 5. Box 3 represents the system in the overexploitation regime, once the disturbance has ceased (*Source*: Puigdefabregas, 1995).

Once a disturbance like the humid rainfall anomaly in the Sahel, for example, ceases, resources continue to be rapidly depleted by the large population and the system reaches its resilience threshold. At this point, unless the pressure on resources decreases, or the management system changes to more intensive or sustainable forms capable of maintaining equilibrium between resource and human utilization, desertification accelerates as the land continues to lose its biological and economic productivity.

However, there is still dissatisfaction with the term 'desertification' because of the ambiguity about whether it is a process or a condition and because of the difficulties of deciding whether processes like overcultivation, deforestation and overgrazing are causes or symptoms. A more rigorous definition is needed in terms of measurable 'indicators'. Furthermore, despite the general consensus, the term still remains vague and has even been challenged as a scientific concept (Forse, 1989; Hellden, 1991). This situation hinders efforts to solve real problems in threatened areas, and therefore, it is urgent to provide the concept with a theoretical basis, particularly now that the International Convention to Combat Desertification has been signed by UN member states. Puigdefabregas (1995) has made a modest start by providing an analogue model based on the well-known predator–prey system, designed for describing the behaviour of closed grazing systems.

## DESERTIFICATION IN AFRICA

Drylands in Africa, including hyperarid deserts, comprise 1959 million ha or 66 per cent of the continent and about one-third of the world's drylands (UNEP, 1992a). One-third of this area is hyperarid desert (672 million ha) that are uninhabited, with the exception of sparse tiny oases, while the remaining two-thirds or 1287 million ha are composed of arid, semiarid and dry subhumid areas with a population of about 400 million (two-thirds of all Africans).

According to UNEP's latest assessment (1991), 1·9 million ha of irrigated croplands (or 18 per cent of the total area), 48·86 million ha of rainfed croplands (or 61 per cent of the total area), and 995·08 million ha of rangelands (or 74 per cent of the total area) in Africa are affected by desertification at a moderate or higher level (Table I).

Table I. Status of desertification/land degradation in the drylands of Africa

| Irrigated Lands | | | Rainfed croplands | | | Rangelands | | | Total agriculturally used drylands | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total (M ha) | Degraded (M ha) | (%) | Total (M ha) | Degraded (M ha) | (%) | Total (M ha) | Degraded (M ha) | (%) | Total (M ha) | Degraded (M ha) | (%) |
| 10·42 | 1·90 | 18 | 79·82 | 48·86 | 61 | 1342·35 | 995·08 | 74 | 1432·59 | 1045·84 | 73 |

*Source*: UNEP, 1992a: 81.

Three distinct areas of the continent are at most risk: Mediterranean Africa, the Sudano–Sahelian region and the Kalahari–Namib region in southern Africa (Figure 3). One-third of Africa is affected by desertification and 73 per cent of the total agriculturally used drylands are degraded (see Table I).

Recurrent droughts are a fact of life throughout the drylands of Africa; virtually every year there is a drought in some part of the continent, with major droughts, regularly affecting large portions of the drylands. Such disasters occurred in 1968–73, 1982–85 and 1990–91, causing many countries of Africa to experience substantial food shortages. With each drought cycle, desertification increases.

Data provided by UNEP (1992a) reveal that all major factors of desertification in Africa remain unabated, leading to increasing land degradation despite modest efforts to arrest it. Although satellite data show large fluctuations in the rainfall-dependent northern and southern boundaries of green biomass production zones, both seasonal and annual, the overall trend is negative. There are clear manifestations of continued ecological degradation.

 

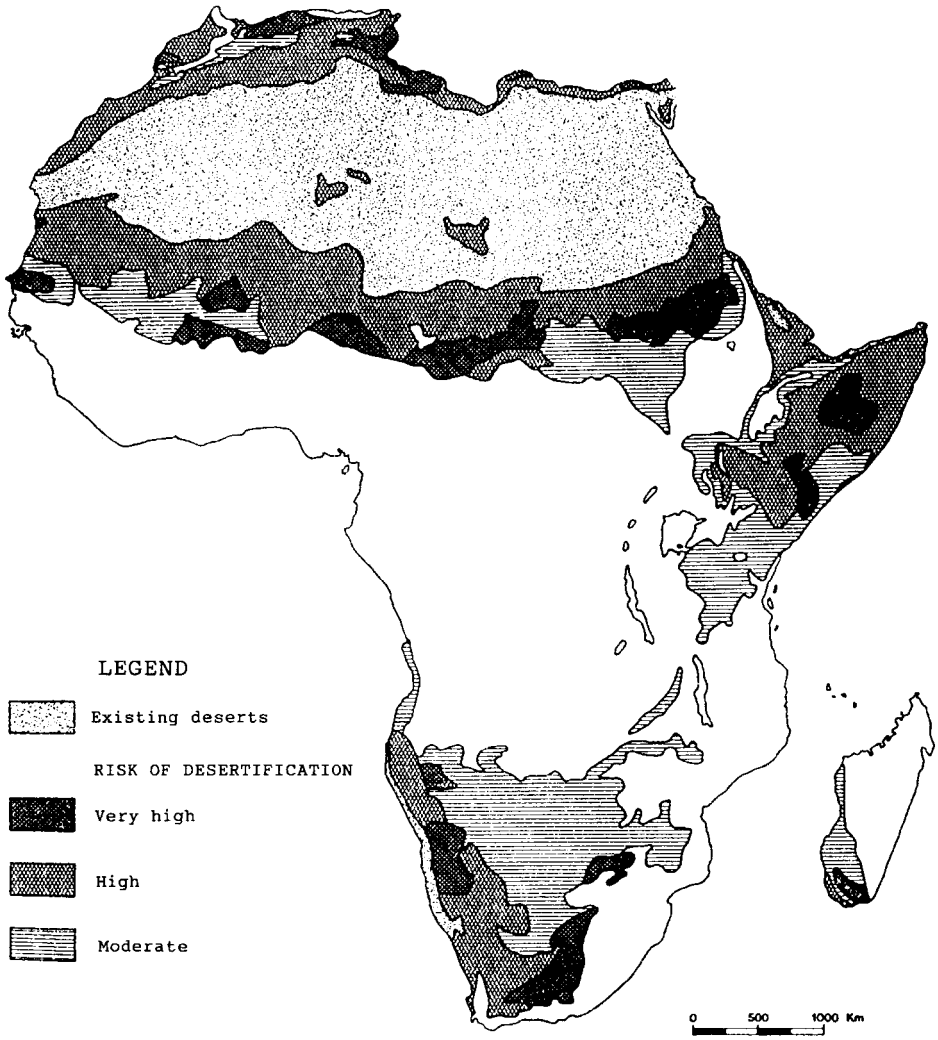


Figure 3. Desertification map of Africa (*Source*: UN Conference on Desertification, *World Map of Desertification*, 1977).

