AN INTEGRATED FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT AND PROTECTION IN ZAMBIA

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Dedication

For my wife Edith and our sons Wankumbu and Wankunda

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ABBREVIATIONS AND ACRONYMS

ADMADE	Administrative Design for Game Management of Zambia
AIDS	Acquired Immune Deficiency Syndrome
ATL	Action Threshold Level
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BOD	Biochemical Oxygen Demand
Cap	Chapter
CFCs	Chlorofluorocarbons
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COD	Chemical Oxygen Demand
BPEO	Best Practicable Environmental Option
DDT	Dichloro-diphenyl-trichloro-ethane
DTCD	Department of Technical Co-operation for Development, of the United Nations
EC	European Community
ECA	Economic Commission for Africa, of the United Nations
EEC	European Economic Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statements
EMS	Environmental Management Systems
ESCAP	Economic and Social Commission for Asia and the Pacific, of the United Nations
ETL	Economic Threshold Level
FAO	Food and Agricultural Organisation of the United Nations
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GIS	Geographic Information Systems
GMA	Game Management Areas
GRZ	Government of the Republic of Zambia
ha	hectare
HDI	Human Development Index
HMIP	Her Majesty's Inspectorate of Pollution
HMSO	Her Majesty's Stationery Office
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
IPC	Integrated Pollution Control

IPM	Integrated Pest Management
IRPTC	International Register of Potentially Toxic Chemicals
IUCN	International Union for Conservation of Nature and Natural Resources
km	kilometre
kg	kilograms
LAAPC	Local Authority Air Pollution Controls
LANDSAT	Land Satellite
MAFF	Ministry of Agriculture Fisheries and Food (UK)
MNC	Multi-National Corporation
mm	millimetres
NAAQS	National Ambient Air Quality Standards
NAP	Net National Product
NEC	National Environmental Council of Zambia
nd	not dated
NDP	Net Domestic Product
NEPA	National Environmental Protection Act of the US
NCS	National Conservation Strategy
NGO	Non-Governmental Organisation
NRA	National Rivers Authority
	Natural Resource Accounts
NSCA	National Society for Clean Air and Environmental Protection
OECD	Organisation for Economic Co-operation and Development
PIC	Prior Informed Consent
ppm	parts per million
PPP	Policies, Plans and/ or Programmes
SADC	Southern African Development Community
SADCC	Southern African Development Co-ordination Conference (former name)
SAPs	Structural Adjustment Programmes
SEA	Strategic Environmental Assessment
SNA	Systems of National Accounts
SOE	State of the Environment
SPOT	Systeme Probatoire d'Observation de la Terre
TOR	Terms of Reference
UK	United Kingdom
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre on Human Settlements (Habitat)
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
WCED	World Commission on Environment and Development
WCS	World Conservation Strategy
WRI	World Resources Institute
WTA	Willingness To Accept as Compensation
WTO	World Tourist Organisation
WTP	Willingness To Pay
WWF	World Wide Fund for Nature
ZNTB	Zambia National Tourist Bureau

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DECLARATIONS

I declare that the study presented in this Thesis is the result of my own investigations and that this work has under no circumstances been submitted in candidature for any other degree.

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ABSTRACT

This study identifies the major environmental issues and problems affecting Zambia and examines the current state and practice of environmental protection and management. A review of the existing legislation relating to environmental protection in Zambia is made.

The relationship between the development process and the environment is explored, in particular giving an overview of the evolution of paradigms in environmental management and development. An outline of the environmental trends in sub-Saharan Africa and the environmental policy in the United Kingdom and how it relates to the framework of EC environmental policy is made. With such a background key issues have been identified to be addressed when considering environmental policy in Zambia.

The mining, agricultural and tourism industries form the sectoral case studies of this study. These sectors have been selected on the basis of their dominance in Zambia's development strategy and their impact on the environment. The immense scale of the mining industry warrants its consideration; agriculture has now been given priority as the sector with the highest potential in the overall economy and; in diversifying the economy, tourism development is emerging as one of the most important sectors.

The study recognises that the absence of definite cross-sectoral guidelines for environmental resources management and a general paucity of information on the environment have been major constraints for the development of environmental protection strategies in Zambia. This has been due to insufficient institutional support for sustained research and monitoring of the environment. Therefore, the study makes general sectoral recommendations for addressing the environmental problems identified in the study.

CHAPTER ONE

INTRODUCTION

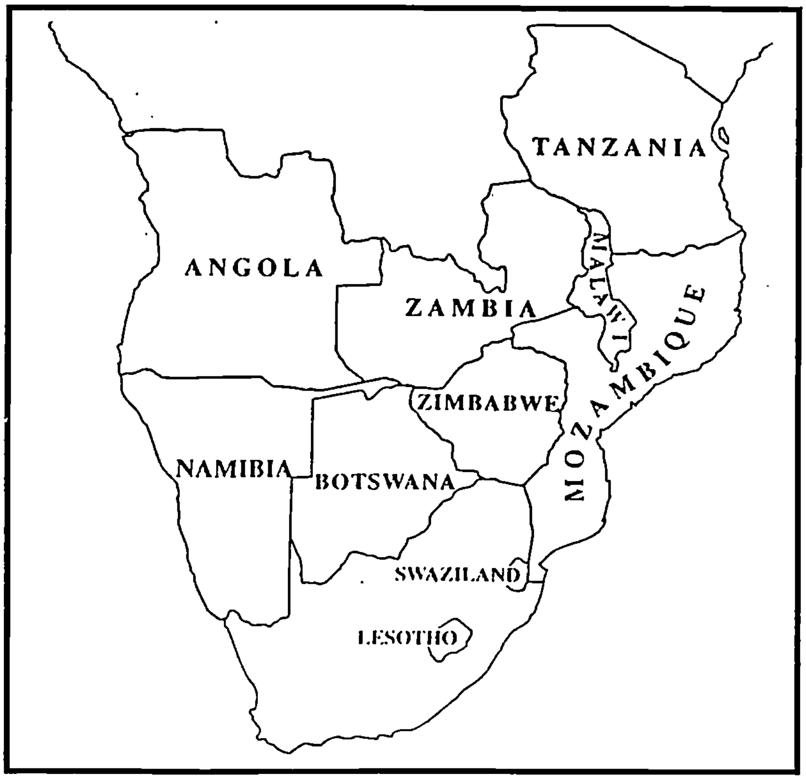
1.1 Introduction

The pressure on some resources becomes clearer when the way they are used and the way their usage interacts is considered. The sum total of population growth and consumption patterns can leave environments impoverished. In Zambia such pressures are becoming more evident. The most urgent environmental concerns include the declining quality of water in streams and rivers. The quality of air in certain localities affected by industrial emissions has been deteriorating. There is also the declining quality of urban life due to inadequate facilities for solid waste disposal and disposal of hazardous waste. This chapter serves as a preamble to my discussion of environmental protection and management in Zambia. It outlines the problems, prospects of addressing these problems, and the prognosis for environmental issues.

1.1.1 Location

Zambia lies within latitudes 8° to 18° south and experiences a modified tropical climatic régime. It lies on the interior of the African high plateau and is land-locked, surrounded by eight neighbours.

Figure 1-1: Location of Zambia



Source: Moyo *et al.* (1993), The Sourthen African Environment.

1.1.2 Environmental Profile

An overview of natural resource and environmental characteristics of Zambia will help to analyse the geographical and environmental profile of the country.

Table 1-1: Natural Resource Base

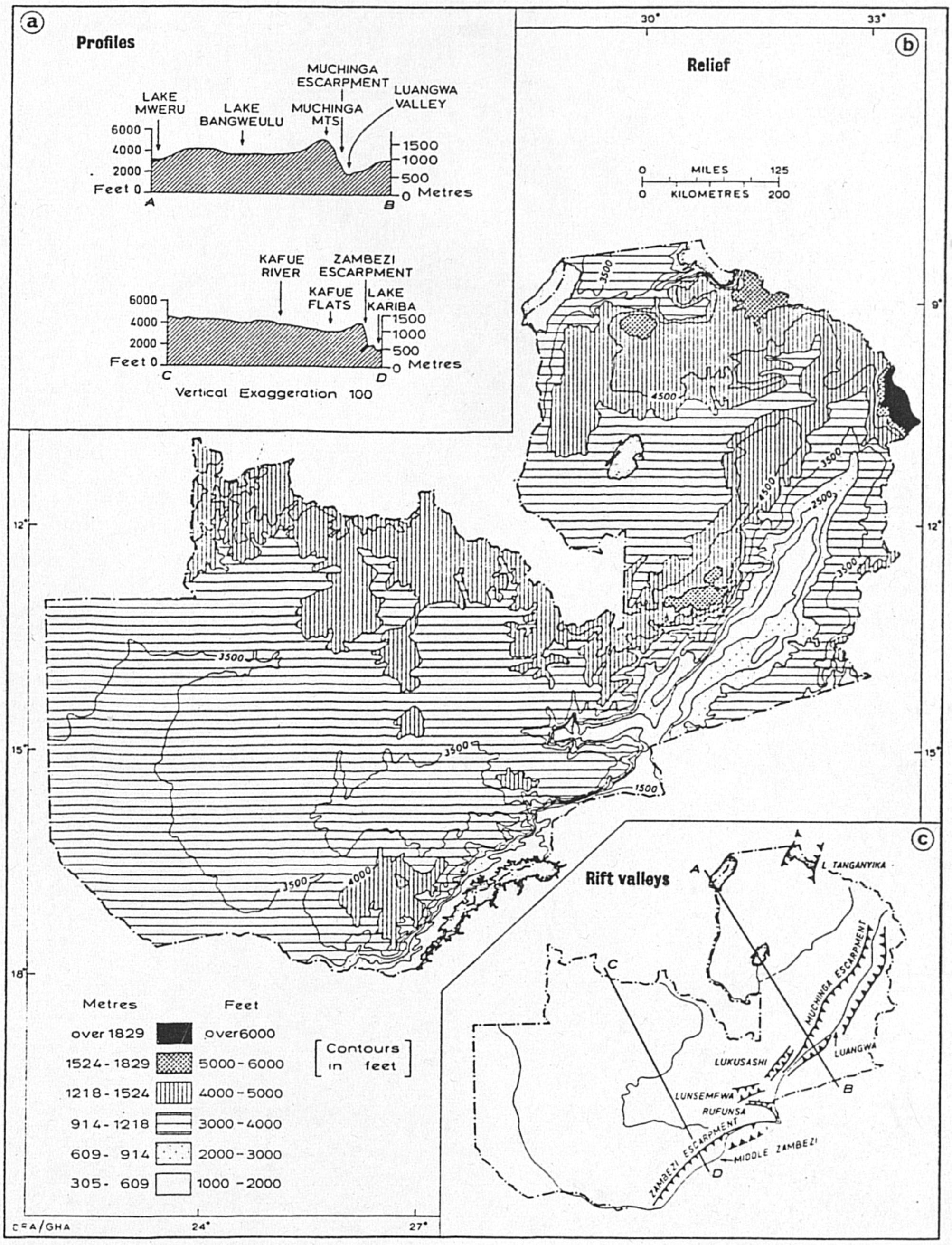
		25-30 Years Ago	15-20 Years Ago	Most Recent Estimate
Area	thousand km^2	753	753	753
Density	population per km^2	5	6	10
Agricultural land	% of land area	46.3	46.5	46.9
Agricultural density	population per km^2	10	14	22
Forests and woodland	thousand km^2	306	299	289
Deforestation rate (net)	annual %	-0.2	-0.2	-0.2
Access to safe water	% of pop.	..	42.0	58.0
Urban	"	..	86.0	76.0
Rural	"	..	16.0	41.0

