Chapter 5

Uncertainties and Environmental Threats in Africa

Introduction

Africa is the second largest of the seven continents in the world, with a land area of 30,000,000 km^2, about one fifth of the world's total area (ECA 2001). The ECA estimates that about half of the cultivable land is arid or semi-arid, comprised mostly of desert, with the least content of organic matter. Yet, the continent remains one of the richest in terms of natural resources.

Additionally, Africa has the highest and most rapidly increasing population, with a correspondingly high population density. Factors that account for the growth and distribution of the population in Africa are ecological and historical (ECA 2001). For example, areas with ecological factors conducive to agriculture have dense populations, while those that are dry and harsh have sparse populations. The slave trade, devastating bloody conflicts and international migrations have significantly reduced the population of Africa; while colonisation and economic factors have modified the distribution of populations on the continent. The majority of Africa's people are poor, and depend on natural resources for their livelihoods.

Coupled with an ever-increasing dependence and pressure on these resources (Darkoh 1998) it is indisputable that Africa is also a region of high uncertainties and environmental problems. This chapter is dedicated to discussing local and regional environmental problems. The terms 'local' and 'regional' describe impacts, which are more or less localised, or confined within the geographical areas where they originate, as well as the impacts that go beyond national boundaries, but are restricted to the continent's boundaries. Such environmental problems include deforestation, land degradation and soil impoverishment, droughts, desiccation and desertification, wildlife de-population and extinction, and water pollution and shortages.

Deforestation

One of the most important resources, of which Africa is proudest of, is the forest. It is estimated that African forests originally covered about 3,620,000 km^2, a surface area about the size of India, Nepal, Bhutan and Bangladesh combined (Martin 1991). Globally, forests cover only 6–7 per cent of the earth's landmass, but provide a habitat for about 50 per cent of all known species (World Bank 1992). In line

with this general assessment, Peters' (1998) work has confirmed that forests containing a large number of different species usually contain an equally diverse assortment of useful plant species, meaning that there is usually correlation between the richness of species and resources. However, he draws attention to an unusual correlation that when there is a high species diversity of plants, individuals of a given species usually occur at very low densities. What this means, for example, is that the higher the diversity of tree species in a given forest area, the lower the rate individuals of each representative species in the area, and vice versa. This is due to constraints of space: there is a limit to the total number of trees that can be packed into, for example, a hectare of forest.

Another unfortunate characteristic, noted by Peters, of the many tropical tree species is that they have difficultly recruiting new seedlings into their population, despite the abundance of pollinators, fruit and seed dispersers and fruit sets. This is so because of a number of constraints. For example, a seed must avoid being eaten, it must encounter the appropriate light, soil moisture and nutrient conditions to germinate, and it must be able to germinate and grow faster than the seeds of other species that are competing in a given micro-site. All this illustrates why it takes millions of years for the forest to be established.

The forests are important in a number of different ways. For example, they serve ecological functions such as protecting and enriching soils, providing natural regulation of the hydrological cycle, affecting local and regional climates, influencing watershed flows of surface and groundwater through water catchment area protection, and helping stabilise the global climate by sequestering carbon as they grow. In addition to these ecological functions, forests support livelihoods and confer dignity on resident rural communities. Many rural communities depend entirely on them for survival.

Unfortunately, these ecological and livelihood support functions are under serious threat, due to the rapid rate of deforestation in Africa. Deforestation refers to the removal of forest stands by cutting and burning to provide land for other purposes, such as agriculture, the construction of residential or industrial building sites, and roads, and the harvesting of trees for building materials or fuel, without replanting new trees. According to the ECA (2002), Africa is consuming its forest and woodlands at a rate only slightly lower than the deforestation rates of Latin America and Oceania, and at a rate of twice the world average.

The causes of this problem on the continent include shifting cultivation, commercial logging, harvesting of fuelwood and building materials, and pastoralism. Shifting cultivation is considered to be the major cause of deforestation (Bundestag 1990). It is a form of traditional agriculture that is widely practised in the drylands of Africa. It is an efficient way of manipulating environments that would otherwise be unproductive under arable farming (Darkoh 2003). According to Schusky (cited in Darkoh 2003), the practice is carried out by between 25 and 33 per cent of African farmers. Schusky identified two kinds of shifting cultivators: those that practise it in order to supplement other, more permanent, cropping activities; and

those that have been forced out of their 'traditional' homes, with little option but to try to earn a living by encroaching on forests and other environments. To this, two other types of shifting cultivators can be added: those who are motivated to acquire large tracks of land in order to gain traditional recognition and prestige; and those who employ it as a strategy for securing sufficient pieces of cultivable land for the family, due to perceived or predicted future scarcity.

Given these four different types of shifting cultivators, there is an obvious correlation between deforestation and population growth (Barnes 1990). In the past, a sparse African population operated the system for subsistence needs (Darkoh 2003). This was characterised by long fallow periods. This explains why in some parts of Africa, such as the Machakos district in Kenya, where shifting cultivation is not the tradition, increasing population pressure leads to intensive and highly sustainable forms of land use (Tiffen et al. 1994). However, the common phenomenon today, as Darkoh (2003) notes, is that increasing population pressure leads to more intensive shifting, and a reduction in the length of the fallow period, a condition that tends to make the system unsustainable as it leads to disastrous declines in soil fertility.

