Chapter 6

Africa and Global Environmental Problems

Introduction

In the previous chapter, there was detailed analysis of the environmental problems confronting the African continent, otherwise referred to as local and regional environmental problems in our continent. These problems, unlike the global problems we are about to discuss, have yet to receive adequate treatment for a better understanding of their impact on the African continent. Global environmental problems will not be analysed in such depth, because much has already been written on the subject. Global problems refer to widespread or global impacts, irrespective of the geographical areas of origin. Although their causes are largely linked to industrialised countries, and there is a very insignificant contribution from Africa, their impacts do not exclude this continent. Global environmental problems include air pollution, global warming and climate change, ozone layer depletion, acid deposition, nuclear waste and waste treatment.

Air Pollution

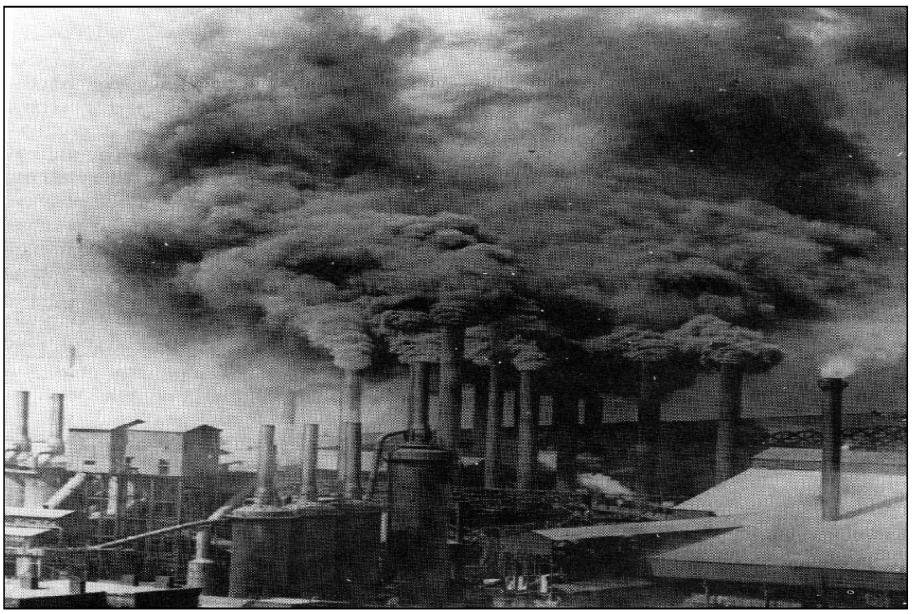
Air pollution is of very serious global concern (Figure 6.1); however at the global level, the causes are more closely linked with industrialised countries. However, it should be noted that every day, even in non-industrialised areas, the air is constantly polluted with smoke from kitchens, vehicles and industry, and through slash-and-burn agriculture, and the indiscriminate burning of refuse. The gases contained in the smoke vary with the sources, but carbon dioxide (CO_2) and carbon monoxide (CO) are the most common. Other smoke-borne substances include lead (PB), nitrogen oxide (NO_x), and sulphur dioxide (SO_2).

C O_2 is a greenhouse gas responsible for global warming, which has already been discussed. CO_2 is mainly produced by the incomplete combustion of carbon-containing fuels (coal, oil, charcoal or gas) and incineration of biomass or solid waste (Cunningham et al. 2003). Once it enters the respiratory system, it binds to haemoglobin and interferes with the transport of blood. The results are impaired perception, frequent headaches and drowsiness.

Airborne lead is derived primarily from fuel additives, metal smelters and battery manufacturing plants. But leaded petrol is by far the greatest source in the

industrialised world. Direct inhalation of lead can lead to circulatory, reproductive, nervous and kidney damage in adults. Children and foetuses are susceptible to even lower levels of lead. They can face reduced birth weight, impaired mental and neurosensory development, and learning difficulties.

Figure 6.1: 1890 Industrial Model of Smokestacks Pollutes the Atmosphere



Source: Cunningham et al. 2003.