Nevertheless, there seems to be little evidence to link desertification with the notion of desert advance in Africa. Earlier observations and assertions have been made that the desert was advancing at approximately 5 km a year (Lamprey, 1975). This has now been disproved by Hellden (1991, 1994) whose work in the Sudan shows no such advance and Tucker, *et al*. (1991) who assert that patterns of vegetation cover in these areas are dependent on rainfall. Hellden (1991, 1994) has further asserted that contrary to arguments advanced, there is no evidence that patches of deserts are spreading outward from villages and water holes within the drylands of the Sahel area, for instance. More sustained research work at microscales in other parts of Africa are needed to determine the impact of human settlements on the phenomenon of desertification to corroborate or disapprove the findings of Hellden.

*The Human Causes of Desertification in Africa*

In Africa, a leading cause of desertification is human population pressure which leads to overexploitation and intensified stresses on the natural environment. Africa's population has doubled in the past three decades to about 708 million (1994) and continues to expand at a rate of some 3 per cent a year. This means

 

that Africa's farmers must feed an additional 21 million people every year, whether the weather is good or bad. By comparison, North America adds fewer than three million people to its population each year.

Rapid population growth, with concomitant high population densities and rapid urbanization, implies growing demand for more land for crop production, as well as wood for fuel, because there are more mouths to feed. Continuous rapid population growth also implies increased use of land in economies dependent on rainfed cultivation. Where suitable land for agriculture is plentiful, increasing population growth and high densities do not immediately pose a problem; but in areas of land scarcity or where population:land resource ratios are high, further increases in population growth can imply shortening of fallow cycles as land comes under increased pressure, leading to consequent declines in productivity, unless, of course, more intensive forms of land use such as the application of manures and fertilizers can be adopted.

Increased population pressure on the fragile and vulnerable soils of Africa's dryland regions, leads to overexploitation of water, land, forest and pasture resources through overcultivation, overgrazing and deforestation. These practices therefore constitute the principal threats to the livelihood of millions of people. These are the foremost causes of soil erosion, the rates of which in Africa are among the highest in the world. Already soil erosion caused by overgrazing, overcultivation and deforestation has robbed the susceptible drylands of more than a quarter of their topsoils (Table II and III). The resulting degradation of productive lands has led to declining production and intensified food insecurity (Figures 4 and 5).

Table II. Main causes of soil degradation in the susceptible drylands of Africa

| Causes | Area affected (M ha) | Area affected (%) |
|---|---|---|
| Overgrazing | 194·4 | 15·1 |
| Overcultivation (agricultural activities and over exploitation) | 115·9 | 9·0 |
| Deforestation | 22·0 | 1·7 |
| Total | 332·3 | 25·8 |

*Source*: UNEP, 1992b: 35.

Table III. African susceptible drylands by degrees of soil degradation (%)

| Degree | Area (M ha) | Area (%) |
|---|---|---|
| Light | 144·2 | 11·2 |
| Moderate | 112·2 | 8·7 |
| Strong | 72·8 | 5·7 |
| Extreme | 3·1 | 0·2 |
| Total degraded | 332·3 | 25·8 |

*Source*: UNEP, 1992b: 29.

Many of the susceptible and highly populated upland areas of the Sahel, such as the northern Ethiopian Highlands, the Ennedi Highlands of Chad and adjoining Darfur in Sudan, have been highly degraded. So also are the Atlas and Rif Mountains in Africa north of the Sahara, where 'badlands' have developed in places. Other susceptible dryland areas include western Madagascar, central Tanzania and the pastoral and arable savanna lands of southern Africa.

Ambiguities, however, surround the impact of population growth and density on desertification (UNSO, 1992; Darkoh, 1994). Caution, must therefore be exercised in evaluating the effects of rapid population growth, since Africa has also been shown to offer good examples in recent times of cases of 'more people, less erosion' (Tiffen, *et al*., 1993; Darkoh, 1994).

 

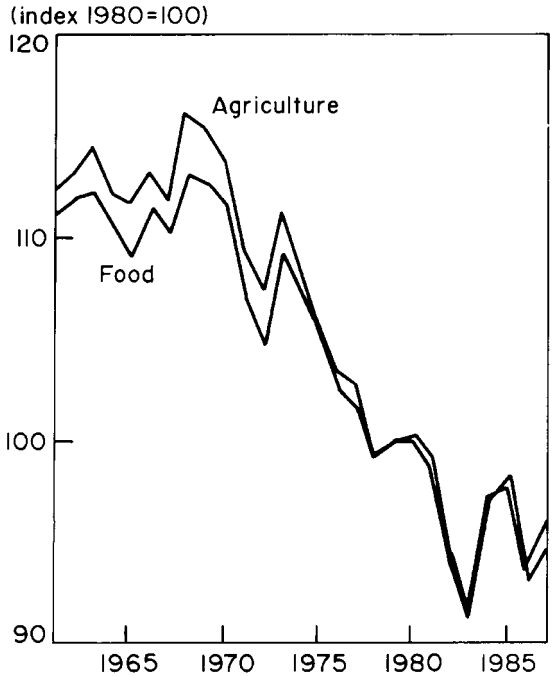


Figure 4. Per capita agricultural and food production in subSaharan Africa, 1962–88. *Note*: 'Agriculture' includes all agricultural products. 'Food' includes products with nutritional value, including cocoa but not coffee (*Source*: FAO data).