Shifting cultivation is generally characterised by what is known as slash-and-burn agriculture. According to Peters (1998), the most intensive and costly way to use the forest is to cut it down, burn it, and plant something else: timber plantation, agricultural crops and pasture grasses. Cutting down and burning the forest would not only eliminate most of the biodiversity and release approximately 150 tonnes of carbon per hectare in the form of carbon dioxide and other green house gases (Keller et al. 1991); it would also increase water movement, soil erosion and nutrient loss, as well as decreasing evapo-transpiration and total ecosystem productivity (Jordan 1987). Continued burning under shifting systems ensures that woody species do not re-colonise and are, eventually, eradicated (Mannion 1995). Faced with the need to produce more food in the face of declining soil fertility, farmers often have no choice but to extend their farming activities to areas that are agro-ecologically unsuited to such forms of land use.

The effects of shifting cultivation are often associated with rapid population growth, in view of the argument that its impact was minimal when populations were low (Darkoh 2003). Although Cleaver (cited in Darkoh 2003) considers this rapid population growth under shifting systems of agriculture to be one of the prime causes of land degradation, this conclusion, according to Darkoh, is no longer tenable in all cases. Darkoh's argument is that while high levels of increasing population are strongly associated with increasing levels of poverty and pressure on the natural resource base, it is now recognised that the strong correlation does not necessarily or always imply a causal relationship running in one direction only. He uses the Machakos case, mentioned above, to illustrate that there are, indeed, other relationships. For example, (Lockwood 2000) observes that rising population densities can lead to either degradational or conservation pathways.

The latter path, that of conservation, which Darkoh (2003) describes as a Boserupian conception, explains the Machachos case. It recognises that capacity is not fixed, but can be influenced by the application of labour, investment and technology. The opposing view, that of degradation is neo-Malthusian. It states that as populations build up, land runs out, giving rise to over-cultivation and degradation. A third view, held among economists, which Darkoh (2003) designates as post-Bruntland view, down-plays the roles of poverty, population increase and land degradation in transitional societies, and highlights the importance of economic growth. This view postulates that as economic growth increases, environmental degradation is enhanced, not necessarily by poverty or rapid population growth, but by what is called the Environmental Kuznet's Curve (Kuznets 1955). The hypothesis states that in the initial phase of economic development, a country experiences increasing environmental degradation, but after attaining a certain income threshold, degradation subsides as further development continues. According to this principle, while there may be negative environmental effects as a result of poverty and rapid population growth during the early stages of economic development, these will be counteracted by later improvements in environmental quality, as incomes and living standards improve. But, as Darkoh (2003) warns, it may be unduly optimistic to apply the Boserupian or the Kuznets' paths in the hopes of successfully redressing the problems of land degradation in Africa without appropriate interventions, such as soil conservation measures and land-use policies. His argument is that the social organisation of African societies differs from those in other regions, such as Europe and South East Asia, where societies have adapted successfully to high population densities.

It has been noted that even the application of what Darkoh describes 'as appropriate intervention' might not guarantee any significant positive results. For example, in the 1990s, agro-forestry and land-use planning initiatives were widely introduced into a huge number of rural communities in Cameroon, by conservation and development projects. The intention was to reduce shifting cultivation and encourage proper land management through crop rotation. But what is the place of crop rotation in the traditional cultural landscape of the populations? Where there was fear of an outright resistance to the new practice, projects started by encouraging what was described as selective burning. This was the practice of gathering the destroyed tree biomass into a few heaps before burning when materials are dry, so as to considerably reduce the surface area affected by fire. But farmers found this not only time-consuming, but also difficult to apply in a majority of circumstances. However, they adopted the agro-forestry option, as they could appreciate its benefits. Of course, agro-forestry has been an integral part of their traditional culture, although the 'introduced' version of planting certain (mostly leguminous) species of trees on their farms could easily be seen as slightly different from their practice of discriminatory felling, aimed at leaving behind trees of economic value. It should also be noted that in some cases, the latter practice was adopted either because the

farmers did not have the appropriate implement, or because it was not financially viable to hire someone else to cut down certain (mostly large) trees.

In Kenya, the government initiated several tree planting campaigns. However, by the late 1940s, these campaigns had become immensely unpopular because they represented a cornerstone of the colonial government's land policy (FAO 1987). Although some communities adopted the 'new' version of agro-forestry, this did not prevent them from continuing with their traditional shifting cultivation. For example, in the late 1920s, the colonial forest service introduced a village forestry scheme in Malawi to promote the protection of indigenous forests, placed under the jurisdiction of village leaders. This initiative was motivated by the traditional practice of communities setting aside some forest areas for protection. The expectation was that since this initiative was in line with, and promoted, traditional practice, it would receive community support. But, instead, it was viewed with suspicion. Why? The simple reason was that the implementers had failed to consider the cultural motivation behind the practice.

Similarly, even if it were popular, the fact that it was placed under the jurisdiction of village leaders would have posed another kind of problem. For example, what could have been presented to the farmers as a disincentive against the drive to gain recognition and prestige for securing large tracts of land for future use by growing numbers of extended family members? All in all, as the FAO notes, some of the problems with tree planting interventions in the past were due to the fact that local people resented foreign initiatives, especially as these brought back memories of some of the negative results of colonialism. Local people distrusted government motives, for fear of further land alienation.