Evaluating the cost of air pollution, as will be seen from the effects of the associated problems, is complicated. For instance, should valuation be limited to the damage of the biophysical environment? Where do the limits lie? Or should it include the secondary health, psychological, social and economic effects suffered by human communities as a result of the pollution? What values can be placed on the effects, which would honestly satisfy each and every affected individual? Must the value placed on these effects be the same as those resulting from natural disasters, or higher?

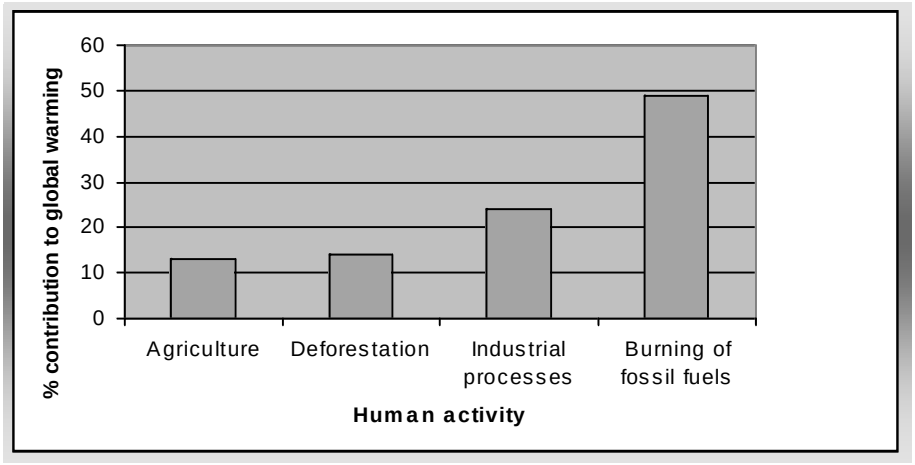
Serious steps should be taken to arrest this problem, including the education of communities in appropriate waste management methods and appropriate technologies, for example, improved local stoves. Equally, there should be strict enforcement of regulations binding signatory countries to international conventions, which stress the need for radical improvement in industrial processes, with a view to reducing the emission of air polluting substances. There is also a need to transfer cleaner technology from the developed world to the developing nations, which mostly still maintain very old models of technology (Figure 5.7).

Global Warming and Climate Change

Scientific evidence shows that the temperature of the earth is increasing at an unprecedented rate. It is estimated that the global temperature has increased by 7ÚC over the last fifty years. This increase is due to what is referred to as the 'greenhouse effect'. The greenhouse effect is the deflection back to the earth of heat trapped by some pollutants emitted into the atmosphere. These air pollutants, popularly known as greenhouse gases, include carbon dioxide, nitrous oxide, chlorofluorocarbons and methane.

These gases are released from such human activities as the burning of fossil fuels, agriculture, deforestation, and industrial processes, and they vary in their contribution to the problem (Figure 6.2).

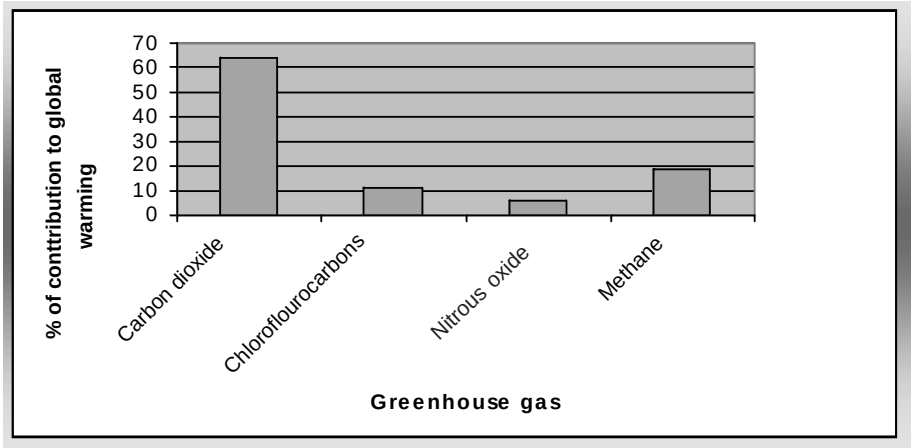
Figure 6.2: Contribution to Global Warming of Various Types of Human Activity



Source: Modified from Cunningham, et al., 2003.