Figure 5. SubSaharan Africa's food trade, 1961–87. *Note*: 'Imports' includes food (*Source*: FAO data; World Bank, 1989).

 

According to UNSO (1992), the connection between land degradation and population is seldom direct. Furthermore, while population may be one cause of land degradation, it is rarely the primary and never the only one. It would appear that in the drylands of Africa, population as a factor in desertification or land degradation commonly acts in conjunction with other factors, such as drought, desiccation, rural poverty (which translates into an inability to invest in land management), land shortages and landlessness, land ownership and tenure patterns, and national policies which lead to excessive development of cash crops.

However, while the linkages between desertification and population growth are seldom direct or clear cut, there seems to be evidence of a link between desertification and population movement or migration in the arid and semiarid lands of Africa. The migration generally takes three forms: rural–urban migration, i.e. that caused by the urban pull; rural-to-rural flows, and emigration or the steady loss of labour, especially of able-bodied males, which is keenly felt in rural areas. All three types are common in the drylands. They are particularly pronounced in the Sudano–Sahelian countries. In Kenya, for example, this author's research reveals three migratory trends: permanent immigration, temporary or seasonal emigration and return migration (Darkoh, 1994). The first two are of particular importance to environmental issues in the drylands. Several factors influence these migration trends. These include climate, security, tradition, availability of central services, famine relief, gainful employment in towns, irrigation schemes and seasonal labour in high-potential districts.

With high population densities in the high-potential areas, more and more people are moving from these areas in search of farming land and employment opportunities (Darkoh, 1982a and b, 1991b, 1994). Environmentally, permanent immigration into the arid and semiarid lands is the most important form of migration in Kenya as it is these immigrants who often cause land pressure and import inappropriate technologies that lead to land degradation. They also disrupt the indigenous management systems which are based on appropriate and locally adapted technologies.

Sometimes this permanent movement of the population into the drylands is part of a deliberate government policy to solve the population-resource problem by encouraging planned settlement and cultivation in the wetter margins of the arid and semiarid lands or near irrigation schemes (Darkoh, 1992; Campbell, 1981, 1986). From evidence gathered during fieldwork in both Kenya and Tanzania (Darkoh, 1982, 1990, 1996a), permanent and seasonal migration within the drylands, especially movement of farmers from the overpopulated high-potential areas (where arable land is in short supply) to the arid and semiarid lands, appear as one of the primary factors posing a threat to the environment in the drylands. It has given rise to land-use conflicts. These conflicts arise as a result of intrusion of agriculture into lands traditionally used for domestic stock. Partly because of a lack of coordinated land-use policies for the drylands, there is competition for resource use between the various production sectors. The major contenders are agriculture, livestock, wildlife and human settlements. Often, the weakest sector – pastoralism – bears the brunt of this fierce competition for resource use, consequently becoming increasingly marginalized.

The conflicts are especially intense in the key production areas within the drylands. These areas include the riverine forests along the main water courses, the natural forests, swamps and hilly areas. The dynamics of the conflicts in these key production areas, which are currently some of the most threatened productive lands within the drylands, need to be studied and remedial policies and strategies devised to protect them from further degradation.

Civil strife is one of the complicating factors influencing resource systems and availability of food in many parts of the continent. Many parts of subSaharan Africa have suffered from breakdown of law and order repeatedly during the last few decades. The problems in Ethiopia, Somalia, Sudan, Rwanda, Burundi, Chad, Angola, Mozambique, among others, in these drylands are well known. Being short-term in itself, this factor contributes greatly to the long-term process of land degradation in many ways, partly by displacing people and leaving land unattended, which is not always good for the natural recovery of land, partly by diverting resources that might otherwise be used for environmental and development purposes and partly by deterring people from their normal way of life and forcing them to use untried methods and into new areas. Civil strife

 

may also give rise to a mass exodus of people, who are often quartered in refugee camps in neighbouring countries. Land degradation around such refugee camps is a common phenomenon in several countries, e.g. Tanzania and Zaire.

The Office of the UN High Commission for Refugees (UNHCR) found that, based on 1989 estimates, roughly 11 million trees were cut for shelter needs during the initial period of refugee influxes in Africa (Cardy, 1994). This represents the deforestation of over 12 000 ha. In addition, about 4 million tons of fuelwood were consumed by refugees in Africa.

In North Africa overgrazing has led to moderate to severe desertification of rangelands in arid and semiarid zones of Algeria, Libya, Morocco and Tunisia. Rainfed croplands have been degraded mainly through the extension of cropping into dry, sandy soils and use of inappropriate heavy machinery. There has also been widespread destruction of woodlands as a result of clearing for fuelwood, agriculture, or grazing and fires. Salinization of irrigated lands is reported from all these countries as well as from Egypt where it is linked to inadequate drainage. Many irrigated lands are threatened by sand encroachment resulting from heavy grazing or the abandonment of irrigated lands.

If we look at the remaining subSaharan African countries in the drylands, especially the Sudano–Sahel and southern Africa today, we find basically similar problems: fragile soils being degraded through improper cultivation practices, fuelwood cutting leading to deforestation, and overgrazing destroying the ground cover over large areas, all of which combine to leave the land more vulnerable to drought and soil erosion (Darkoh, 1988, 1989, 1993). As a result, vast tracts of land are being transformed into 'dust bowls', losing their productivity and impoverishing their populations. As Whitlow (1980) has shown for Zimbabwe, a major cause of soil loss in southern Africa is vegetation destruction. The forces and dynamics involved are illustrated in Figures 6a and 6b.