Logging

Second to shifting cultivation as a cause of deforestation in Africa is logging. This activity is largely promoted by high foreign demands, due to the extremely high rates of consumption by the industrialised nations (Struhsaker 1998; Durning 1992). Added to this is the fact that tropical countries often struggle under massive debts that drain their viability and encourage them to liquidate their forest capital more quickly, in order to raise foreign exchange. Similarly, logging offers an easy means of providing access roads in rural areas, and easily wins rural community and national support. However, it has been noted that commercial tree felling has produced a notable impact on the forest ecosystem. The physical evidence of this disturbance is immediately apparent. It persists for many years in the form of logging roads, skid trails and scattered stumps (Peters 1998).

To reduce the rising problem of deforestation due to logging, many exporting countries now insist on timber companies processing wood before it is exported. This not only provides another source of employment for citizens, but also tends to 'delay' the destruction of the forests, as time is divided between forest logging and wood processing. Furthermore, these companies are often given twenty to thirty years to carry out logging operations in their concessions, usually divided into plots.

The rule is that each plot is to be logged within a year, in a defined order. No company is allowed to move to the next plot within the same year, whether or not there is enough wood in that year's plot (Efansa Sunny 2003, personal communication). Also, by specifying the DBH (diameter at breast height) of every timber species that a timber company is authorised to harvest, the aim is to set some limits on logging, with a view to avoiding more serious forest damage, and encouraging forest management. Other practical measures have also been proposed to reduce the impact of logging operations. For example, companies are usually heavily taxed (Enviro-Protect 1997); and a percentage of the tax money is set aside for reforestation of the exploited area.

High taxes could control the number of companies able to operate in a country. But, as Enviro-Protect (1997) observes, the tax money is often either not well managed, or the regeneration effort is instead concentrated on the planting of exotic species that present a threat to the genetic diversity of the area. A combined effort of establishing tree plantations, improving forest management practices, and getting more value out of existing wood resources is required to curb the prevailing unsustainable logging of tropical forests, and to help developing countries meet growing demands for wood products (Postel and Heise 1988). The practice of selective logging has been espoused as a sustainable logging method. This involves selective cutting and removal of only the most desirable timber species. But, as Peters (1998) notes, this practice is also known to produce a number of ecological repercussions, although it is generally less damaging than total forest conversion. In tropical forests, crowns of many large canopy trees are lashed to those of neighbouring trees by a profusion of vines, lianas and clumbers. When selected timber trees are felled, other canopy tree species are pulled down and the whole woody mass crash through the lower canopy to cause even more damage. In the final analysis, harvesting even a small number of stems can destroy up to 55 per cent of the residual stand, and seriously damage an additional 3–6 per cent of the standing trees (Johns cited in Peters 1998). There is also the strategy of 'debt-for-nature' swaps proposed by conservationists. Here a conservation organisation purchases a given amount of debt owed by a timber exporting country at a discount. Taking advantage of the local currency exchange, the money is used to fund conservation efforts.

Harvesting Fuelwood

There is a flood of literature that has largely blamed deforestation in Africa on the harvesting of fuelwood and building materials by rural communities. Although this allegation cannot be totally dismissed, it did not, as it does not, reflect the real picture of the situation in comparative terms. Darkoh (1998) offers a comprehensive comparative analysis of the *status quo*. Based on 1989 estimates, the Office of the UN High Commission for Refugees found that roughly 11,000,000 trees were cut for shelter needed during the initial period of refugee influxes in Africa (Cardy 1994). This represents deforestation of over 12,000 hectares for that year. In addition, approximately 4,000,000 tonnes of fuelwood were consumed by refugees in Africa

in the same year. Taking a more general view, there were widespread reports of the destruction of woodlands as a result of clearing for fuelwood. However, Darkoh (1998) observes that 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 generally to be localised in the dryland areas, especially around settlement nodes. It has also been generally observed that most local people collect only dead wood of selected species to satisfy their fuelwood requirements. UNSO (1992) notes that in a purely rural setting, with dispersed settlements, fuelwood has seldom been a big problem. In line with this, Darkoh notes that, with the exception of some highly localised or highly populated rural areas, such as the Ethiopian Highlands and parts of Central Tanzania, little evidence exists to suggest that rural household fuelwood consumption is responsible for large-scale deforestation in Africa. Accordingly, mounting evidence, notably from Zambia, Kenya and Sudan, points out that it is rather urban demand, usually for charcoal, that leads to the extensive cutting down of forests. It should also be noted that high charcoal production is often carried out in areas where logging operations are extensive, as locals collect waste-wood free of charge, or at low cost. Urban charcoal demands are also evidently high in Cameroon and Nigeria where some 'modern homes' additionally construct what is known locally as firewood kitchens. This is not only a strategy to reduce the cost of consuming the rather expensive commercially produced gas, but it is also necessitated by the belief that certain traditional dishes would not taste as good if they were not cooked on biomass stoves.

Several methods have been proposed to combat deforestation due to the fuelwood crisis and increasing demand. These include publicly-supported tree growing programmes, community management of natural forests, and the use of improved biomass stoves. The first two strategies constitute what FAO (2003) identifies as the two models of wood production. Ethiopia provides a historical example of a publicly initiated tree growing programme to promote the production of fuelwood (FAO 1987). In the late 1890s, the Ethiopian Emperor Menelik introduced legislation to exempt land planted with funds from taxation. Furthermore, he arranged for the distribution of eucalyptus seedlings at nominal prices. All this was a response to an extreme scarcity of wood around the then new capital of Addis Ababa. Although the programme was slow to start, by the 1920s the streets and paths of Addis Ababa were already looking like a vast continuous forest. Apart from its use as fuelwood, people found other uses for eucalyptus, such as house construction, implements and furniture. So the activity spread to other parts of Africa, mostly more sparsely forested areas. However, today the eucalyptus tree is gradually losing popularity, due to its observed water-losing rather than water-conserving capacity; however, it continues to be maintained wherever it was planted. The spread of neem trees in West Africa and the Sahel, introduced into Senegal in 1944 and into Mali in 1953, is another striking example of the successful introduction of a new tree species in the

more recent past. The eucalyptus and neem tree species are highly valued for both their rapid growth, and multi-purpose uses.