Source: World Bank 1992a. Social Indicators of Development, 1991-92, p.340

1.1.3 Physical Features

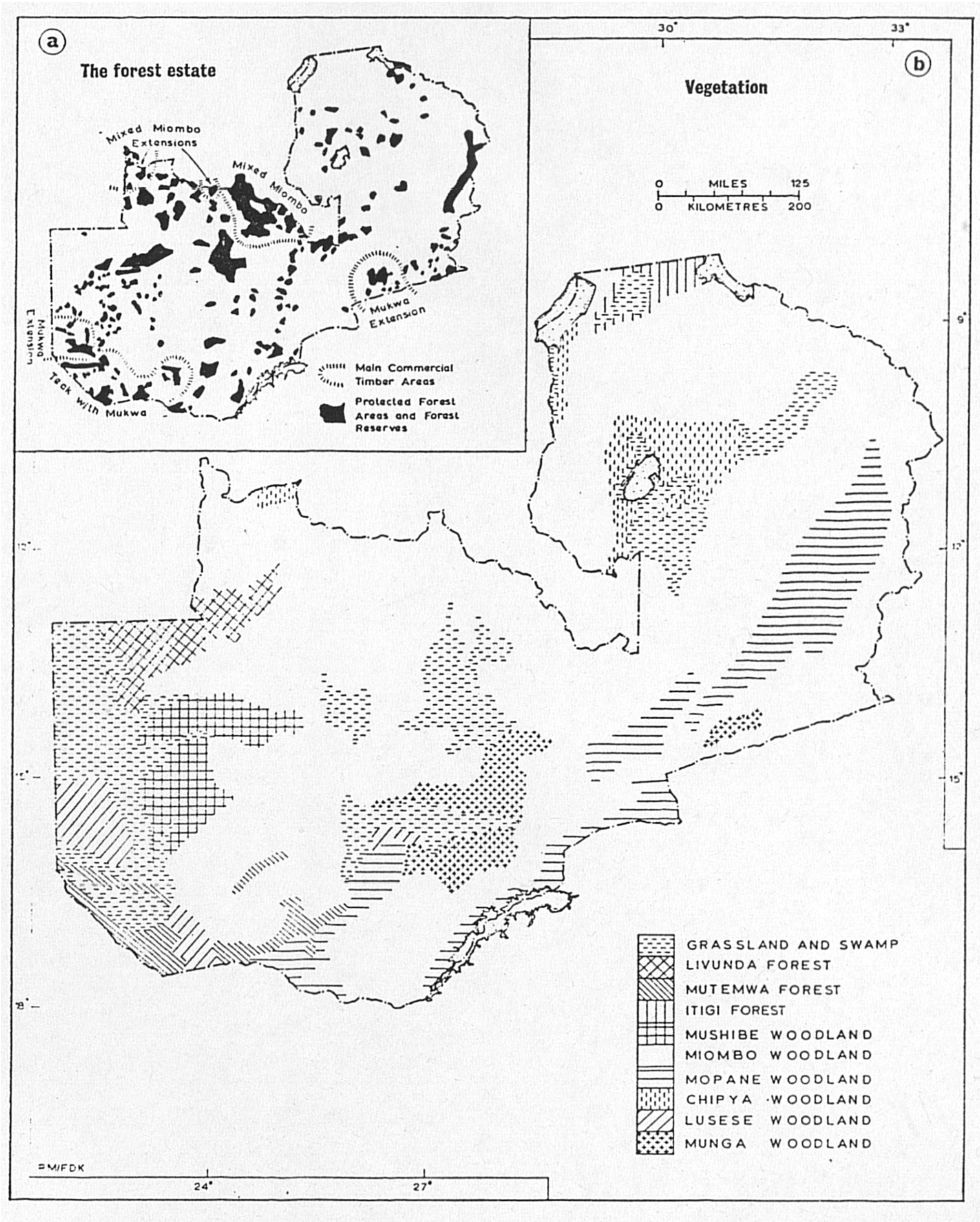
The topography of Zambia consists mainly of a series of gently undulating plains and flat plateaux (Figure 1-2). The plateaux at different levels either merge or are separated by escarpment zones. The plateaux decrease in height towards the south and south-west. Most of the Country lies between 900 and 1200 metres and the average altitude is 1200 metres above mean sea level (Archer, 1971). A wide range of environmental conditions exist in Zambia. Rainfall varies from place to place - from below 700mm in the Zambezi valley to over 1400mm in some parts of the north. This diversity is also reflected in the soils. Soil types range from the Kalahari sands in the

Figure 1-2: Zambia: Relief Features



Source: Davies, (1977). Zambia in Maps

Figure 1-3: Zambia: Types of Vegetation



Source: Davies, (1977). Zambia in Maps

west and extensive areas of poor shallow lithosol, to small areas of fersiallitic clay loam such as upper valley soils around the Mazabuka District (Veldkamp et al., 1990).

1.1.4 Natural Vegetation Cover

In Zambia the vegetation cover ranges from grassland to woodland and forest (Figure 1-3 and Table 1-2).

Table 1-2: Zambia: Types of Vegetation

Vegetation Type		Coverage (Km^2)
Forest		
	Parinari	420
	Marquesia	430
	Lake Basin Chipya	16150
	Cryptosepalum	17640
	Kalahari Chipya	1420
	Baikiaea/Thicket	8430
	Itigi	1550
	Montane	40
	Swamp	1530
	Riparian	920
Woodland		
	Miombo	352280
	Kalahari	97610
	Mopane	47520
	Munga	37270
Termitaria	27730	
Grassland	130160	
Vegetated Land	742100	
Open Water	10500	
TOTAL	752600	

Source: GRZ, 1990 National Soil Conservation and Agro-Forestry Needs Assessment, Department of Agriculture, Lusaka

The savanna woodland is the main type, covering about 71% of the country. The natural vegetation cover provides water catchment properties, helps build soil fertility and prevents soil erosion.

1.1.5 Population policy

Population policy is, and has always been, a contentious issue. This was evident at the third decennial United Nations International Conference on Population and Development (ICPD) held in Cairo in September 1994. This conference succeeded in both shifting concern about world demographics into a gender-sensitive, people-centred approach of sustainable human development and launching ideologically charged population issues into the public domain. The international consensus in Cairo was summarised in a World Programme of Action (WPOA). At this forum women were engaged in the population debate to redress gross abuses and failings they see in population policies and programs. Among these are overemphasis on demographic goals at the expense of individual welfare, bureaucratic approaches to family planning that fail to address women's broader health needs, coercive practices, and no choice of contraceptive methods or over-reliance on nonreversible methods (Chen *et al.*, 1994).

Corral (1994) questions the ideology of population control - beliefs and practices that identify rapid population growth as one, if not the, principal cause of poverty, economic underdevelopment and environmental degradation. Until now population control methods have targeted women's fertility to reduce birth rates as fast and cheaply as possible (Peñon de Cotter, 1994; Spivak, 1994). Contraceptives and sterilization have proved to be weapons rather than tools of reproductive choice. Spivak (1994) accedes that what is required is empowerment of women. Chen *et al.* (1994) define empowerment of women as improving the status of women and achieving gender equity through education and economic opportunities, thereby allowing women to exercise control over their reproductive and productive lives. "Reproductive rights" are perceived in terms of power and resources that enable individuals and couples to make informed and safe decisions about their reproductive health.

Emerging from the "empowerment" debate is a new population policy. Policy that focuses not on controlling numbers but on providing broadly defined reproductive health services and on acknowledging women's reproductive rights. While the WPOA acknowledges the problem of numbers in the South, it also highlights unsustainable production and consumption in the North with regard to environmental effects. This is a clear departure from the Malthusian language, characteristic of the previous population documents from the 1974 Bucharest and 1984 Mexico City conferences (Sen, 1994).