Figure 6.3 shows the relative contribution to the phenomenon by human-induced release of each of the greenhouse gases. The continuous and increasing warming of the earth by these gases is contributing to human-induced climate change. As defined in the section on desertification, 'climate change' refers to the short-term climate variability and longer-term climatic trends or shifts caused by natural mechanisms or by human activity (Hulme and Kelly 1993). The climate has been changing naturally, constantly but slowly, for hundreds of millennia. As a result of the slow advance of natural processes, the planet has warmed and cooled, passing through ice ages to warm interglacial periods. These gradual transitions, often spanning thousands of years, have made it possible for life on earth to adjust relatively smoothly to each new climatic equilibrium. The results have included obvious shifts in the boundaries of ecological communities. Associated human cultures flourished, and, occasionally, disappeared during the transitions (Darkoh 1998). Today the phenomenon is accelerating due to human activities. This has disastrous effects for life on earth, as it does not allow for any smooth adjustments to new climate regimes.

Figure 6.3: Relative Contributions of Human-induced Greenhouse Gases



Source: Modified from Cunningham, et al., 2003.

According to the ECA (2002), Africa contributes very little to global climate change, with low carbon dioxide emissions from fossil fuel-use and industrial production in both absolute and per capita terms. Africa accounts for only 2–3 per cent of world's carbon dioxide emissions from energy and industrial sources, and 7 per cent, if emissions from land use (forests) are taken into account. South Africa is by far the largest emitter of carbon dioxide in Africa, responsible for about 39 per cent of the continent's total emissions. South Africa's per capita carbon dioxide emissions (1.88 tonnes) are higher than the global average of 1.13 tonnes per year year. Contrastingly, studies from the period 1990–6 found that Zimbabwe, like other forested countries of Africa, is a 'greenhouse gas sink', as the country's forests are able to absorb a higher quantity of gases than all other sectors emit (ENDA cited in ECA 2002).

Global warming, evidenced in the melting of the polar ice caps, causes an apparent increase in sea levels during the wet periods, resulting in severe flooding of low-lying areas, with the attendant destruction of human life and property. It is also characterised by high incidents of drought during the dry periods, resulting in the destruction of delicate habitats, for example, the drying up of swamps and water bodies, with the concomitant destruction of aquatic life. Droughts, cyclones, floods and bushfires have brought untold hardship to millions of people in southern Africa (ECA 2002).

"'Global warming' is described as 'global warning' by some environmentalists" since it signals catastrophes of global scale, and of serious global concern. Drastic steps must be taken to halt this; otherwise life on earth itself will be at stake. The rate of air pollution and the destruction of the ozone layer must be drastically reduced. This can be achieved mostly through strict implementation of the terms of international conventions that seek to reduce emissions of greenhouse gases, particularly from industrial activities.

Ozone Layer Depletion

Ozone is a gas high up in the atmosphere in the stratum known as the stratosphere. It protects the earth from the ultra violet (strong harmful) rays of the sun. Ozone is constantly formed and destroyed naturally through a series of chemical reactions. But the rate of destruction today is increasing, with the result that the ozone layer or shield over Antarctica is gradually being eroded (a hole was discovered over Antarctica in May 1985). This ozone shield depletion is due to the addition into the atmosphere of chemicals such as chlorofluorocarbons (CFCs), emitted from products such as aerosols, fridges and fire extinguishers.

CFCs are resistant to chemical break-down in the troposphere. Therefore they can move slowly upward into the stratosphere where they are carried by strong winds across oceans and continents (Westman 1985). At that high level, they finally find themselves in the appropriate, very cold, region, where they encounter frozen particles, with which they react chemically, releasing the chlorine atoms they contain. One atom of chlorine can destroy 100,000 molecules of ozone (Mader 1990; Baird 1999). This is possible because the chlorine atom is not involved in the chemical reaction with ozone and so does not get destroyed, but rather acts as a catalyst.