Similar to tree planting, there is increasing emphasis in the continent on what is popularly known as community forestry. Community forestry could be defined as any situation which immediately involves local people in a forestry activity, in areas which are short of wood and other forest products, through the growing of trees at farm level to provide cash crops and other income generating products, large-scale industrial forestry, and any other forms of forestry which contribute to community development. On-farm community forestry has taken the form of agro-forestry activities that have been widely promoted, technically and financially, by the conservation and development projects that have proliferated on the continent. Tree nurseries have been established and seedlings distributed to community members, free-of-charge or at very minimal costs. On the other hand, management of natural forest areas, in what are now popularly known as community forests, has been done with the technical assistance of governments, though often with the financial support of conservation and development projects. According to FAO, they are generally designed to use land under direct community ownership, or state land, which has been specially designated for community control. Unlike farm-based community forestry, control of which is by the individual farmers, in this situation management is either by the community as a whole, or through a community group.

Perhaps the best known community forest initiative, albeit outside of Africa, has been the Chipko Movement in the Himalayan region of Northern India. It started when a large group of people with common interests in tree resources saw that by organising themselves into a group, they could more effectively influence the political and economic forces that were improperly managing their physical environment. This movement first came to public attention in 1973, when members demonstrated against the commercial felling of trees in forests where they lived by hugging the trees to stop fellers from cutting them down.

Despite the acclaimed success of community forestry in some parts of the continent, there are many instances of less encouraging results from such programmes in other parts. For example, we have seen the obvious failures of tree-planting campaigns in Kenya and Malawi (FAO 1987). Specifically, many agro-forestry programmes have failed for the same or other reasons. One other reason is the progressive reduction in tangible benefits to farmers, especially when there is an increasing surplus of supplies, and prices are low. Another important reason for failure is related to the labour-intensive nature of the activity, vis-à-vis normal farming operations. Also, since such projects are often imposed to meet mostly long-term objectives, rather than desirable short-term community objectives, participants begin to feel sooner or later that it is merely a wasted effort on their part to continue. One popular project management recommendation today is to avoid undue introduction of new practices, but rather to build on or, at worst, fine-tune indigenous systems in order to make them culturally acceptable, socio-economically realistic and viable, and, therefore, sustainable.

According to FAO (2003), local management of natural forests is also hampered by weak and slow-changing institutions, rent capture by local elites, inconsistent laws and regulations, and a cumbersome bureaucracy. In some cases the government has refused to give full ownership and control of community forests to communities. It may seem logical to conclude that the concept of participatory forest management more appropriately describes what are generally designated as community forests by most African governments. Participatory forest management is all-encompassing. It includes different types of forestry activities that involve local communities exercising different levels of decision-making authority. Concepts such as community forestry, community-based forest management, social forestry, joint forest management, collaborative forest management, common property forest management, and participatory forestry all refer to approaches that involve local communities at various levels. The use of such a broad definition is important because it embraces the experiences from countries that differ in their approaches.

Improved biomass stoves are fast becoming popular. They are seen as an effective means of reducing fuelwood consumption due to their heat retention capacity. This type of appropriate technology has the obvious advantage, over and above using very little wood at once, of encouraging the use of what would have otherwise been wasted. Although many samples of high quality stoves are available on the market, there is the need for further research to increase their quality in terms of heat retention and smoke emission (Eyabi 2005, personal communication).

Pastoralism

Pastoralism is another cause of deforestation in Africa. It is a form of agriculture that is carried out in lands that cannot be readily cultivated to produce crops, or where it makes economic sense to generate animal products. It may involve cutting down forest areas and replacing them with pasture grasses. Nomadic pastoralism occurs in arid and semi-arid environments, which necessitates the migration of animals and herders on a regular basis from one area to another. Like shifting cultivation, nomadic pastoralism, when well managed, is ecologically balanced through the varying requirements of livestock components. This makes the agricultural system stable in a fragile environment. Grazing, however, becomes a threat to biodiversity because it not only displaces wildlife but also disrupts the composition of plant species. When the population increases, there tends to be a permanent replacement of naturally occurring biota, with lasting changes in the output, input and components of the system. This system is associated with a major reduction in species diversity, as just a few domesticated animals replace the wide range of wild species (Mannion 1995). Farmers often remove trees from grazing lands with the intention of improving grass growth by reducing competition for water and soil nutrients. But this has an adverse effect on biodiversity because of tree loss.

Land Degradation and Soil Impoverishment

Although there is a distinction between the two concepts of land degradation and soil degradation (or soil impoverishment), they both describe a decline in land or soil quality due to human activities. Darkoh (2003) defines degradation as diminution or destruction of the biological 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, of which the soil is one component. 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).

When land degradation is a result of human activities, it usually arises from a mis-match between land quality and land use (Beinroth et al. cited in Darkoh 2003), with attendant implications for land productivity. Constant exposure of a piece of land, through, for instance, forest clearance, bush burning and over-grazing, destroys the soil structure and texture, as well as the useful organisms responsible for its formation. Land and soil degradation are also due to over-cultivation, which results in the depletion of plant nutrients, as well as inappropriate or over-application of fertilizers, poor irrigation and other inappropriate land-use practices.