Zambia's population growth rate of 3.2% per annum is among the highest rates in the world. High population rates have negative impacts on the provision of social services. In recognition of the effects of recent demographics a national population policy has been adopted to complement other development policies (GRZ, 1994b). The objective of the policy is to help improve the quality of life of all Zambians. Its components include measures for reducing the rate of population growth; integration of population factors in the country's policies and programmes; provision of information and contraceptives to ensure that couples make informed decisions about family size; and providing maternal and child health services to help reduce infant, child and maternal mortality. There is no doubt that the

Table 1-3: Zambia: Demographic Profile

		25-30 years ago	15-20 years ago	Most Recent Estimate
Size, growth, structure of population				
Total population (mre[1]=1990)	millions	3.61	4.85	8.11
14 and under	% of population	45.6	46.5	49.3
15-64	"	52.0	50.9	48.5
Age dependency ratio	unit	0.92	0.97	1.06
Percentage in urban areas	% of population	23.3	34.8	49.9
Females per 100 males				
Urban	number	-[2]	94	-
Rural	"	113	-	
Population growth rate	annual %	2.8	3.0	3.7
Urban	"	8.2	5.7	5.3
Urban/rural growth differential	difference	6.9	4.1	3.5
Projected population: Year 2000	millions	-	-	11.0
Stationary population	"	-	-	41.56
Determinants of population growth				
Fertility				
Crude birth rate	per thousand population	49.1	49.2	48.7
Total fertility rate	births per woman	6.64	6.75	6.74
Contraceptive prevalence	% of women 15-49	-	-	
Child (0-4)/woman (15-49) ratios				
Urban	per 100 women	-	101	-
Rural	"	-	99	-
Mortality				
Crude death rate	thousand population	20.1	17.1	14.9
Infant mortality rate	per thousand live births	121	96.4	82.1
Under 5 mortality rate	"	-	-	131.2
Life expectancy at birth:				
overall	years	44.3	48.5	49.7
female	"	45.9	50.2	51.5

Source: World Bank 1992. Social Indicators of Development, 1991-92, p.340

[1] mre=most recent estimate

[2]=not available

AIDS epidemic will have serious implications for the national population policy. A review of such policy should consider its overall impact on population and the social structure.

1.2 Urbanisation and the Environment

Many developing countries are facing immense environmental challenges in their cities. Many cities in developing countries are threatened by pollution, congestion and environmental hazards resulting from unprecedented rates of urban growth and industrialisation. As urban populations swell, so do environmental problems. Cities are both engines of growth and sources of concentrated environmental problems. As the physical environment in and around cities deteriorates, the urban poor are affected the most. A large proportion of the urban population live in substandard conditions. Urban poverty is growing faster than rural poverty because of the effects of macroeconomic adjustment and inefficiencies in the urban economy (Bartone *et al.*, 1994). When subsidies are removed due to budget constraints and fiscal reforms, the poor are faced with higher prices for food, shelter and essential services. The level of economic development is an important element of environmental conditions in any city (Figure 1-4). Pollution problems change as technologies progress and as economies develop.

Figure 1-4: Economic-Environmental Typology of Cities

Urban environmental problems	**Lower-income countries (<$650/cap[3])**
Access to basic services	
• Water supply and sanitation	Low coverage and poor quality; especially for urban poor
• Drainage	Low coverage; frequent flooding
• Solid waste collection	Low coverage especially for urban poor
Pollution	
• Water pollution	Problems from inadequate sanitation and raw domestic sewage
• Air pollution	Severe problems in some cities
• Solid waste disposal	Open dumping; mixed wastes
• Hazardous waste management	Non-existent capacity
Resource losses	
• Land management	Uncontrolled land development and use; pressure from squatter settlements
Environmental hazards	
• Natural and man-made	Recurrent disasters with severe damage and loss of life

Source: Adapted from Bartone *et al.*, (1994), p. 19.

In the case of water pollution, for example, the low-income countries are still coping with rudimentary problems of organic waste loads while most developed countries - with technology to deal with such - are

[3] Income based on 1990 national GDP per capita data

concerned with the effects of low concentrations of toxic substances on water quality.

In Zambia, leading among the environmental concerns of the urban poor are health problems resulting from substandard living environmental conditions. Domestic and human wastes are not discharged properly. Mortality and morbidity from malnutrition, gastroenteric and respiratory infections such as tuberculosis are significantly higher for the urban poor. The chronic disrepair of water treatment plants, erratic supply of water treatment chemicals, unsanitary disposal of domestic refuse coupled with poor sewerage systems have resulted in cholera and dysentery outbreaks. For example, there have been three major outbreaks of cholera in the period 1992-1994, with many dead numbered among the urban poor. Zambia has the second highest number of cholera cases in Africa (GRZ, 1994a). The most important environmental problems facing Zambian cities relate to:

- access to adequate basic sanitation facilities
- pollution from industrial waste and emissions

Constraints to social service infrastructure provision include:

a) inappropriate institutional structures

b) inadequate technical personnel and logistical support

c) poor regulatory frameworks

d) lack of cross-sectoral coordination

The major industries creating environmental hazards are the manufacture of chemicals, textiles, pharmaceuticals and cement, leather tanning, food processing and petrol refining. No systematic or complete survey has been done of the sources, volumes and characteristics of industrial pollution in Zambia, although partial surveys and investigations have shown the seriousness of industrial pollution in a number of locations.

1.3 Macroeconomic Policy and Environment

Economic development and the environment are inextricably linked. There is a link between macro- and micro-economic policies on the one hand and the pattern of natural resource use on the other hand. Therefore the economic structure and policies of a country will have corresponding environmental implications.

Environmental effects are associated with the pattern of sectoral expenditure allocations at the macro level. When poor nations' resources are consumed predominately by allocations to infrastructure, defence and debt-servicing, little is left for the social sectors. This makes it difficult to slow the population growth rate, and thus could be considered to be an indirect effect of sectoral allocations on the natural resource base.

Particular economic instruments also have an effect on the natural resource use, either directly or indirectly. An example is the fertilizer subsidies in agriculture which can lead to inappropriate usage, hence soil degradation. An indirect instrument is an overvalued exchange rate, which encourages capital-intensive processes in agriculture and industry.

The third connection between economic policy and natural resource use is lack of policy. The absence of policies or programmes that include particular price/subsidy indications as well as project funding can have an impact upon natural resource use.

With development funds constrained by the priority to defence and debt-servicing, significant limitations to the Plans, upon which the attainment of equity objectives depend, can be observed.

The last two decades have seen a serious erosion of the physical and social infrastructure and an acceleration of structural imbalances in the economy. Measures to rectify the balance of payments, fiscal and infrastructural difficulties have entailed stringent sectoral and macro-economic adjustment programmes, underwritten by international donor agencies.

The complex linkages between economic policies, instruments and allocations and the degradation of the environment remain to be explored. Apart from inappropriate price and subsidy signals, natural resources have been adversely affected by allocative neglect of the social sectors. A third economic source of environmental degradation has been the lack of policies to encourage sound natural resource use and to penalize polluters.

1.4 Appraisal Of The Environmental Effects Of The Main Sectoral Policies

Currently, Zambia does not have specific policies on the environment at the sectoral level. This appears to be a serious omission. At present environmental concerns tend to be expressed implicitly or to be subsumed within specific sectoral and supporting policies.

In 1985 the Government adopted the National Conservation Strategy. The scope of the Strategy was to deal with natural resource implications of all major sectors of the economy, those in evidence now and those that may be in the short term (IUCN, 1984). There was recognition that the environmental problems and opportunities associated with mining, energy development and human settlements needed to be tackled, as well as those that follow from agricultural and forestry and wildlife management. The objectives to be pursued were:

- to ensure the sustainable use of natural resources
- to maintain the country's biological diversity and;
- to maintain life support systems including soil protection, nutrient recycling and the availability of clean air and safe water.

However, the main constraints to achieving the above include the absence of definite cross-sectoral guidelines for land and other natural resources allocation and preservation according to productive capacities. There is also inadequate co-ordination between present conservation and development efforts. The other constraints are in the areas of finance, legislation and lack of an information inventory.

1.5 Environmental Policy and Legislation

In the absence of an explicit policy framework it is difficult to manage a country's natural resources. Although the Development Plans explicitly refer to the sustainable development of the country's natural resources, some indirect inferences can be made. Nevertheless, in relation to providing explicit and comprehensive guidelines about the environment the Plans are disappointing. However, in articulating the Plans' growth strategy, some recognition of the importance of environmental issues becomes apparent.

General principles have been important in providing the framework for approaches to environmental legislation. The following are some of the most important principles which have helped shape the direction of environmental policy:

1. Polluter Pays Principle

2. Precautionary Principle

3. Proximity Principle

4. Sustainable Development

The principle of the polluter pays was first formulated in the early 1970s by the Organization for Economic Co-operation and Development. It states that:

> "*The polluter should bear the expenses of carrying out the pollution control measures decided upon by public authorities to ensure that the environment is in an acceptable state*". (Institution of Chemical Engineers, 1993a).

The ministerial declaration of the May 1990 Bergen Conference, of the UN Economic Commission for Europe promulgated the "precautionary principle". It states:

> "*Environmental measures must anticipate, prevent and attack the cause of environmental degradation. Where there are threats of serious or irreversible damage lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

The "proximity principle" seeks to affirm Principle 14 of the Rio Declaration :

"States should effectively co-operate to discourage or prevent relocation and transfer to other states of any activities and substances that cause severe environmental degradation or are found to be harmful to human health".