In order to reduce, or stop, the rapid destruction of the ozone layer, individuals would have to refrain from using products that contain CFCs. Also, there should be a mechanism for ensuring that manufacturers are given an incentive to use substitutes that are not dangerous to ozone. This could be either through the implementation of subsidies for substitutes to ozone depleting substances, or through stricter enforcement of the regulations of the convention that aims to cut down, and eventually ban, the use of such substances.

Acid Deposition

This phenomenon, like air pollution, is largely associated with highly industrialised regions, characterised by high levels of coal burning (Westman 1985). As a result of the increasing tide of industrial activities, large quantities of nitrogen oxide and sulphur are emitted into the air. They undergo chemical reactions and become acids as they are absorbed by the moisture. These substances finally return to the earth in the form of rain, fog or dust, causing damage to forests, buildings and other materials. They also result in the acidification of soils and aquatic ecosystems: streams, rivers and lakes. The end result is unprecedented crop failure and massive losses of aquatic life.

The only possible and visible solution to the problem of acid deposition is the stringent implementation of the laws and regulations, which have been set by the international convention aimed at abating the problem. They call for radical reforms in industrial processes to curb air pollution, enforceable with strict sanctions against violating nations. This could involve the application of the 'polluter pays' principle (PPP), which requires that the polluting nations are asked to bear the cost of the air pollution problem. It is important to note that the PPP is not only applicable and limited to pollution: it applies to all environmental problems. It is a means of

enhancing the capacity of governments to deal with environmental and development issues in a cost effective manner, promoting technological innovation, influencing consumption and production patterns, and providing an important source of funding (Panayotou cited in ECA 2002).

Nuclear Wastes

The discovery in 1942 of the use of nuclear energy by the Italian physicist, Enrico Fermi, brought in what is known as the nuclear age. Nuclear energy is produced by splitting uranium atoms. This new technology has proved important in the areas of warfare, medicine and electricity.

Many developed countries, and some developing ones, have well established nuclear plants for the production of nuclear weapons, or the generation of nuclear power, which is considered to be very cheap. However, there are strong moves to prevent any more countries from developing nuclear technology. This is not only because of the fear of proliferation of 'weapons of mass destruction', as nuclear weapons are now branded, but also because of the serious problem of nuclear waste.

Nuclear wastes are highly hazardous and causes serious health problems, such as body tissue damage, cancer, degenerative diseases, for example, cataracts, mental retardation, genetic disorders and weakened immune systems. The materials are radioactive, and can spread quickly through the environment by means of air and water. Materials from a nuclear plant can affect organisms thousands of miles away. An atmospheric nuclear bomb testing created radioactive 'fallout' that spread around the globe (Lenssen 1991).

The problem of nuclear wastes accumulation is a great concern. The waste created since the beginning of the nuclear age is yet to be effectively managed. Packaging and burying wastes deep in the earth was thought to be the best option. But it is now clear that there is no guarantee that the materials will remain permanently sealed off from the biosphere. There is evidence of leaking, which could result from tectonic crushing or chemical bursting of the containers in which the wastes are stored, as well as from the corrosive and contamination-spreading action of groundwater.

The technology of packaging wastes minimises the risks to the present generation. But its use is controversial because of the danger it poses to future generations, given that the materials remain radioactive for hundreds of thousands, or millions of years. Several other methods have been proposed, some of which have been discarded, due to their associated risks, while others are being studied. However, none of the current methods have the potential to address the problem of radioactivity of nuclear waste. So far, only the natural decay process is known to diminish it; however, unfortunately, this takes a long time (Baird 1999). This suggests that the nuclear business is risky and should not be encouraged until there is more advanced technology to address the question of waste management.