The processes of land degradation include water erosion, wind erosion and sedimentation; long-term destruction of vegetation, diminution of many plants and animal populations; or decreases of crop yields, salinization or sodication of soils (Darkoh (2003). Lal (1994) identifies, in broader terms, three key mechanisms that initiate land degradation: physical, chemical and biological processes. Physical processes include a decline in soil structure leading to crusting, compaction and erosion. Chemical processes include acidification, leaching, salinization, decrease in nutrient retention capacity and fertility depletion. Biological processes include reduction in biomass carbon and decline in land biodiversity. Physical soil degradation results in the deterioration of the structure of the soil, making it more compact and harder to use, due to impermeability to rain and poor drainage. The soil also develops hardpans and surface crusting (ECA 1999). Soil structure is the important property that affects all three degradational processes.

Soil degradation is more pronounced where the soil is exposed to agents of denudation and erosion. Erosion has been defined as the washing away of the topsoil, together with its valuable plant nutrients. Wind and water erosion types are extensive in many parts of Africa, with an estimated 25 per cent of the non-desert landmass prone to water erosion and 22 per cent prone to wind erosion (WMO cited in ECA 2002). Using South Africa to illustrate the gravity of erosion, water erosion alone affects 6,100,000 hectares of cultivated soil, 15 per cent of which is seriously affected, 37 per cent, moderately, and the rest slightly. Wind erosion is more severe as it claims an estimated 10,900,000 hectares of cultivated soil, 7 per cent of which is seriously affected, 29 per cent, moderately, and 64 per cent, slightly (Landcare Supplement cited in ECA 2002).

As in the case of deforestation, high population density is readily considered the root cause of soil degradation in Africa. For example, Darkok (2003) argues that increasing population pressure leads to more intensive shifting, and to a reduction in the length of the fallow period, to such a degree that the soil is no longer allowed to replenish its nutrient store; hence a decline in soil fertility. However, although increasing population density cannot be wholly dismissed, it is not the root cause of land degradation in Africa. Rather, the extent of degradation is determined by what a population does to the land (ECA 2002). For example, poor land-use practices, such as slash-and-burn agriculture, over-cropping and other farming methods, and the inappropriate use of fertilisers, have deleterious effects on soil fertility. According to the ECA, land degradation is closely linked to land tenure systems. This is evident in the fact that if a people do not own the title to the land, they have no incentive to invest in long-term improvements. Similarly, due to the question of ownership, traditional methods of managing grazing have become less effective. The consequence is that free-range grazing has led to overgrazing, especially in arid and semi-arid areas, resulting in deteriorated land cover. It could, therefore, be concluded that land degradation is a biophysical process driven by socio-economic and political causes (ECA 1999).

The picture of soil degradation in Africa is frightening. In sub-Saharan Africa, 72 per cent of arable land, and 31 per cent of pasture land, are degraded. The rate of soil loss in South Africa is estimated at 400,000,000 tonnes annually (Griffen cited in ECA 2001). An estimated 30 per cent of smallholder farmland in Zimbabwe is now totally degraded. The situation is worse in the densely populated areas of Malawi, such as the Lilongwe plains. It is estimated that 14 per cent of degraded soil results from vegetation removal, 13 per cent from over-exploitation, 49.5 per cent from overgrazing, and 24 per cent from agricultural activities (WRI cited in ECA 2002).

Land degradation was a major global issue in the twentieth century. It will remain high on the international agenda for many more decades to come. This is due to its impact on world food security and the quality of the environment (ECA 2002). When soils are subjected to severe and extreme degradation, their original biotic functions are damaged. Reclamation is, at worst, impossible and, at best, difficult or costly (FAO cited in Darko 1998). The resulting degradation of productive lands has led to declining production and intensified food insecurity (Darkoh 1998).

Several measures have been taken to address land degradation in Africa, ranging from modern to traditional methods and techniques. Modern methods, promoted by governments and NGOs, include improving farming methods and systems, with specific emphasis on agro-forestry for soil enrichment, or conservation and erosion control. Practical steps have been taken to introduce modern cultural practices, such as terracing and 'horizontal ridging' on slopes.

In the case of traditional methods, Leach and Mearns (cited in ECA 2002) have shown that in West Africa, counter to assumptions about environmental destruction, indigenous rural land users have maintained and increased environmental produc-

tivity. This has been achieved through maintaining a balance between the amount and constituents of forest and retained grassland cover, using traditional land management techniques, which respond to changing socio-economic environments.

Another striking example of traditional methods is the Machakos experience in Kenya. Tiffen et al. (1994) investigated the processes leading to the recovery of the landscape of Machakos District. It was observed that for a period of sixty years, landscape degradation had been followed by the improvement of the same landscape, despite a six-fold rise in human population. The recovery of the landscape was accompanied by and linked to marked improvements in human welfare. The improvements in physical and human environments had been achieved through a complex blend of externally generated technical innovations and economic changes. But their successful adoption has been due to indigenous initiatives. Toulmin (1995 cited in ECA 2002) also notes that the Machakos miracle was created by ordinary people adapting to livelihood opportunities, thus underscoring the importance of applying indigenous knowledge when addressing the environment.