The publication of the Brundtland Report by the World Commission on Environment and Development in 1987, popularized the principle of Sustainable Development. It was defined as:

"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs"

1.5.1 Environmental Policy and Legislation in Zambia

The enactment of The Environmental Protection and Pollution Control Act of 1990 ushered in the country's environmental legislation. Until then no single corpus of law existed that would respond adequately to environmental issues. There were earlier specific enactments relating to the environment and administered by different ministries and government departments. These included the following:

- Natural Resources Conservation Act Cap. 315 of 1975 administered by the Department of Natural Resources restricting practices leading to natural resource degradation
- The Water Act Cap. 312 of 1964 administered by the Department of Water Affairs covering abstraction and discharge of water into natural water, rather than prescribing mandatory abatement
- The Local Administration Act Cap. 480 of 1980 through which District Councils have tried to introduce water pollution standards (but enforcement has been disappointing)
- The Forest Act Cap. 311 of 1973 administered by the Forestry Department, covering issues of forestry development in Zambia
- The National Parks and Wildlife Act Cap. 316 of 1968 administered by the Department of National Parks and Wildlife, providing for the setting aside of national parks and game management areas to conserve representative wildlife and ecological units

- The Town and Country Planning Act Cap. 475 of 1962 providing for the appointment of planning authorities and preparation, approval and revocation of development plans for the control of physical development and sub-division of land
- The Fisheries Act Cap. 314 of 1974 providing for the supervision and management of major fisheries in the country through the Fisheries Department
- The Industrial Development Act of 1974 Providing for regulation of resource extracting activities such as mining

Although these statutory provisions seem adequate to deal with the problems of the environment, their fragmentation made execution difficult.

The Environmental Act provides for the creation of the National Environmental Council (NEC) as the overall body for the co-ordination of environmentally related activities. The Act provides for the regulation of the environment through the creation of inspectorates responsible for the quality of water and air; the regulation and control of waste disposal; the regulation of the manufacture, distribution and use of pesticides and toxic substances; the regulation of noise pollution and ionizing radiation and natural resource conservation. The application of the `Polluter Pays Principle' and the `Best Practicable Technologies' is envisaged through regulations, licensing procedures and environmental impact assessments.

It is important to note, however, that with all best intentions there are various types of constraints on policy which can impede the State from effectively dealing with environmental problems. These inhibitions may lie in the form of structural, bureaucratic, legislative and political limitations. The system of land tenure is one of the long-term structural constraints, which has been operating for several decades and creates conditions and promotes practices that exacerbate the problem of ecological impoverishment. Carriere (1991) documents the experiences of landless peasant families in Latin America who are pushed to fragile, marginal lands which they cannot help but over-exploit and degrade in their search for livelihoods. Population is another structural constraint that he identifies. Greater population density in the absence of dynamic nonagricultural sectors, he postulates, implies greater pressure on all natural resources. A third constraint is the severe economic climate which has pervaded many developing countries. This has resulted in budget cuts in many agencies and those concerned with environmental protection, management and control have not been exempt. Carriere further points out that in addition to these long-term structural constraints there are also legal and institutional obstructions to sound environmental control and management. The main one is the absence of a single coordinating environmental agency with sufficient authority to co-ordinate and implement environmental policy. Tromans (1987:9-18) echoes this view when he observes that the success of an instrument of policy will to a great measure depend upon the adequacy of the legal and institutional framework within which it operates. He further observes that, in the absence of what he calls "the third leg of sound law, adequate administration and a well resourced enforcement, the whole edifice will be at best unstable and at worst ruinous". This seems to be the testimony of developing nations like Zambia.

1.6 Rationale of Study

It is now being argued that the development policies of developing countries ought to be designed to achieve sustainable development. In particular, it has been accepted that economic development policies should not only pursue socio-economic objectives, but also strive to attain environmental stability. In many developing countries environmental protection is usually undertaken on an *ad hoc* basis. The institutional framework is either lacking or insufficient to implement a proper system of environmental management. Whereas environmental issues have assumed greater importance in economic policies of industrial countries, the same can not be said of developing countries. Environmental problems are becoming more evident in many developing countries like Zambia. This is likely to worsen in the future unless steps are taken to redress the situation. It is with this view in mind that this study is being undertaken. It is intended to appraise the institutional framework of environmental protection and policies designed for achieving economic development and show how these can be harmonized in an environment of sustainability.

1.7 Scope Of The Study

This study examines the status of the Zambian environment, in particular the framework for environmental protection. The task is made extremely difficult by deficiencies in availability of data, gaps in the data and out of date data. This is one of the major limitations of the study. However, painstaking efforts have been made in obtaining current information pertaining to the environment in Zambia.

This study:

- Identifies the major environmental issues and problems affecting the country
- Examines the current state and practice of environmental protection and management
- Undertakes a review of existing legislation relating to environmental protection
- Assesses the significance of tools for environmental management systems in environmental protection

The research focuses on what may constitute ecologically sustainable development and on socially viable approaches to development planning. An analysis of the human ecology, energy utilization, sustainable agriculture and rural-urban systems is likely to produce results that reflect the general state of environmental problems in Sub-Saharan Africa.

The following points will, therefore, receive detailed discussion:

(1) The role of the environment in development planning. Attention will be directed at an assessment of principles of resource management with an emphasis on integrating ecological/physical, economic and social considerations in contemporary problems of resource management.

(2) The law and environmental protection. Environmental protection covers three aspects - legislation, monitoring and enforcement. The study seeks to analyze whether the framework for environmental protection is effective with regard to environmental protection systems, in attempting to prevent a degraded environment.

1.8 Methodology

This work is devoted to developing an overview of environmental protection, and how this is achieved in both the developed and developing countries. A review of environmental policy in the EC and the United Kingdom provides a background for a discussion of environmental policy in developing countries and the general direction of environmental policy. Sectoral case studies on mining, agriculture and tourism are used to illustrate the institutional framework for environmental protection in Zambia. The mining sector was chosen because of its dominance as a base for foreign exchange earnings. The role of agriculture and tourism will assume greater significance in the future as the economy diversifies.

The study will rely on primary documents and studies conducted in this area, especially in developing countries. The sources should allow me to:

a) construct an overview of environmental protection;
b) identify the specific content of environmental policy objectives; and
c) begin to identify the aspects of government policy which will affect the environment most directly in its pursuit of economic growth.

Sources used include:

- records of activities of government agencies such as the Environmental Council and other agencies working to promote environmental stability
- studies carried out in government documents (preparatory studies for national development; surveys of the state of the environment)
- environmental policy documents of other developing countries.

1.9 Objectives of the Study

A) to highlight the relationship between physical and socio-economic factors in environmental degradation

B) to examine the compatibility of economic development and environmental protection

C) to appraise Zambia's environmental laws and policies for legislative compliance

D) to assess the laws and policies and how they can be modified to promote sustainability in particular:

   1. address environmental needs of Zambia through environmental management systems/tools such as Environmental Impact Assessment (EIA) and Geographical Information Systems (GIS)

2. achieve an understanding of application of such tools in resource utilization and management

I anticipate that this study will provide the basis for advancing a set of conclusions about the impact of economic growth on the environment and provide the basis for government policies adopted in response to the impending crisis of the environment in many developing countries and indicate the direction of trends likely to be seen a decade from now.

CHAPTER TWO

A REVIEW OF LITERATURE ON ENVIRONMENT AND DEVELOPMENT

2.1 Introduction

In this chapter an attempt is made to explore the relationship between the development process and the environment. A review of literature is made, discussing the overview of the evolution of paradigms in environmental management and development. It considers the different environmental perspectives, the role of political economy, environmental management tools and the experiences of developing nations in the field of environmental protection. The main sections of the chapter consider the relationship between environment and development and the prevailing environmental perspectives; environmental impacts of development; the experiences of developing countries from the Stockholm Conference on the Environment to the Rio Summit and the environment management systems.

2.2 Environment And Development

The term development has been a subject of many interpretations. It implies change in favour of general human well-being. This change should involve expansion in consumption and enhancement of welfare.

In neo-classical economic terms, development is expansion in economic growth leading to an increase in production or consumption. Monolithic statistical aggregate measures such as the Gross National Product (GNP) have been applied as barometers of economies. Economic growth is, therefore, seen as the driving force of the entire mechanism of national priorities. It is this growth that generates the wealth for investment, employment, and social welfare. However, recent trends in development theory have been taking a broader perspective of what development entails. Development also connotes many processes that are non-economic in nature - social, political and cultural. This re-examination has incorporated the broader societal goals of human welfare, equity and social justice. Considerations in the development process have been advocated to be extended to the environmental sphere.