Treatment of Wastes and Pollutants

All along, we have been stressing the need for the prevention of pollution. But what if a level has been reached where prevention is no longer the only solution? How can we address situations where soils, sediments and water bodies have already been loaded with wastes or chemical pollutants? Different methods are used to address the problems of the accumulation of solid wastes and the contamination of soils and sediments by anthropogenic (man-made) chemicals.

Solid Wastes

The production of solid wastes in most big cities of the world is alarming. In some cities at least hundreds of tonnes of wastes are produced every day, from manufacturing, packaging, construction and demolition work. These are normally dumped in specific sites, where municipal council trucks go round to collect them.

Some of the wastes are disposed of as landfill, the cheapest method. We have already identified the problem associated with landfill: contamination of groundwater in the course of waste decomposition. But there are improved landfills in which the holes are lined with thick plastics to prevent the leachate (liquid that settles at the bottom of decaying materials) seeping into the groundwater. In a well organised system, landfills are not used for hazardous wastes, and are located where they have minimal impact on the environment.

Other solid wastes, particularly organic matter, are eliminated by incineration. A good incinerator is capable of reducing wastes into their simplest forms, with reduced gaseous emissions. However, the incineration of hazardous wastes is complicated, fraught with the possibilities of more serious effects. It requires more advanced technology. Baird (1999) described three types of incinerators, which have been developed to address this situation: molten salt combustion, fluidised incinerator and plasma incinerator, which make use of very high temperatures and other substances. Additionally, supercritical fluids are being employed as a more modern alternative to traditional incinerators.

Recycling is also used as a method of managing solid wastes. Four 'R's constitute the philosophy of waste management: *reduce* the amount of materials used in the manufacture of products, *reuse* the materials once they have been made into products, *recycle* the materials by fabricating them into new products, and *recover* the energy content of the materials if they cannot be reused or recycled (Baird 1999). The purpose of recycling, or more generally waste management, is to reduce the amount of waste produced and to conserve the natural resources from which products are made.

Chemical Pollutants

One of the results of pollution is the contamination of soils, including sediments, and water. Some of the pollutants are so toxic that they destroy plants, including crops, or, at best, inhibit their growth. Other pollutants are less toxic, and taken up

by the roots and become part of the food chain, where they cause health and reproductive problems. Two important technologies have been developed to remove pollutants from soils, sediments and water. These are: bioremediation and phyto-remediation. Bioremediation describes the use of micro-organisms, such as bacteria and fungi, to degrade or break down wastes and pollutants, as they utilise waste as food substances. Nitrogen-containing fertilizers are applied to the contaminated soils and sediments to stimulate the rapid growth of micro-organisms that facilitate the biodegradation process. It should, however, be noted that some pollutants and wastes are not biodegradable; these are known as recalcitrant.

Phytoremediation is the use of plants for the decontamination of soils and sediments that have been loaded with heavy metals, such as lead, or organic pollutants. This is an attractive technique, because metals are often difficult to extract using other technologies due to their low concentrations (Baird 1999). When pollutants are absorbed by plant roots, they may be incorporated into the biomass, while a small quantity are emitted into the atmosphere. Some are broken down by oxygen and enzymes are released by the roots; the enzymes of fungi and microbes are released from the plants. Once the plants have done the work of decontamination, they are harvested and burnt in time to prevent recontamination through leaf-fall.

Conclusion

This chapter has concentrated on the analysis of global environmental problems: air pollution, global warming and climate change, ozone layer depletion and acid deposition. It has highlighted their causes and impacts and proposed possible practical control measures. The chapter also touched on issues of nuclear waste, describing methods for treating not only nuclear waste, but also solid and chemical waste.

Revision Questions

1. With at least three examples of environmental problems, distinguish between the local and the global problems.
2. Name three global environmental problems, analyse their causes, and propose solutions.

Critical Thinking Questions

1. What is the correlation between deforestation and global warming?
2. Air pollution and acid deposition are problems associated more with industrialised nations. Why should an African worry about these problems?
3. Can the saying 'Global warming is global warning' be justified?
4. Nuclear technology is both a blessing and a curse to the world. Discuss.

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