Droughts, Desiccation and Desertification

Africa's dryland environment poses formidable problems for sustainable development. Amongst these are unpredictable and severe drought, and desiccation or aridification due to persistent drought and dryland degradation and desertification. Darkoh (1998) offers clear definitions of desertification, drought and desiccation, terms, which there is a tendency to confuse. He defines 'drought' as a naturally occurring short-term phenomenon, when precipitation is significantly below normal recorded levels. It is a dry period from which an ecosystem recovers rapidly after the rains return. Such temporary deficits in rainfall can generally be accommodated by existing ecological, technical and social strategies. 'Desiccation' or 'aridification' is defined as a longer-term deficit in rainfall, which seriously disrupts ecological and social patterns. It requires national and global responses. Recovery after desiccation is much slower, because trees may have died and vegetation may take many years to recover.

Several definitions have been advanced for desertification. The most current and widely accepted is that used by UNCED (1992). According to UNCED, desertification is 'land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities'. An important limitation is that desertification is restricted to the drylands. The definition identifies two key factors responsible for desertification: 'climatic variation' and 'human activities'. '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).

Meanwhile It is important to note that the human activities responsible for desertification are not different from those that cause land degradation. They include over-cultivation, over-grazing, poor irrigation and other land-use practices.

Desertification is effectively land degradation restricted to dryland areas. Similarly, there is an obvious correlation between drought and desiccation, and desertification. However, as Darkoh warns, it does not necessarily follow that drought and desiccation will give rise to desertification. His argument is that this is only likely to be the case when human misuse or mismanagement of the land weakens the natural environment (Darkoh 1998). Whether desertification is likely to occur or not depends on the resource management in the dryland areas. Therefore, climate variations alone, characterised by droughts and desiccation, are unlikely to result in desertification where there is proper resource management, as this should work against the natural factors.

Desertification has been mistakenly understood as shifting sand dunes, as expressed in the widely used term 'desert encroachment'. The common feature of a desert is hence understood as a large expanse of barren rock or sand, with very sparse vegetation. This misconception originates in concerns about shifting sand dunes and sand drifts, where wind erosion is particularly serious in cultivated areas in which dry farming is practised (Darkok 2003). UNCED (1992) has dispelled this misconception by stating categorically that the process of desertification is not due to shifting sand dunes, but rather 'patches of increasingly unproductive land breaking out and spreading over hundreds of square kilometers'. Desertification may take centuries. However it should be noted that once a desert has formed, it is very difficult to restore it as arable land.

According to WWF (1988), deserts are spreading over 6,000,000 hectares of land every year. This is a very serious situation, given the estimate that 73 per cent of the total drylands used for agriculture are degraded (Table I), and a third of Africa is affected by desertification. Three distinct areas of the continent are at most risk: Mediterranean Africa, the Sudano-Sahelian region and the Kalahari-Namib region in southern Africa (Darkoh 1998).

Drought, desiccation and desertification have dire consequences for the continent. Darkoh (1998) reports that the great drought in the Sudano-Sahel region in the early 1970s claimed about 250,000 lives. This was actually less severe than the drought of 1982–5, which affected the entire sub-Saharan region. Ethiopia was the worst affected, with an estimated 1,000,000 people starving to death from the combined effects of drought and civil war. Drought reduces millions of people to destitution, driving mass migration to urban areas in search of work and relief. Additional pressure is placed on basic city services such as water and sanitation, which introduces another set of problems. The agro-economic effects of drought include lower and more variable yields, reduction in acreage of cropped lands, less high-yield food 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). As would be expected, the effects of desertification are even more pronounced:

> Desertification 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 cited in Darkoh 1998:13).

> …[It] translates into a spiral of declining production, increasing poverty and diminished potential productivity. The exacerbated poverty, 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' (Darkoh (1998:15).

Ghai (1992) adds that desertification and resource-scarcity may provoke social unrest and political and armed conflict. Several governments, most notably the Haile Selassie regime of Ethiopia, have been swept from power due to the suffering and unrest associated with drought and famine. With continuing degradation and the 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

Wildlife De-population and Extinction

Wildlife de-population describes a considerable drop in the population of wildlife, due largely to the excessive exploitation of species, and the uncontrolled habitat destruction by humans. Exploitation of wildlife for commercial purposes (e.g. hunting and logging) renders the future of some wildlife species rather uncertain. It is important to note that many rural communities largely depend on the sale of game meat for income. Wilcox and Nzouango (2000) carried out hunting studies at the Banyang-Mbo Wildlife Sanctuary in southwest Cameroon. They recorded a total kill of 8,139 animals in eighteen months. This increased rate of hunting is due to a combination of high population growth, improved hunting techniques, and a high

demand for game meat. The meat is usually smoked and sold in local markets on a weekly basis. With increasing external demand, a commercial network is developing to expedite movement of this product from the rural area to the urban area, where game meat is an important source of protein (Robinson 1996).

Wildlife–human conflict is another cause of the severe declines in wildlife numbers, due to increased poaching, as communities consider shooting to be the most effective method of addressing the problem (Douglas-Hamilton 1997; Inyang 2002). This conflict may be attributed in large measure to a combination of rapid human population growth and poor land-use management strategies, such as shifting cultivation, which impose increasing demands on the land. This demand results in ever-increasing encroachment on wildlife habitats for agricultural activities, and the development of human settlements. The situation is clearly explained by Hunter (1996) who postulates that the geometry of natural habitat fragmentation, induced by agriculture, indicates that as the wildlife range contracts in the face of human expansion, the interface of potential wildlife-human contact increases. Inyang (2002) observes that even the hunting that Banyang-Mbo in Cameroon communities often employ, as a strategy for resolving conflict (resolution through the elimination of key individuals), instead perpetuates conflict, as the targeted species are forced to disperse wildly and cause more widespread problems due to increased disturbance.