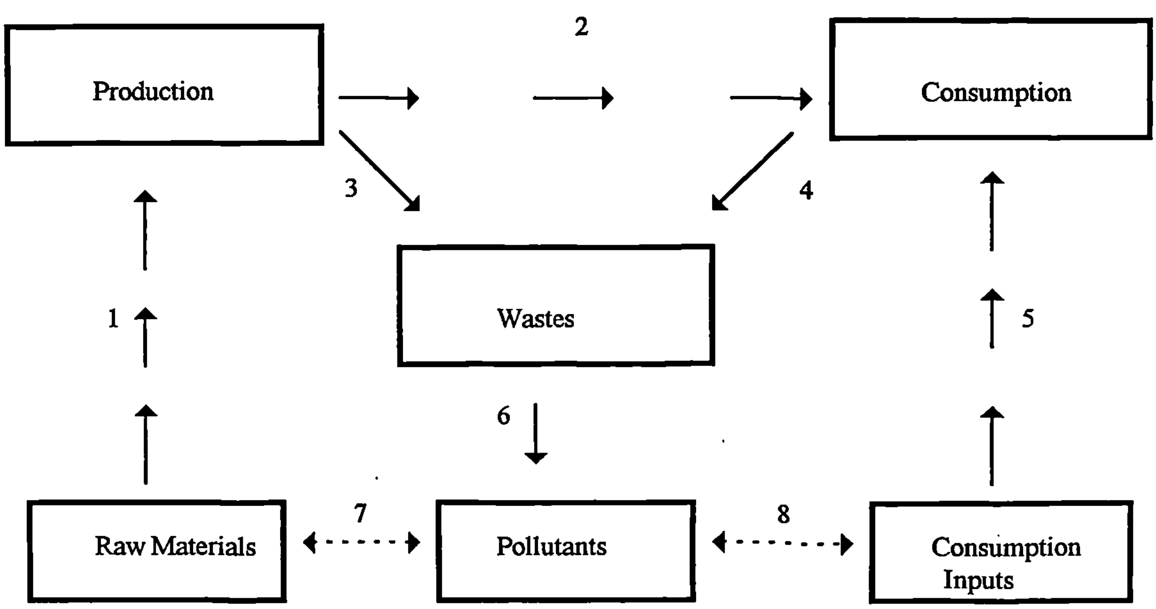
The United Nations Development Programme (UNDP) in bridging the gap left by more popular indicators has come up with the Human Development Index (HDI) as a yardstick of human progress. This progress leads to a long and healthy life for individuals, the acquisition of knowledge and access to resources needed for a decent standard of living (UNDP, 1993). It has now been realised that classical economic models of maximising production and consumption without looking at the quantity of resources available and how or whether these could be renewed has contributed to environmental deterioration. Ecology has now become one of the basic parameters of development. The protection of the environment has become a key element of the development action. There are three considerations underlying the importance attached to the environment:

1. The requirement that development should be sustainable
2. The acceptance that there is no guarantee that science and technology will prevent irreversible damage to the environment and;
3. Acceptance that economic decision-making must give thought to the effect of both the development on the environment's potential together with its long term protection.

Reviewing the question of linkages in environment and development, Myers (1993) underlines theories that economic linkages serve to reflect or reinforce environmental linkages and vice versa. Population growth is one issue most likely to be affected by synergism, as is apparent in its linkages to food, agriculture, water, energy, urbanisation, employment and a host of other sectors. The air we breathe can be saturated with pollutants from the economic system and our water which all people use for their drinking can also be contaminated. Environmental problems can undermine the aims of development. Environmental quality would of necessity require that water is safe and plentiful and the air is healthy to breathe, as part of improvement in welfare that development brings. If the benefits from economic growth are offset by the costs imposed on health and quality of life by pollution, this cannot be considered development. Similarly environmental damage can undermine future productivity. Soils that are degraded, aquifers that are depleted and ecosystems that are destroyed in increasing earnings today can threaten the prospects for securing income tomorrow. (World Bank, 1992b; FAO, 1990a).

Siebert and Antal (1979) conceive of the environment as a capital good which allows for many types of uses. This capital good can regenerate itself through biological, physical and chemical processes.

Figure 2-1: The Economic System and The Environment



Source: Siebert and Antal (1979).

Depicted diagrammatically, in Figure 2-1 arrows 1 and 2 illustrate the relationship between the economic system and the environment. The economic system contains raw materials and the pollutants as well as inputs into consumption. Wastes are inescapable by-products of both production and consumption activities. The three roles of the environment in the economy are illustrated by arrows 1, 3, 4 and 5. The reproductive mechanisms in the environment are characterised by two traits. First, they can only occur within certain limits. A second feature of the environment as a capital good is that although the system can regenerate itself, humans cannot easily replace what they destroy, nor can they always correct the processes of change they have set in motion. Arrow 6 describes the relationship between wastes and pollutants as a function of diffusion and transformation. The desired standards of environmental quality must be expressed in terms of the pollutants present in the medium, or its ambient quality. Arrows 7 and 8 are referred to as the damage function. The determination of this damage function is the decisive pre-condition for the formulation of economic policy measures. The conservation of the environment, Siebert and Antal (1979) conclude, is therefore an objective of economic and social policy and should be placed alongside other societal goals of development. Economy and Ecology, they surmise have more in common than their first three letters.

To further illustrate this relationship, Pearce and Turner (1990) show how the environment supplies input into the economy (See Figure 2-2). The last column of the matrix, representing land, water and air, act as receiving media for the waste products that flow from the economy. The environment, therefore, acts as input and receiver of waste.

Figure 2-2: Input-Output Table With Economic and Environmental Commodities

	Commodities	Industries	Demand	Final Total	Waste Discharge
Commodities		A	D	F	N
Industries	B			G	O
Primary Input		C	E	H	
Totals	K	L	M	J	P
Environmental Commodities	Q	R		S	

Source: Pearce and Turner (1990)

The inputs and outputs in the last row and last column in Figure 2-2 is in physical terms i.e. tonnes of sulphur dioxide, tonnes of copper etc. Matrix ***N*** shows the amount of waste discharge as a result of final demand for commodities in box ***F***. Matrix ***O*** shows the discharge of waste products by each industry. Box ***P*** will be a vector and will show the total amount of waste discharge by the economy, classified by type of waste. Matrix ***Q*** shows the inputs of environmental commodities, how much water is used, how much land is used and so on. Matrix ***R*** shows the inputs of environmental commodities to industrial and final demand. Pearce and Turner (1990) conclude that the basic aim of the figure is to show that economy and environment are linked in various ways and that in principle it is possible to model these linkages and extend it to the environment.

2.3 Environmental Perspectives

There are two perspectives reflecting Mankind's attitude to the natural environment. These have been labelled as the *ecocentric* mode and the *anthropocentric* mode (also referred to as *Technocentric*) (O'Riordan, 1981; Pearce and Turner 1990). Ecocentrism advocates virtues of responsibility and care in resource use. It seeks permanence and stability based upon ecological principles of diversity and homeostasis. The Technocentric ideology, presumes that Man is supremely able to understand and manage nature. These ideologies have been discussed in great details in environmental literature (O'Riordan 1981; Pepper 1986; Pearce and Turner 1990; Merchant, 1992)). The interpretations of the ecocentric perspective is evident in *Bioethics*, a reasoning seeking to protect the integrity of natural ecosystems, not merely for the pleasure of man but as a biotic right. This is a view adopted by "deep ecology", which criticises "anthropocentrism", the idea that human beings are masters of the world. Central to this philosophy is a view that humans are just one species among many others, therefore they have no right to dominate or destroy the environment. This has been extended to the discipline of economics with the emergence of environmental economics. Pearce and Turner (1990) assert that in environmental literature there are three basic value relationships underlying the policy and ethics adopted in society. These values are expressed through individual preferences; public preference value which finds expression through social norms; and functional physical ecosystems value. They maintain that ecocentric ideologies seek to base policy on social norms that individuals accept as members of the community and that are operationalised through `social' legislation. Deep ecology advocates, they conclude, place primary emphasis on a distinction between instrumental value and intrinsic value. This is non-preference value laying particular stress on the argument that functions and potentials of ecosystems themselves are a rich resource of intrinsic value. With the emergence of environmental economics, attempts to place economic value have been made by introducing theory of discounting, utilising specially weighted interest rates to reflect the uniqueness and irreplacebility of natural areas (Krutilla, 1973; Krutilla and Fisher, 1975).

2.4 Development In Perspective

2.4.1 From Stockholm To Rio: The Experiences Of Third World Countries

The publication of *Limits to Growth* in 1972 reinforced fears of growth trends in world population, industrialisation, pollution, food production and resource depletion. It urged a change in growth trends and establishing conditions for ecological stability that would be sustainable far into the future. The physical and biological limits identified included cultivable land, non-renewable resources and the ability of the Earth to absorb pollution (Meadows *et al.,* 1972). The decade following the Stockholm Conference in 1972 focused increasing attention to the growing threat to the environment in developing countries. "Only One Earth" was the slogan that launched the United Nations Conference on the Human Environment. It noted the need for change in the human attitudes, especially, about over-population if Man was to survive. It was also observed that poverty in the developing countries was as much an element in the environmental equation as pollution or the depletion of resources. It was at this forum that it was acknowledged that whereas in the industrialised countries environmental problems were generally related to industrialization and technological development, in developing countries most of the environmental problems were caused by under-development. Therefore, developing countries were urged to direct their efforts to development, bearing in mind their priorities and the need to safeguard and improve the environment. The natural growth of population was identified as presenting problems on the preservation of the environment, and adequate policies and measures should be adopted to solve these problems. To this end industrialized countries were implored to make efforts to reduce the gap between themselves and the developing countries. This was expressed in Principle 12 which stated thus: "*Resources should be made available to preserve and improve the environment, taking into account the circumstances and particular requirements of developing countries and any costs which emanate from their incorporating environmental safeguards into their development planning...*" (United Nations, 1972).

Reviewing the events of the 1972 Conference, Stone (1973) poignantly asks, *"Did We Save the Earth at Stockholm?"* His conclusion was that, *"We"* took the first step. Yet during the Stockholm Conference and for a number of years afterwards, developing countries needed persuasion that long term and sustainable development could only be achieved through sound environmental management. To them concernS for environmental policies were considered as unaffordable non-essentials (Ahmad and Sammy, 1984: Pearce and Turner, 1990).

The 1980s brought environmental problems to the fore. Ahmad and Sammy (1984) and Timberlake (1988), suggest that such persuasion is no longer necessary. They catalogue a number of major ecological disasters such as: the Sudano-Sahelian drought and famine across the African continent; deteriorating soils in Southeast Asia, loss of forests in Latin America; and visible results of ill-considered and short-term development activities which destroy the ecological balance of regions. They conclude that all these have tended to drive home the lesson.