Caution, however, must be exercised in assessing the effects of these macro- and micro-factors or processes. For example, in Africa as a whole, while the incidence of deforestation resulting from fuelwood requirements can have some serious effects because fuelwood and charcoal are critical resources for the poor, recent research has revealed that these effects tend to be generally localized in the dryland areas, especially around settlement nodes. Most local people only collect dead wood of selected species. UNSO (1992) has noted that in a purely rural macrocosm, with dispersed settlements, fuelwood seldom has been a great problem. Except in some highly localized or highly populated rural areas such as the Ethiopian Highlands and parts of Central Tanzania, little evidence exists to suggest that rural household energy consumption is responsible for large-scale deforestation. Mounting evidence, notably from Zambia, Kenya, and Sudan, would seem to point out that it is rather the urban demand, usually for charcoal, that leads to the extensive cutting down of forest. The commodity status of charcoal makes it an attractive choice for entrepreneurs who can derive incomes from its production and distribution (Darkoh, 1990, 1991 a and b, 1994).

Furthermore, while the causes of overgrazing are sometimes mechanically attributed to the increasing number of animals, recent evidence seems to point out that, in areas where overgrazing occurs in the drylands, there are other crucial factors which exacerbate the situation. These include population pressures in rainfed croplands and increasing encroachment of cultivators on adjacent rangelands which tend to diminish the areas of available grazing lands and intensify overstocking and overgrazing.

An additional factor is the historical one in which colonialism undermined the traditional systems of pastoral resource management. The imposition of political boundaries, restrictions on movement of nomads, resettlement schemes or sedentarization and concentration of men and animals around new high-capacity watering places, the development of towns and villages, commercial agriculture and new land tenure systems have disrupted the mobility and seasonal grazing patterns of nomads and their herds and reduced the area they formerly occupied. Denied access to traditional grazing reserves, these herdsmen have been pushed to marginal lands. Overuse of such restricted areas has eroded the basis for their livelihood and initiated a downward spiral of poverty, degradation and marginalization.

Like the population factor, however, the connection between land degradation and pastoralism is not that straightfoward. Except in limited areas where populations are high, according to UNSO (1992) grazing has

 

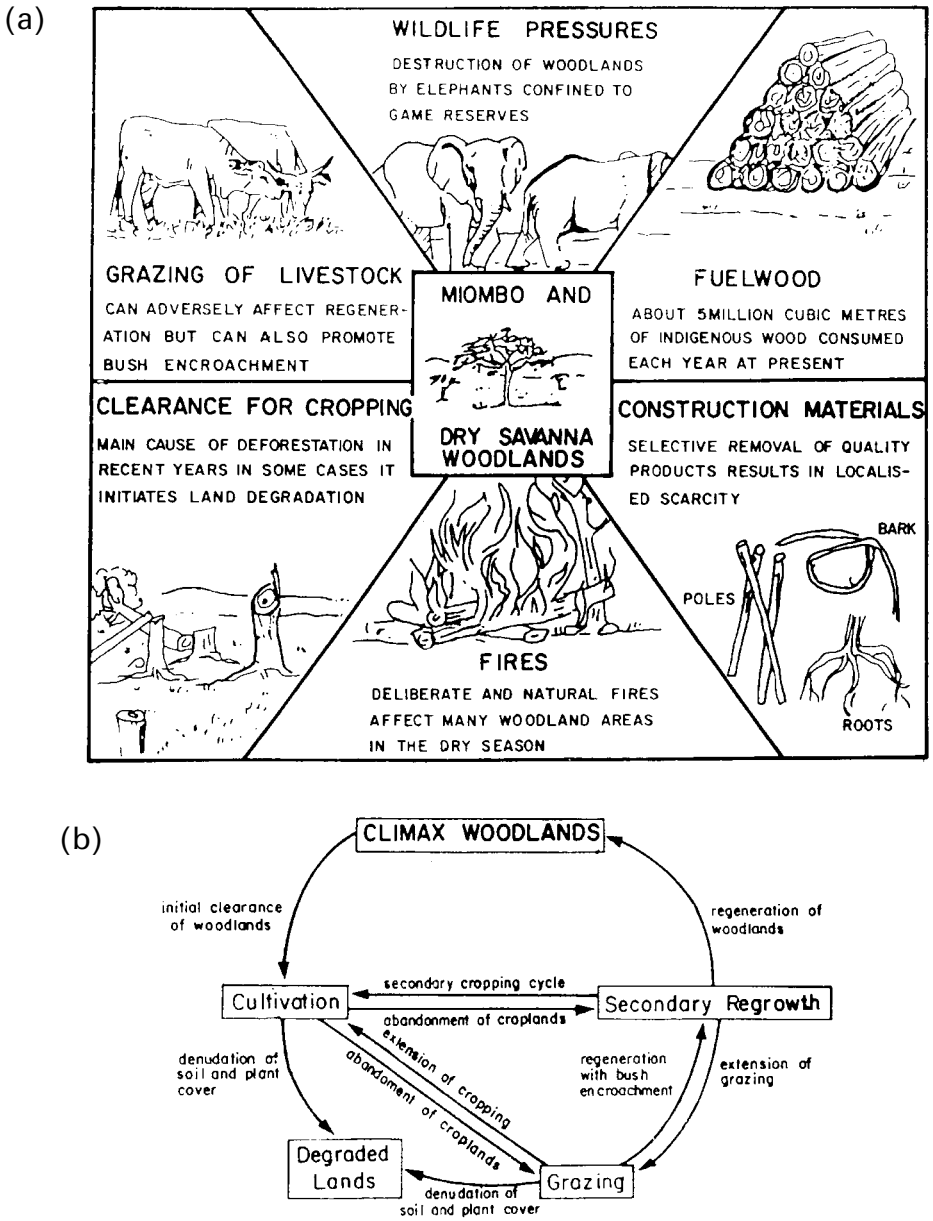


Figure 6. (a) Some reasons for the destruction of woody vegetation in Zimbabwe; (b) Dynamics of vegetation changes in relation to agricultural activities (*Source*: Whitlow, 1980).

probably not inflicted more damage than drought and desiccation of the rangelands. UNSO further notes that the problem is not just one of too many animals relative to available grazing areas, but that the state of the rangeland ecosystems in arid and semiarid areas has more to do with the highly irregular supply of rainfall than anything else.