The destruction of valuable wildlife habitats to make way for plantations and human settlements is a serious threat to the wildlife. A drastic drop in the population of a species may render it endangered. A species is considered endangered when it is faced with extinction or when it is in danger of becoming extinct. There is a long history of why certain species became endangered.

One way of controlling wildlife de-population is to stop the unsustainable exploitation of species, as well as the indiscriminate destruction of their habitats, through a combination of environmental education, livelihood support activities and law enforcement. Environmental education should form the greater part of the effort, and law enforcement should be a last resort, mostly effective if and when there assured continued collaboration of the target population. Reducing the consumption of endangered species through the introduction of supplementary sources of income and protein offers sustainable redress. But this approach can be deceptive, because preferences are influenced by a combination of factors that include fashion, taste, cultural values and taboos, production cost, and price differences. This approach presupposes availability to be the only economic factor that could influence such preferences. But it should be noted that these are substitution preferences, differing from one individual to another. They are often coloured or complicated by such economic variables as scarcity, elasticity of demand, elasticity of supply, and opportunity cost.

Moreover, some cultural taboos have a far greater influence on individual choices than economic factors. For example, most people from some ethnic groups in the North West Province of Cameroon still hold the firm belief that by eating snails, they would develop scabies all over their bodies, among other fearsome conditions.

No amount of persuasion, or motivation, would entice them to contravene or violate their beliefs. Unfortunately, some project-implementers may be excited about the idea of introducing snails or some other alternative livestock, having learnt about their success elsewhere.

Alternatively, some of the alternatives introduced may satisfy all the cultural factors, as well as taste, but not the economic factors. For example, the introduced livestock may eventually be found to cost more than what it was intended to outcompete, due to the high cost of production. In this case, the income level of the community members would become the determining factor. It could therefore be concluded that for new livestock to be introduced, it must be both culturally and economically acceptable. Therefore, a series of studies must be conducted before deciding what introduction would satisfy both economic and cultural factors, i.e., what has the potential to place itself high on the scale of the communities' preferences.

Extinction

As a result of continued wildlife de-population, many valuable plant and animal species are being lost. This happens mostly before their uses have been discovered, as a result of excessive exploitation of the earth's flora and fauna and the unchecked destruction of wildlife habitats. Scientists estimate that every hundred years, one species, either a plant or an animal, becomes extinct naturally. But today an astounding number of species become extinct every year, due to a wide range of unfriendly and outright destructive human activities.

Extinction is the end-result of wildlife de-population. It may be local or global. Local extinction is the loss of a species in a particular region, while global extinction describes the complete extermination of a species from the earth. Local extinctions are a common phenomenon in fragmented habitats and islands. Habitat fragmentation could be brought about through road construction and agricultural activities. The resultant fragmented blocks share similar characteristics with islands. Local extinctions in these habitat areas can be countered by re-colonisation from larger habitat blocks, in the case of habitat fragments, and from the mainland or other islands, in the case of islands. But in the case of endemic species on a remote island or habitat fragment, re-colonisation is impossible. This type of local extinction is therefore precisely equivalent to global extinction (Begon et al. 1996), which is an irreversible phenomenon. Normally, local extinction could be addressed through breeding and reintroduction programmes. But a solution to global extinction is yet to be discovered: there simply is no solution. The loss of a species may have great ecological, economic and cultural consequences.

Ecologically, the removal of a species, especially a keystone species, which may be a top predator or an important prey, could disrupt the ecosystems that perform a wide range of functions, from nutrient recycling to global climate moderation.

Economically, some species provide direct sources of income for local communities. Indirectly, they provide a free source of materials for food, building and medicine. Culturally, some rural communities are said to have spiritual relationships with certain species, the removal of which could mean the collapse of such links.

To prevent extinction requires banning the trade, exploitation and purchase of endangered species. Another strategy is an expanded programme of environmental education aimed at enabling the target populations to identify the problem, appreciate its magnitude, analyse its causes, identify possible solutions, distinguish between the species in question and those that are not affected, and appreciate the roles they can play in addressing the situation.

Water Pollution and Shortages

This is the contamination of seas, rivers and other water bodies with refuse, human and industrial wastes, or pesticides and fertilizers (Figure 2.11). There is also a common practice by some local communities in, notably, some parts of Cameroon and Nigeria, where people use gamalin 20 or gamalin 40 (insecticides) to kill fish in rivers. This is a serious form of water pollution, resulting in the massive destruction of aquatic life. People eating the fish may easily become sick and eventually die due to the poison. Others may suffer long-term effects, such as infertility or abnormal births.

The excessive use of the now banned pesticide known as DDT (dichlorodiphenyltrichloroethane) produced devastating effects on birds, to the point where some, the dodo for example, became extinct. The pesticide was used to launch an effective campaign against the malaria-transmitting anopheles mosquitoes. But it was later discovered to be responsible for the thinning of the birds' eggshells. Because the eggs were thinner than normal, they easily broke whenever the birds sat on them to effect incubation.