Environmental concern in the 1980s also became global with attention focused on acid rain, depletion of the ozone layer and the phenomenon of global warming. In 1987 this culminated in the publication of *Our Common Future* by the World Commission on the Environment and Development (WCED). Some of the major problems identified in this report include poverty amidst plenty and degradation of the environment. Twenty years on, the conclusions of the *Limits to Growth* have been rewritten in *Beyond the Limits* which suggest a comprehensive revision of policies and practices that perpetuate growth in material consumption and population. The transition to a sustainable society is seen when there is a balance between long-term and short-term goals and emphasis on sufficiency, equity and quality of life rather than quantity of output. The authors conclude that the important limits to growth are limits to throughput - to the flows of energy and materials that keep society functioning (Meadows et al., 1992).

Faced with serious threats at global level, the international community in 1992, two decades after the Stockholm Conference, met in Rio de Janeiro to address current environmental issues. Environmental problems in developing countries featured prominently at this forum. The environmental crisis in the developing world is often looked upon as a policy problem. However, some critics of this view contend that causes of the environmental crisis are structural, deeply embedded in social institutions and economic relationships. Therefore any treatment of the environmental problems, other than a political one would be less credible (Redclift, 1984). Putting resources in a global perspective, environmental problems may be seen to stem from the structure of demand in the affluent countries of the North and their relationship with the underdeveloped world. Redclift (1984) notes that economic relations between the North and South contribute to environmental problems in the following ways:

a) each individual in the affluent societies of the developed world makes larger demand on the world's resources than individuals in the less developed countries.
b) the resource and environmental pressures felt in the least developed South are linked to the high living standards in the North.

In the developing countries, people living below the breadline have increased in terms of absolute numbers. Four-fifths of these live in the rural areas and are heavily dependent on natural resources. Ecological dysfunction is often rooted in demographic pressure, although cause-effect relationship is not as automatic as it appears. There is no doubt that for some people getting poorer has something to do with fast population growth and environmental degradation. The environmental crisis in the developing world is often looked upon as a policy problem. However, some critics of this view contend that the causes of the environmental crisis are structural, deeply embedded in social institutions and economic relationships (Redclift, 1984). In Africa at least, there is an inclination to see a causal relation between greater population growth, a deteriorating ecological environment and a decline in per capita agricultural production (World Bank, 1992b; EEC, 1992). However, an alternative hypothesis which needs consideration is that demographic pressure is a problem because there are more basic issues which have not been addressed. It is evident that socio-spatial disparities have been seriously affected by demographic pressures as people move from areas of economic stagnation (usually the rural poor) to the cities. Energy utilization has become a source of concern in developing countries. Many developing countries have a substantial reliance on wood biomass for fuel. The poorest countries tend to have the

highest reliance on it. The sources are not sustained and have a major direct impact on the population.
In the developing countries rural areas are dedicated to agricultural production. Goodman and Redclift (1991) list a long litany of "unsustainable" development practices within the confines of agricultural development in Latin America.

In Latin America, as in Africa, environmental problems are development problems. Rural poverty in Africa is either explained in terms of socio-economic factors or looked upon as an outcome of impoverished natural resources. Real incomes of peasant farmers are falling in relative terms. To compensate for such loss they have recourse to the natural environment. The process of environmental degradation is accelerated as a consequence. More land in semi-arid areas is brought into arable cultivation and is then seriously over-grazed. Soil erosion and deforestation are the inevitable consequences of poverty among such producers. Therefore, human poverty then makes the physical environments poorer, just as poor physical environments make for greater human poverty (Redclift, 1984). Removing structural constraints on the activities of the poor lies in the political and economic support for such groups. Thus, environmental objectives have to consider the political and redistributive aspects of resources.

If the post-Rio landscape is to accomplish anything, it should be dominated by the will to achieve real change. This will call for global partnership to address the environmental problems besetting many nations of the developing world. Yet this cannot be achieved if environmental problems are seen as separate from the economic malaise afflicting these countries.

2.5 Sustainable Development - Exploring The Concept

The production of the World Conservation Strategy (WCS) in 1980 by the International Union for the Conservation of Nature (IUCN) , the World Wildlife Fund (WWF) and the United Nations Environment Programme (UNEP) ushered in a new development philosophy, that of sustainable development . The World Conservation Strategy's (WCS) objectives of conservation were:

- to maintain essential ecological processes and life-support systems;
- to preserve genetic diversity; and

- to ensure the sustainable utilisation of species and ecosystems.

The separation of conservation from development, together with narrow sectoral approaches to resource management was identified as the root of current resource problems. It called for a cross-sectoral and interdisciplinary approach. Other obstacles to conservation acknowledged included the lack of capacity to conserve, due to inadequate legislation and lack of enforcement; poor organisation; lack of trained manpower; and a lack of basic information on priorities, on the productive and regenerative capacities of living resources, and on the trade-offs between one management and another (IUCN/UNEP/WWF, 1980).

The concept of sustainable development, like many in social sciences, has been open to considerable debate. As stated earlier, the World Commission on Environment and Development (WCED) which popularised the concept in *Our Common Future*, defines it as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (1987). FAO (1990a), notes that such sustainable development conserves land, water, plant and genetic resources. In doing so it is "environmentally non-degrading, technically appropriate, economically viable and socially acceptable". WCED (1987) notes that the concept provides a framework for the integration of environmental policies and development strategies. "Development" is conceived in its broadest sense as a process of economic and social change. The crucial objectives for environment and development arising from the concept include:

- reviving growth
- changing the quality of growth
- meeting the basic needs for jobs, food, energy, water and sanitation
- ensuring a sustainable level of population
- conserving and enhancing the resource base
- reorienting technology and managing risk; and
- merging environment and economics in decision-making

Pearce *et al.*,(1989) observed that the philosophy of sustainable development borrows freely from the science of environmental economics. A basic aspect of environmental economics concerns the understanding of the ways in which economies and their environments interact. This is a realization that economy is not separate from the environment in which we live.

The constant allusion to `sustainability' as a desirable objective has been considered by Redclift (1987). He observes that it has served to obscure the contradiction that `development' signifies for the environment. He contends that development needs to be redefined, "since it is impossible for accumulation to take place within the economic systems without unacceptable environmental costs". Whereas sustainable development is the objective of many perspectives on the environment, the role of the market in defining the several outcomes is rarely considered. Sustainable development is a concept which draws on two frequently opposed intellectual traditions: one concerned with the limits which nature presents to human beings, the other with the potential for human material development locked up in nature. Sustainable development, if it is not to be devoid of analytical content, means more than seeking a compromise between the natural environment and the pursuit of economic growth. It means a definition of development which recognizes that the limits of sustainability have structural as well as natural origins. The first contradiction that lies dormant within `sustainable development' then is that we cannot rely on market forces to sustain our environment. In the south the environmental objectives are rather different. The environment, especially the rural environment, is a contested domain because it is the sphere in which value is created through the application of labour to nature. Our first task is to recognize the links between environmental rationality and the political economy which has contributed to its formulation and intellectual origin. In this regard political economy being viewed as the theory in which economic, social and political power relations are considered to be central to the understanding of development processes at all levels. Adams (1990), in his critique of the concept of sustainable development, also reiterates the limitation in its failure to address political economy.

Other critics of the concept argue that it is a contradiction in terms. Woodgate (1991) argues that development as a process cannot be sustained in perpetuity in a finite world. He prefers to use the term `sustainable livelihoods', which he argues does not imply the possibility of continued development in future.

He further posits the idea of Co-evolution developed in relation to agricultural change, as a useful concept of exploring the general dynamics of nature/society relationships and the sustainability of specific livelihood strategies. In his study of the phenomenon, he argues that these relationships can only be sustained if the social agents are cognisant of the agro-ecosystem's responses to the new interaction. As this process has continued, not only have nature/society relationships become complex, but also increased in their intricacy. He notes that juxtaposing "primitive" agriculture and "modern" agriculture we observe that co-evolution from small-scale, labour-intensive, poly-cultural near subsistence interaction with the environment to large-scale, mechanised, energy intensive mono-cultural commodity production, involves social evolution. This evolution involves implement and agro-chemical industries; highly developed marketing systems and government institutions to generate and disseminate knowledge, develop new inputs, regulate markets, absorb risks, limit the distributional impacts of adjustments and control the environmental and health related externalities which result from high-external-input industrialised agriculture. He concludes that co-evolutionary theory suggests that in order for "development" policy to be successful, it should ensure that the extension of agricultural practices foreign to specific cultural settings is accompanied by appropriate knowledge and organisational structures necessary to sustain the practices and monitor and react to the environment's responses to the new technology. Alternatively new techniques are allowed to develop out of local knowledge and experience, thus being pre-adapted to existing organizational structures. Whatever definition one adopts, a significant observation has been made by Schmidheiny (1992:11), when he states that:

> "...*this is the crux of the problem of sustainable development and perhaps the main reason why there has been great acceptance of it but less concrete actions to put it into practice: many of those with the power to effect the necessary changes have the least motivation to alter the status quo that gave them that power*".

In the discourse of the concept of sustainable development it becomes apparent that poverty, environmental degradation and population growth are inextricably linked and that these problems cannot be addressed in isolation. Investing in people, which decreases poverty and population growth, "*is an urgent moral imperative and essential, in the long run, for arresting environmental degradation*" (World Bank, 1994:103). A holistic moral understanding and action in every society is required if sustainable development is to be elevated to an effective global ethic (Engel, 1990). Yet as Naess (1990:96), concludes:

> "*the victory of the notion of 'sustainable development' over the post-war notion of 'economic development', 'economic growth', and the simplistic 'development' in itself is a sign of an awakening from ecological slumber*".