While the literature may disagree on the issues of overgrazing, population and rural household fuelwood consumption, there is general agreement that a major cause of desertification in the drylands of Africa is

 

inappropriate agricultural practices. Among these are poor agricultural management, inappropriate crops, overirrigation and inadequate drainage, and inappropriate use of chemical fertilizers. Other factors include the expansion of cash cropping into marginal areas, inappropriate agricultural machinery, pricing policies that reduce the value of local product, and land tenure policies that promote short-term exploitation over long-term sustainable development. Expansion of agriculture is also a prime cause of deforestation (agrodeforestation). Sedentarization or villagization of nomads without improved life styles and better management practices have also done little to prevent degradation in the drylands.

In summary, the human causes of desertification in Africa are still not fully understood, although they are generally better known than the physical ones. Changing paradigms and varying views seem to be working against consensus. While some researchers have focused on the more immediate causes others have concentrated on those that are deeper rooted. The range of solutions have depended on whether one or the other has been emphasized.

While the causal factors of desertification have been studied extensively, one dimension that has escaped attention is the spatial scales (Lambin, 1993). Much of the controversey surrounding the subject relates to the discrepancy between cause and effect – the different spatial scales at which the effects are perceived and the causes (responsible for the threats) are unfolding. Desertification is best detected and probably only conceived on a continental and sub-continental scale – the macromanagement level. Yet, it is a product of innumerable land-use decisions at a local scale – the micromanagement level.

*Impact of Desertification and Drought*

While the causes of desertification in Africa are not fully understood, there is a much greater problem with assessing its impact. Part of the problem is due to the lack of reliable data: few African states have accurate statistics on it. Existing data, even at the national level, are not based on quantitative measures, but are best-guess estimates at a high level of generality, which means that they cannot be used as a baseline against which to measure change. Another aspect is that little attention has been given by researchers to the socio–economic indicators of desertification. To date, for example, there are no significant studies that have assessed and monitored human reactions to desertification. A third aspect of the problem relates to the difficulties of separating the effect of changes caused by desertification from those of other events and policies.

Desertification in Africa, as elsewhere, reduces the productivity of land and deprives people of biological resources that are important for human sustenance. These impacts, in turn, lower incomes (and subsistence levels) of hundreds of millions of already poor, dryland peasants, herdsmen and urbanities who form part of the same economy. Prolonged periods of drought under these circumstances lead to hunger, malnutrition and starvation, high infant mortality and accelerated rural migration. Loss of biodiversity in cultivated plants and domesticated animals, and in wild foods which are so important when agriculture fails at times of drought, is a direct threat to food security (IPED, 1994). Desertification is therefore a major scourge (Darkoh, 1993).

In the Sahel, desertification has brought an alarming drop in agricultural production: millet, sorghum and groundnut harvests have been critically low in Mali since the 1970 drought (Lo, 1994). Production has dropped by 50–80 per cent compared to the situation in the 1930s and the loss per year in income is estimated at US$5·7 million. In Senegal, groundnut production has fallen to 800 kg per hectare since 1991, having reached 1100 kg $ha^{-1}$, a quarter of a century ago; and the 'Groundnut basin' has moved southwards to less degraded soils (Figure 7).

The great drought in the Sudano–Sahel region of the early 1970s, claimed about 250 000 lives. Millions more were reduced to destitution, provoking mass migrations to urban areas in search of work and relief. The 1982–85 drought affected the entire subSaharan region. The worst affected country was Ethiopia where an estimated one million people starved to death from the combined effects of drought and civil war.

Drought has accelerated the migration of farmers from the countryside to the cities, putting additional pressure on basic city services such as water and sanitation. Water-dependent factories and mines shut down,

 