Many soils have become degraded to such an extent that farmers who can afford to do so often use fertilisers. But often, as Cunningham et al. (2003) note, many farmers over-fertilise because they are unaware of the specific nutrient content of their soils, as well as the nutrient requirements of their crops. Large amounts of phosphates and nitrates contained in the fertilisers become a major source of aquatic ecosystem pollution. These nutrients may find their way into the aquatic system and cause cultural eutrophication or enrichment, a condition, which favours 'algae bloom' (the rapid multiplication of algae). When the algae decay, they choke off oxygen and sunlight required by other aquatic plants and animals (French 1990), which find themselves competing for the fast reducing dissolved oxygen. This phenomenon is termed biological oxygen demand (BOD). It has very serious consequences for aquatic life.

A similar, but worse, situation is when there is an oil spill, such as that which happened at Santa Babara in 1969. This may require a clean-up effort to ameliorate the situation. But the damage is already done, because when the oil spills, oxygen is

prevented from dissolving into water since it cannot even penetrate through the oil layer. Considering the fact that most living organisms cannot survive without oxygen for a very short time, this produces a very serious and unfortunate situation that can cause untold devastation of aquatic life within just a few minutes.

Farmers using pesticides wrongly is another serious source of water pollution, as these chemicals are eventually washed into streams and rivers. The chemicals contain poisonous substances that not only destroy aquatic life, but may be stored in their organs, undergoing constant recycling through the food chain in a process known as bio-magnification. When these chemicals finally reach humans at the top of the chain, their levels are usually so highly concentrated that they constitute serious health and reproductive problems.

Addressing the water pollution problem, especially at a community level, requires the proper education of communities about health and other effects. Traditional injunctions have been used in some rural communities; these have proved to be successful. At a national level, there is need for intensified law enforcement to restrict the movements of harmful and commonly abused products. If many countries increased their enforcement policies, manufacturers might be forced to cease producing such products, due to the loss of markets. In other words, international laws should be strengthened, duly backed by the appropriate political will, to ensure the effectiveness of the international convention; the objectives of which are to fight against the trade in such products, and the discharge of toxic wastes.

The problem is so serious that water, once a freely available common access resource, has become scarce. It is difficult to access, and is often an expensive commodity in many countries (ECA 2002). Although water scarcity is defined more in terms of its physical unavailability, more accurately, water is available, but is polluted, and therefore scarce because it is not safe for drinking. Other factors that cause water scarcity are natural: such as a prolonged dry season or frequent droughts; others are anthropological activities, such as catchment destruction. The problem of water scarcity is severe on the African continent, and the consequences are many. As ECA (2002) notes, lack of access to good quality water has far-reaching impacts on the social, economic and environmental security of African communities, with the most seriously affected being the poor.

In rural Africa, about 65 per cent of the population do not have access to an adequate water supply. Water demand in the SADC region is projected to rise by at least 3 per cent annually until 2020, in line with population growth projections (ECA 2002). Consequently, it is estimated that by 2025, up to 16 per cent of Africa's population will be living in countries facing water scarcity, and 32 per cent will live in water-stressed countries (WWF 2000 cited in ECA 2002).

With the increasing demand for water, water-poor countries are looking to cross-border sources for future supplies. In most cases, such countries try their best to store large quantities of water in dams, thus altering and reducing the natural flows of rivers. The dams themselves do not provide any guarantee of water security for the host countries, as their future depends largely on land-use patterns in the neigh-

bouring countries. For instance, soil erosion in the river catchments, due to activities of neighbouring countries, will cause siltation, thereby reducing water quality and the viability of dams. Thus, a dam is affected 'upstream' by a neighbour, which in turn, causes impacts on a 'downstream' neighbour (ECA 2002). In a number of African countries, as an alternative to dam building projects, efforts to address the problem of water scarcity, largely by local NGOs, have concentrated on the development of bore-holes and wells in rural communities, with the financial assistance of international NGOs, and foreign embassies. Although there are many success stories, such initiatives do not in themselves provide long-term water security for the beneficiary communities, because the sustainability of such projects depends not only on the water management potentials of communities, but also on a reduction in the degradation activities that have implications for water table levels.

Conclusion

This chapter has set out the different types of environmental problems in Africa. Although these problems are generally due to human activities, some are more closely associated with a lack of development, with poverty as the root cause; while others are linked with unsustainable economic development, with over-consumption as their root cause.

It may be summarised that environmental problems are generally due to two major factors: resource depletion and environmental pollution. Resource depletion, leaving aside other contributory factors, encompasses deforestation, land degradation, wildlife de-population and species extinction. Problems associated with environmental pollution include air, water and land pollution, global warming, acid deposition and ozone layer depletion.

Revision Questions

1. With at least three examples for each, distinguish between local and global environmental problems.
2. Name three environmental problems, analyse their causes and propose solutions.
3. Discuss some measures used to check logging activities in Africa and why it has remained one of the major causes of deforestation.
4. What factors contribute to wildlife depopulation in Africa?
5. Land degradation is at the root of hunger and starvation in some parts of Africa. Discuss the contributory factors and propose measures to ameliorate the situation.

Critical Thinking Questions

1. To what extent is shifting cultivation a major cause of deforestation in Africa?
2. Tropical rain forests are disappearing at rates that threaten the economic and ecological functions they provide. Discuss.
3. What is the correlation between deforestation and global warming?

4. Wildlife-human conflict is another cause of severe declines in wildlife numbers. Expatiate. Air pollution and acid deposition are problems associated more with industrialized nations. Why should an African worry about these problems?
5. When can the saying 'Global warming is global warning' be justified?
6. Nuclear technology is both a blessing and a curse to the world. Discuss.

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