2.6 Foreign Debt, Structural Adjustment and the Environment

The interrelationships between people, resources, environment and development has become a subject of international interest. Links between poverty, inequality and environmental degradation have been made in the analysis of problems experienced in the least developed areas of Africa, Asia and South America. It has become apparent that to attempt to deal with environmental problems without a broader perspective that encompasses global poverty is an exercise in futility. For poor countries their very poverty is a major cause and effect of environmental problems (Hombergh, 1993; Schmidheiny, 1992; Pearce and Turner, 1990; Redclift, 1984). In the past few decades serious environmental problems have emerged in the developing countries. Rural areas are coming under pressure from growing numbers of farmers and the landless. Cities are congested with people, vehicles and factories.

The resource gap between developing countries and rich nations is widening. Many developing countries depend on exports of natural resources, which remain a large element in their economies. Most of these countries face immense pressure, both international and domestic, to over-exploit their environmental resource base. The environmental stress evident in most developing countries is the result of growing demand for scarce resources. The crises in Africa caused by drought portray the manner in which economics and ecology can interact destructively (WCED, 1987). These problems often lie deep in government policies that neglect the requirements of poor farmers and threats posed by rising populations. Within these countries the poor and hungry will often destroy their immediate environment to survive (FAO, 1992). They will cut down forests, their livestock will overgraze grasslands and they will over-use marginal lands. These roots stretch also to a global economic system that takes more out of poor nations than it puts in. Some examples of these structural problems will be discussed in later sections of this chapter.

International debt has many repercussions for both the socio-economic prospects and environmental outlook of developing nations. Global poverty is one of the greatest threats to the sustainability of the physical environment and to human life. Most of the poor (80% in Latin America, 60% in Asia and 50% in Africa) live in the most ecologically vulnerable areas (UNDP, 1992). In some of these regions such as Africa, agricultural growth has been weak, earnings from exports and the capacity to import have declined since the 1980s (World Bank/UNDP, 1989). Compounding these conditions has been the debt build-up. Many developing nations rely heavily on loans and aid from industrialized countries for capital investment. For example countries in Africa receive over 25% of their GNP from Official Development Assistance, grants and loans (World Resources Institute/IIED, 1988). Sub-Saharan Africa's outstanding and disbursed debt increased from U$6 billion in 1970 to U$129 billion in 1987. The region's debt now equals 100% of its GNP and more than 350% of its total exports (World Bank/UNDP, 1989). The debt service obligations amounted to 45% of sub-Sahara Africa's export revenues in 1986 and can amount to U$50 billion a year debt-related transfer to industrialized countries (UNDP, 1992).

The ensuing financial crisis reflected in the debt service ratios has pushed many developing countries to the brink of collapse (Brown *et al.*, 1986). The major policy reforms, often prescribed by the International Monetary Fund (IMF) and the World Bank, have been macroeconomic programmes of Structural Adjustment. These include *inter alia* reduction in imports and government expenditure and currency devaluations. The reduction in government expenditure has often entailed removal of subsidies on consumer staples, which in turn has often resulted in poor nutrition for a broader section of the population. In some countries like Zambia this has resulted in social unrest, as was the experience in 1986.

In the last decade there has been a move to link gender, environment and development (Dankelman and Davidson, 1988; Shiva, 1989; Merchant, 1989; Engel and Engel, 1990). The designation of gender being the culturally and historically accepted concepts of femininity and masculinity, and the power relations between men and women. Schrijvers, (1993)and Hombergh (1994), affirm that gender is fundamental in understanding human interactions with the environment. She identifies three strongly interrelated factors which are important in explaining why gender, environment and development are so closely connected: the sexual division of labour, the "feminisation of poverty" and gender ideology. The sexual division of labour makes women, especially poor rural women in the South, dependent on the environment. This means women bear the heaviest burden of environmental degradation (Pietilä, 1990). The "feminisation of poverty" implies the male bias in development policies and co-operation, have caused relatively greater impoverishment among women. An important factor in all of this is the prevailing gender ideology, which defines women's subordinate position and hence allows less access to and control over resources. There is obviously need to change national and international policy in involving women in environmental management. Examples of success have been noted in the Green Belt Movement in Kenya and elsewhere (Wangari, 1988). However, as most work is done by western scholars, such efforts may be dismissed as feminist ideas brought into the environmental arena, especially with emerging labels such "ecofeminism" becoming more commonplace.

2.7 Environmental Impacts Of Development

The ways in which Man is affecting the environment are proliferating. Certain trends can be observed in human manipulation of the environment as a result of advances in technology. For example, progress has been made in agriculture through the use of fertilisers, pesticides and the selective breeding of plants and animals. The quest for cheaper sources of energy led to the increasing construction of nuclear facilities and their attendant problems. As a result problems which were local have assumed regional and global significance. Compounding the effects of rapidly increasing populations in some areas is a general increase in *per capita* consumption and their resulting environmental impact (Goudie, 1986).

The current global attention given to the phenomena of the green-house effect and ozone depletion caused by chlorofluorocarbons (CFCs), has brought to the fore the environmental impacts of development (Speth, 1990; Her Majesty's Government , 1994). In developing countries the deforestation of forests for timber, pollution by mining and refining and land degradation by cash cropping are a result of pursuing the export-led growth model. In most cases this is purely extractive, involving mining rather than the management of resources. The problems in industrialised countries are quite the opposite - they reflect the lifestyle of affluent societies. Whereas the environmental problems in developing countries are often a matter of distribution of resources and wealth, overconsumption underlies many environmental problems. The depletion of natural resources and increasing environmental toxicity are by-products of societal excess. Thus, both poverty and excessive wealth are detrimental to the environment. Problems of urban pollution exist on a large scale in developing countries which have industrialised. The most serious pollution problems arise from the disposal of wastes and by-products of industrial processes (Brown *et al.*, 1992;

Barrow, 1994). Pollution is one of the major aspects of the environmental impact of development.

2.8 Environmental Resource Management

Resource management is a process of decision making in which optimal solutions concerning the way, the timing and allocation of resources are sought within the socio-economic, political and institutional framework (Henning and Mangun, 1989; Omara-Ojungu, 1992). I shall consider two approaches to resource management, namely, ecological and economic. The former rests on the premise of an understanding of the functional components of the physical and biological environment and their relationships. The latter looks at resources in terms of their scarcity and pricing mechanism.

These two approaches will be looked at by discussing the role of Environmental Impact Assessment and Economic Valuation of resources as tools for management.

2.8.1 Environmental Impact Assessment

The important role of EIA has long been recognised in developed countries. The purpose of environmental assessments is to equip the decision-makers with guidance for making informed trade-offs among conflicting aspects of environmental quality and other societal objectives.

Environmental quality encompasses the functional and aesthetic attributes of natural systems that sustain and enrich human life (Hyman and Stiffel, 1988).

The experience in the less developed countries shows that environmental assessment procedures have promise, but have been of limited effectiveness to date. Less developed countries often face stringent constraints on budgets, available expertise, baseline data and political feasibility. These tools can be used for bringing environmental information into the planning process. Environmental assessments are not substitutes for baseline data, strengthening institutions, educating the public on environmental issues, designing incentives and disincentives for managing natural resources, enforcing or changing existing laws and monitoring actual impacts as they occur. (Biswas and Geping, 1987; Hyman and Stiffel, 1988).

2.8.2 The Function of Markets in Environmental Assessments

Natural resource accounting, can change the outlook of policy makers so that environment and development are no longer looked at as two separate domains. Assessing the monetary benefits and cost of environmental quality has been the contribution of the discipline of environmental economics. A significant amount of literature on the subject is now available (Pearce *et al.* 1990; Hyman and Stiffel, 1988; Barbier, 1988; Markandya and Perrings, 1991; Markandya and Richardson, 1992; Barde and Pearce, 1991). The main concepts of environmental economics pertinent to impact assessment are externalities, pure public goods, and material balance. Externalities are spill-over effects of someone's production or consumption that affect the well-being of other producers and consumers. (Klaassen and Opschoor, 1991; Schmidheiny, 1992). Since these effects are not directly reflected in market transactions, there can be a big difference between private and social benefits and costs of free market activities. Environmental economics deals comprehensively with the use of charges and subsidies to induce an efficient allocation of resources to pollution control. However, the production and distribution of most environmental goods and services fall outside market processes, therefore market processes for making rational decisions on their use are unavailable (World Bank, 1992b). Yet it is important to be able to market trade-offs between benefits and costs and other societal objectives. Money provides a convenient yardstick for comparing these trade-offs on a common scale. Some environmental benefits are easy to examine in a benefit-cost analysis because they directly affect production processes or consumption. For instance, pollution can precipitate large economic losses from decreased output of agricultural and livestock products. Air pollution can cause large economic losses in agricultural production. Air quality studies have largely centred on acute health impacts due to measurement problems and the difficulty of showing that ambient exposures induce chronic health impacts. Yet the economic losses from chronic health impacts may exceed those incurred from the acute health impacts.