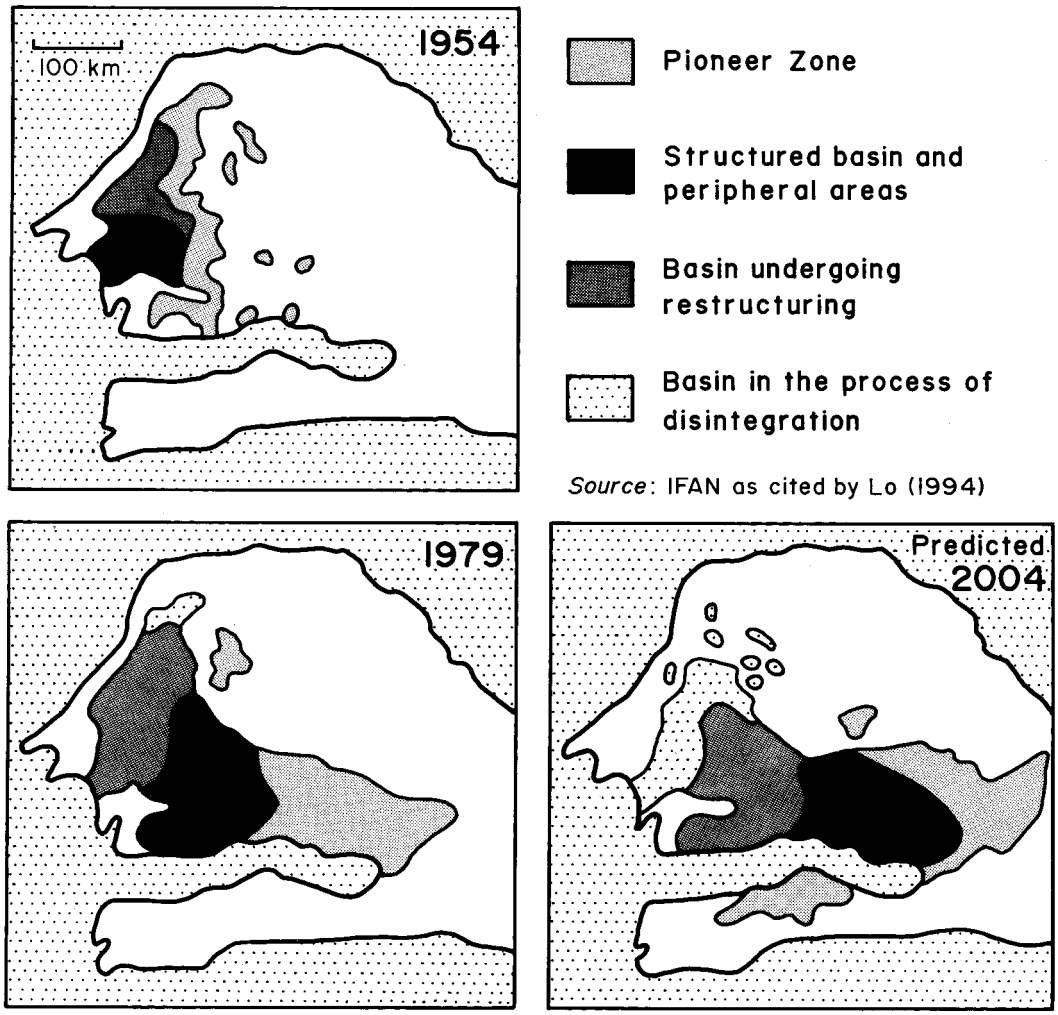


Figure 7. Movement of the groundnut basin, Senegal (*Source*: Institute Fondmental d'Afrique Noire (IFAN) cited in Lo, 1994).

throwing thousands out of work. Many schools and hospitals also had to close, unable to operate without water. At the height of the 1992 drought Bulawayo almost ran out of water completely.

The agroeconomic effects of drought have included lower and variable per hectare yields, reduction in acreage of cropped lands, less high-yield flood cropping, diminished rangeland productivity, changes in pastures and in the composition and size of herds, and lower prices as herdsmen flood the market with sickly cattle seeking to sell them before they die.

The effects of desiccation on croplands and rangelands have been much more serious than those of droughts. In the Sahel, many peasant and pastoral communities have 'simply ceased to exist after the desiccation of the last 20 years' (UNSO, 1992: 30).

Unfortunately, despite growing concern, there are no exact or reliable figures available to quantify the economic costs of desertification either for individual farmers or society as a whole in Africa. However, some partial estimates have been made. Cardy (1993) has cited one unpublished World Bank Study which estimates that the equivalent of 20 per cent of the annual GDP of one Sahelian country could be lost through capital depletion of natural resources. In Madagascar, average loss through soil erosion is estimated at US$100–150 per hectare each year, the equivalent of 70–100 per cent of the average Malagasy's annual

 

income (Randrianarijaoa, 1983). In Ethiopia, soil erosion is estimated to result in annual loss in grain production of 1 million tons (Milas and Asrat, 1985). In Zimbabwe, the financial cost of erosion on a per hectare per year basis varied from US$20–50 on arable land to US$80 on grazing land (Ponzi, 1993). In Namibia, the monetized costs of land degradation at household level aggregated over a standard period for a communal area (Uukwalundi) were estimated at US$2065–2565 (Quan, *et al*., 1994).

One effect of soil erosion, as we have noted, has been a declining or stagnant production of food and cash crops for millions of small farmers. The resulting shortages of food and cash has led to a search for supplementary income-earning opportunities through part-time jobs and migration to urban areas. Sometimes farmers have had to contend with the problem of reduced yields by growing less nutritious substitutes such as cassava.

Deforestation, apart from precipitating and accelerating soil erosion, has had tremendous socio–economic impact in Africa. Fuelwood availability has become a major problem in parts of the Sahel and limited parts of the eastern and southern African region. Where dry dung is used in place of scarce fuelwood as in Lesotho, Ethiopia and other parts of the Sudano–Sahel region, the soil is robbed of its natural replenishment. The resulting loss in soil fertility reduces harvests, although the magnitude of this loss is not easily quantifiable.

More readily documented is the social cost in terms of scarcity and hardship – especially, for women and children who do most of the wood collecting. In central Tanzania fuelwood has become so scarce that the average household spends well over 250 working days per year gathering its supply (Mnzava, 1979). Similar desperate situations are found in Ethiopia, Lesotho, Somalia and northeast Kenya, among others.

Ecological and social mismanagement of irrigation schemes account for a good share of the productivity losses the UN attributes to desertification. Through their role in the spread of schistosomiasis, poorly planned irrigation projects can involve health costs that, for the infected individuals at least, surely outweigh the benefits.

Desertification translates into a spiral of declining production, increasing poverty and diminished potential productivity. It exacerbates poverty which, in turn, exacerbates desertification because, as the pressure increases, people are forced to exploit their land to survive. In doing so, they further diminish its productivity – and the cycle continues. The result is seen today in the Ethiopian Highlands and all across the Sudan–Sahel: starvation, death, disease and the exodus of millions of environmental refugees moving in desperate search for survival to the urban areas or to other less degraded lands elsewhere.

Directly or indirectly desertification slowly erodes the genetic base for human staple food and undermines the whole production system. Entire societies and cultures are now threatened. The pastoralists of the Sahel are a case in point. For most, the loss of their livelihood means a life in relief camps or in shanty towns mushrooming around Sahelian cities and those of the countries to the south.

Finally, desertification and resource-scarcity can provoke social unrest and political and armed conflict. Several governments, most notably the Haile Selassie regime of Ethiopia, have been swept from power by the suffering and unrest associated with drought and famine. With continuing degradation and increasing scarcity of natural resources, the struggle and competition for the remaining resources are likely to become a potent source of conflict among communities and countries in the African drylands (Ghai, 1992).

## FAILED PLANS AND ACTIONS

Over the past three decades, there have been major efforts to combat desertification in Africa. In 1968, African governments, under the auspices of the Organization of African Unity (OAU), adopted the ‘African Convention on the Conservation of Nature and Natural Resources’, in Algiers, Algeria. Contracting parties agreed to adopt the necessary measures to ensure conservation and sustainable utilization of natural resources in accordance with scientific principles. The Lomé Conventions also took up the issue of desertification seriously. For example, Lomé III (signed in 1984) dealt exhaustively with the safeguarding of natural resources, and especially with desertification control. The UN General Assembly addressed the

 

problem of desertification in Resolution 3202 (VI) of 1 May, 1974. This resolution recommended that the international community undertake concrete and speedy measures to arrest desertification and assist the economic development of affected areas. The UN Economic and Social Council's Resolution 1978 (LVII) of 16 July, 1974 requested all concerned organizations of the UN system to pursue a broad attack on the drought problem. The United Nations Conference on Desertification (UNCOD) convened in September 1977 in Nairobi, Kenya, is the most important global conference organized to initiate concerted international action to combat desertification (United Nations, 1978).

Organized under the auspices of UNEP, UNCOD drew up a Plan of Action to Combat Desertification (PACD). The immediate goal of the PACD was to prevent and arrest the advance of desertification, and where possible to reclaim desertified land for productive use. The ultimate aim was to sustain and promote, within ecological limits, the productivity of arid, semiarid and dry, subhumid areas that are vulnerable to desertification. The PACD recommended 28 measures for improving productivity and sustainability of the major types of land use, coupled with attempts to prevent soil erosion and reclaim land already desertified (United Nations, 1978).

As part of the attempt to arrest desertification and mitigate the effects of drought in Africa, a confusing array of organizations have been set up during the last three decades (Impact Team, 1992). These include: the Permanent Inter-State Committee on Drought Control in the Sahel (CILLS) established in 1973; the United Nations Sudano–Sahelian Office (UNSO) established in 1973 as a mechanism for the coordination of UN efforts to assist Sahelian countries in combating drought; the Committee of Ministers on Desertification (COMIDES) with its headquarters in Dakar; the Intergovernmental Authority for Drought and Development (IGAAD); the Centre d'Agrométéorogie et d'Hydrologie Opérationnelle (AGRHYMET) in Niamey; the Drought Monitoring Centre (DMC) in Nairobi; the Sahara and Sahel Observatory (OSS); and African Desert and Arid Lands Committee (ADALCO) established in 1987 to combat desertification in the Kalahari–Namib region.

Despite the plethora of plans, activities and organizations to combat desertification at national, regional and international levels, the efforts have met with limited success. In Africa this has been attributed to many factors: lack of political will, lack of funds, lack of people's participation, lack of coordination, destructive land tenure policies, war, misdirected research priorities, failure to include desertification control activities in national development plans and failure of African governments to make desertification a priority (Darkoh, 1989, 1993). An external evaluation of the PACD in 1990 identified several of the factors mentioned above as causes of the failure of the PACD, even though it concluded that the PACD should remain the global strategy for desertification control, with slight revisions that should give greater emphasis to socio–economic factors associated with desertification (UNEP Governing Council, 1990).

Furthermore, because of tremendous debt burdens (currently standing at over 90 per cent of GNP for subSaharan Africa) and the Structural Adjustment Programmes imposed by the International Monetary Fund and the World Bank, national governments in Africa find it difficult to finance the expenses of environmental programmes designed to protect natural resources. Governments and national policies in Africa consequently still promote inappropriate agricultural policies that place a premium on higher priced non-food cash crops that generate foreign exchange often through unsustainable practices. Increasing protectionism of developed countries have caused international markets for the products, and thus the earning capacities of these poor countries, to shrink further. The direct environmental effects of all these factors is often to force the latter to exploit their natural resources over-intensively and to eat away at their capital stocks.

Also, much of the financial and technical assistance many of these African countries received from the developed countries seems to have gone largely on showpiece projects and into measures aimed at appeasing the more politically advantaged urban populations. By comparison, rural populations which tend to lack political clout – especially in the more remote arid and semiarid regions – are all but ignored.

The environmental and social problems facing the drylands of Africa are of such magnitude that governments alone cannot handle them. The people whose survival is at stake must be given the rights and the power to determine their own future. Despite all the intervention and plans of action, including activities

 

and pressures from NGOs and international conventions (see below), African governments still suffer from failure or refusal to devolve power to the people and to link environmental degradation to economic policy (Impact Team, 1992). Partly because of this, many programmes to combat desertification and drought have been hindered for lack of local support or have been undermined by conflicting trade and agricultural policies. Like donors, African governments prefer to invest in projects that yield quick, visible results that can be easily quantified in economic terms, and environmental programmes do not yield such immediate returns. It has also been estimated that 90 per cent of the activities aimed at reducing desertification in Africa are not directed to field projects, but are channelled into planning and coordination, infrastructure provision and public awareness programmes (Stiles and Brennan, 1986).

Nowhere did the problems associated with the combat of desertification become so clear as at the Earth Summit, the United Nations Conference on Environment and Development (UNCED), convened in Rio de Janeiro in June 1992, and during its concurrent or subsequent negotiations on conventions on climate, biodiversity and desertification. UNCED (1992) presented to the international community concrete evidence demonstrating the complexity of the problem of desertification and the difficulties which arose when efforts to combat it were implemented at national and regional levels. The main conclusions reached at UNCED showed that, apart from a few countries which have a national strategy for combating desertification based on and integrated into social and economic development plans, desertification is only tackled at national level within the framework of cooperation projects financed completely by outside sources. Plans to combat desertification reached at national and regional levels have often encouraged curative intervention by the authorities while neglecting to develop subsistence policies for the local population based on their age-old skills and know-how. The destruction of traditional production systems further aggravates social problems and poverty in the affected regions.

*Agenda 21*, the blueprint for action adopted at UNCED, appealed to the poor nations to give priority to combating desertification and drought by the implementation of preventive measures, and mapped out national strategies for doing so. Chapter 12 of *Agenda 21*, which specifically deals with this problem, outlines several measures which can promote sustainable development and counter the threat of desertification and drought. These include: information and monitoring systems, soil conservation, integrated programmes for eradication of poverty and promotion of alternative livelihood systems, integration of anti-desertification programmes into national development plans, drought preparedness and drought relief schemes, and popular participation.

Apart from the adoption of the special chapter in *Agenda 21* on desertification and drought, UNCED also achieved some measures of success on international negotiations on climate change and biodiversity. The resulting international Framework on Convention on Climate Change (FCCC) signed by 153 nations during the Earth Summit, has since been ratified by over 50 nations and has subsequently come into force. The FCCC has the objective of stabilizing GHG concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. The Biodiversity Convention, which has also come into force, has the objective of equitable and sustainable use of biodiversity resources. It adds a new impetus to conservation, particularly in the African countries, where the genetic erosion of agricultural crops, loss of species and natural habitats and their long-term effects are significant. The International Convention to Combat Desertification signed in Paris in June 1994 had as its main objective the combating of desertification and the mitigation of the effects of drought, particularly in Africa, through effective actions at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach which is consistent with *Agenda 21* (INCD, 1994). It recognizes that achieving this objective will involve long-term integrated strategies which focus simultaneously, on affected and threatened areas, on management of land and water resources, leading to improved living conditions, in particular at the community level. The major message emanating from the Convention is that effective programmes for combating desertification must involve the very people who are affected by it.

Much general research has been carried out in many parts of Africa on desertification or land degradation. Now, more than ever, research is needed at the local and community level in order to understand better both

 

the multifaceted causes likely to lead to environmental stress and the human reactions to desertification, and to assess realistically what can be achieved through local and community-based actions and policies. It is time to identify and address the root causes of desertification at the field level in the drylands of Africa (Dowdeswell, 1993).

## CONCLUSION

The conditions that were enunciated by the Brundtland Commission (WCED, 1987) and UNCED's *Agenda 21* with regard to the poor, remain unchanged in the developing African countries. For instance, levels of poverty are on the increase and population growth in subSaharan Africa, where the ecological base is most fragile and is deteriorating, is projected to be the most rapid (Titi and Singh, 1994). External and internal central urban institutions and individuals, governments and commercial interests, continue to extend their power, ownership and exploitation of rural areas; they compete for and appropriate resources, such as forests, fisheries, and grazing and ranching lands, resulting in the decline of biological productivity; rural communities are marginalized from the political process; and the people's freedom to migrate or fend for themselves is reduced, thus generating conditions for local population growth and pressure on the environment.

Development interventions targeted towards the poor in the arid and semiarid regions of Africa have not yielded expected results and the countries in these regions remain among the most disadvantaged in the world. This failure has been attributed partly to the failure of external intervenors to familiarize themselves with the strategies employed by the poor and to support and strengthen them (Titi and Singh, 1994). Where desertification control projects have been implemented, the programmes stem from insights and models of development tested elsewhere, rather than from those based on experience, local knowledge and adaptive strategies of the affected people. Many researchers have drawn attention to this failure and lack of appreciation or understanding of indigenous management systems by both national and international intervenors, and the result has been a proliferation of research on indigenous knowledge, adaptive and coping strategies.

It is now recognized that the poor in these socio–ecological systems use diverse adaptive and coping strategies to deal with ecological, social, political and cultural risks (Chambers and Conway, 1992; Titi and Singh, 1994; Oba, 1994; Darkoh, 1996b). These strategies need to be strengthened by public policies as well as by intervention from international and national institutions and organizations. The welfare of the people in the affected dryland areas needs to be put at the centre of the development agenda, and those adaptive strategies of their livelihood and production systems that confer drought resistance or lessen their susceptibility to famine must be bolstered (Darkoh, 1996b). Also, within the framework of desertification control at the local and community level, project activities must strengthen people's standard of living through, for example, the introduction of alternative livelihood systems so that the population can attain an economic standard which makes it less vulnerable to stress and more resistant to drought and famines.

Presently many interventions from outside are weakening instead of strengthening local adaptive strategies, livelihood and production systems. For example, the adoption of Structural Adjustment Programmes and the subsequent policies of trade liberalization to achieve equilibrium and economic growth in many of the African countries have worsened the standard of living and undermined efforts at achieving food security (Titi and Singh, 1994; Khor, 1995). The ability of the poor to sustain adaptive strategies towards sustainable livelihoods is constrained by their vulnerability to loss of access and assurances into the capacity to evolve strategies to deal with change (Chambers and Conway, 1992; Singh and Titi, 1993). The need to facilitate some measure of empowerment to give the people of the drylands opportunities to shoulder the risk of change towards sustainable livelihoods has become critical (Singh and Titi, 1995).

At the national and international levels, wealth created by trade is one of the essential means of empowerment and poverty alleviation. Barriers to trade at the national and international levels can create impediments for the achievement of sustainable development, especially for the countries in the drylands of

 

Africa. One of the greatest ironies of the current relations between the poor countries and the rich, industrialized ones is that the beneficial effects of billions of dollars in development aid may be cancelled out by the deleterious effects of trade barriers. Greater access to markets in the latter and reduced subsidization of their exports could do more for development and the environment in Africa than a tripling of development assistance (Stevens, 1995). Because of the imperatives of the Structural Adjustment Programmes adopted by most of the affected African countries, the poor nations in the drylands of Africa understand the link between trade and sustainable development. The threats protectionism and environmental standards in developed countries and Structural Adjustment Programmes pose to poverty alleviation, environment and sustainable development, call for greater access by the poor African countries to developed country markets and a fundamental revision in the design and implementation of the programmes.

Furthermore, while the peoples and governments of these poor African nations (and others in the rest of the developing world) are being persistently asked to be conscious of the importance of curbing destructive activities and achieving sustainable development of their resources, we must also caution the people and governments of the developed countries to curb the manner and rate of consumption of their own and other's resources (Sadik, 1993). Controlling desertification and land degradation in Africa has global implications. It can simultaneously contribute to minimization of global warming/climate change in two ways. First, by the effect on atmospheric concentrations of carbon dioxide through rehabilitation and/or conservation of biomass. Second, by minimizing the possible effects of devegetation on surface reflectivities and surface-water transfers. Two further issues of potential global climatic significance are the role played by changing surface character on local or perhaps global rainfall patterns and the role of aggravated dust emissions. On the latter, for example, dust emission levels in the Sudano–Sahel zone of Africa have risen considerably in recent years with potential global effects. Clearly desertification control in Africa is in the interest of global well-being, and thus requires funding from globally-oriented funds.

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