Evaluation for scenic, cultural and historic resources that are collective goods is also difficult. The value (use value) of non-reproducible environmental amenities might increase over time because of increased scarcity and changes in preferences due to income growth and lack of close substitutes for amenity. At the same time the value of economic goods relative to environmental services might decrease over time due to technological progress. Apart from use value, option value may be relevant in valuing environmental amenities. Option value refers to benefits that people place on the availability of a resource or good even if they do not use it at present. Hypothetical valuation methodology has been developed for extra market goods and services. The purpose is to derive shadow prices to estimate the aggregate consumer surplus. Contingent Valuation (CV) is used to derive values for multidimensional environmental effects. These methods include direct questioning to establish people's maximum Willingness To Pay (WTP) for various quantities and qualities of environmental goods. Alternatively, respondents are asked about the smallest amount of money they would be Willing To Accept as compensation (WTA) for a decline in the quality or quantity of an environmental good. Generally WTA measures produce higher values than WTP because it is limited by respondents disposable incomes. Since the poor have little disposable income their WTP bids would always be relatively low. Economic evaluation often fails to account for equity and social justice. The initial distribution of income affects market prices and estimates of willingness to pay. Since the rich have greater influence on preferences revealed in the market they also have greater weight in market-based indicators of social values. Rich respondents tend to bid higher values (Stirling, 1993). Writing with the Business Council for Sustainable Development, Schmidheiny (1992) observes that, one way to internalize the environmental costs would be to alter the System of National Accounts (SNAs) to reflect the depreciation and damage of natural resources. He notes that when a forest is felled for timber, GNP includes the income earned, but no loss of future productive capacity is recorded. If countries were run like businesses, he concludes, there would be an accounting for depletion of valuable assets such as forests, oil, topsoil and water. In the developing countries, in particular, the depletion of natural resources adds to the GNP and suggests economic success, but no allowance is made for the reduction of income that will follow when the resource is exhausted. Some economists argue that the best way to improve SNAs is to subtract from GNP not only capital depreciation but also money spent repairing and protecting against environmental damage ("defensive expenditures"), a monetary equivalent for any residual of degradation remaining after defensive expenditure (such as soil erosion), and an allowance for depletion of natural capital such as forests. This would produce a "net national product" (NAP) (Repetto, 1992). Current indicators of economic performance usually fail to account for the consumption or the degradation of the non-renewable natural resources. Concurrently, the cost of their conservation and maintenance is not adequately assessed (FAO, 1992).

Attempts to obtain the Net Domestic Production (NDP) were made for Java for the period 1971-1984. The adjustments took into account the natural resource depletion in petroleum, timber and soils. The value of the GDP fell from an average annual rate of 7.1% to only 4% (FAO, 1992). Results from a study of Costa Rican natural resource accounting for the period 1970-1989, also reveal that resources were exploited beyond their capacity to recover, and their capacity to generate income was consequently diminished (Repetto, *et al.*, 1991). Perhaps developing countries whose economies are dependent on natural resources should consider an accounting framework that accounts for these assets more adequately. It is clear that the partial accounting systems employed at present to assess macro-economic performance, offer misleading signals for use of natural resource stocks and environmental services that underpin our economies.

2.8.3 Land-use Planning As A Tool of Environmental Policy

The protection of the environment from pollution and nuisance is an obvious objective of planning control. The planning functions imposing conditions for the operational aspects of the site play an important role in environmental protection. The planning system is of central importance, especially when used in conjunction with other regulatory controls (Ball and Bell, 1991). For instance the planning function can, through the application of the Best Practicable Environmental Option (BPEO), ensure that waste is disposed of in the way which causes least harm to the environment as a whole. Tromans (1987) outlines the appropriate use of BPEO policy in the following framework:

- what is economically practicable;
- what is scientifically and environmentally sound and;
- what is legally achievable within the legal powers available.

The achievement of BPEOs would seem to depend heavily on site positioning and land allocation. Bad planning can make worse the environmental consequences of a given activity and can reduce the range of options open. Good planning on the other hand can reduce, if not eliminate, adverse environmental impacts and in some cases the principle of BPEOs may prove useful in resolving a particular problem.

However, planning law has limitations. Planning involves the exercise of development control powers. Not every activity carried out on land needs planning permission. Such activities may potentially or actually give rise to environmental problems. One example is that of activities carried out under existing planning permission or existing use rights. Here the changes in the process will not be controllable unless operational development is involved or an intensification in activity sufficient to amount to material change in use has occurred. Other activities which give rise to environmental problems may be excluded from the need to obtain planning permission by the general Development Order, for example development by statutory undertakers (Telling, 1990; Heap, 1987). The major limitation is perhaps that enforcement procedures in planning law are weak (Ball and Bell, 1991). Failure to comply with a planning condition is not *per se* an offence. It becomes so only when a valid enforcement notice is served and not complied with. Where scientifically complex matters are concerned, the rigour necessary in framing an effective notice may be lacking. Goodman and Redclift (1991) comment on the experiences in physical planning controls in Latin America. They note that planning controls are easily avoided, and few environmental agencies are able to police protected areas effectively.

2.8.4 The Role of Environmental Impact Assessment

The principle of BPEO is significantly relevant to the growing emphasis on preventative and anticipatory as opposed to remedial action. In its widest sense it could be seen as a step towards comprehensive environmental planning in which the social, economic and political impact of a proposed activity are evaluated within an environmental framework. If EIA leads to the conclusion that the BPEO is discharge of waste to water, then a condition of the planning consent should be that the developer must accept the consent conditions imposed by the relevant authority and use this method of disposal.

The common sense, precautionary response to burgeoning pollution problems is to seek to prevent pollution before it happens. Where it is already occurring, the main aim should be to eliminate the source of the problem rather than attack symptoms through often expensive "end of pipe" methods such as filters, scrubbers, treatment plants, and incineration(Schmidheiny, 1992).

2.9 Environmental Management Systems

This is the organisational structures, responsibilities, practices, procedures, processes and resources for implementing environmental management. The system should be designed so that emphasis is placed on the prevention of adverse effects, rather than on detection and amelioration after occurrence. It should:

a) identify and assess the environmental effects arising from the organisation's existing or proposed activities, products, services;

b) identify and assess the environmental effects arising from incidents, accidents and potential emergency situations;

c) identify the relevant regulatory requirements;

d) enable priorities to be identified and pertinent environmental objectives and targets to be set;

e) facilitate planning, control, monitoring, auditing and review activities to ensure both that the policy is complied with, and that it remains relevant;

f) be capable of evolution to suit changing circumstances.

Many organisations have undertaken environmental 'reviews' or 'audits' to assess their environmental performance. To be effective they need to be conducted within a structured management system. Such a system enables an organisation to establish procedures to set an environmental policy and objectives, achieve compliance with them and demonstrate compliance to others. Audits assess both the effectiveness of the environmental management system and the achievement of the environmental objectives. Reviews check the continuing relevance of the environmental policy, update evaluation of environmental effects and check the efficacy of audits and follow-up action.

2.9.1 Environmental Monitoring And Auditing

The term "Environmental Auditing" has become associated with a wide range of activities in environmental protection and management. The term relates to the evaluation of performance against specified objectives.

It is aimed at facilitating management control of environmental practices; and assessing compliance with company policies which would include meeting regulatory compliance.

2.9.1.1 Objectives of Environmental Auditing

The objective of Environmental Auditing is to measure environmental performance. It measures what has been achieved and the effectiveness of the systems or management process which are or have been used to achieve it. Audits help avoid accidents, fines, legal action, jail and bad publicity.

2.9.1.2 Legal Aspects of Environmental Auditing

There is no law, existing or proposed, in Great Britain, the European Community or the USA which would require a company to have an Environmental Audit. Nevertheless, the checking of a company's activities for compliance with the legislation is one of the most important components of Environmental Auditing. In the US The Environmental Protection Agency has a policy of encouraging the use of Environmental Auditing to help achieve and maintain compliance with environmental law and regulation. Ascertaining potential liability under common law is also important. The environmental impact of all industries is increasingly subject to a rigorous regulatory regime. Failure to comply with environmental regulation may result in legal action and give rise to financial loss through fines, property damage claims, remedial action costs and personal injury claims. In certain circumstances it may even result in imprisonment of responsible personnel.

2.9.1.3 Scope of an Audit

A pro-active approach to operational problems and practical solutions, legislative fulfillment and present and future societal standards is required. This should reveal wherever possible, limitation of hazards, waste minimisation, control operations by standards and procedures, selection and training of personnel, and monitoring and review of systems and achievements. The primary concerns for legislation include:

- Atmospheric emissions
- Water protection
- Waste production
- Noise
- Hazardous substances installations

- Site decontamination and redevelopment
- Transport of materials

2.9.2 The Audit Process

Basic steps of an audit:

1. Investigate and understand the management systems.
2. Assess the internal controls.
3. Review of records, sampling and verification.
4. Data evaluation.
5. Report finding

2.10 Resource Surveys And Evaluation

2.10.1 Land Resources Inventories

Natural resources inventories and baseline surveys are necessary for the assessment of the quality and quantity of natural resources. They provide the basis for monitoring ecological processes and should include the following:

1. Identification of community zones (swamps, grasslands, forests etc.).
2. Description of natural processes and an assessment of the extent to which people affect the ecosystem.

3. Analysis of inventory data to evaluate the functional significance of the ecosystem components.
4. Recommendations of alternative uses based on the established functional significance (Omara-Ojungu, 1992).

The national assessments and long term projections of environmental resources, demographic and economic trends are very important. The explicit projections of ecological trends will facilitate the analysis of changes in the natural systems and how these will affect economic trends. However, data insufficiency, particularly data gaps, make it difficult to support analysis of environmental trends with reliable statistics (Friend and Rapport, 1991).

Remote sensing has made a huge contribution in the area of agriculture and water resources surveys. Satellite imagery has been used for the detection of groundwater depletion through irrigation (Allan, 1986). Low level aerial census and systematic reconnaissance flights have also been used for livestock and wildlife monitoring.

2.10.2 Geographic Information Systems (GIS)

The development of Geographic Information Systems (GIS) has added a new dimension to the area of resource surveys. GIS are computer-based systems that are used to store and manipulate geographic information (Aronoff, 1989). Computer-aided mapping and modelling in the monitoring and appraisal of resource use and trend projections, are becoming commonplace. Examples of application include agriculture, which is of such national and economic importance that it is usually inventoried and monitored more than other natural resources.

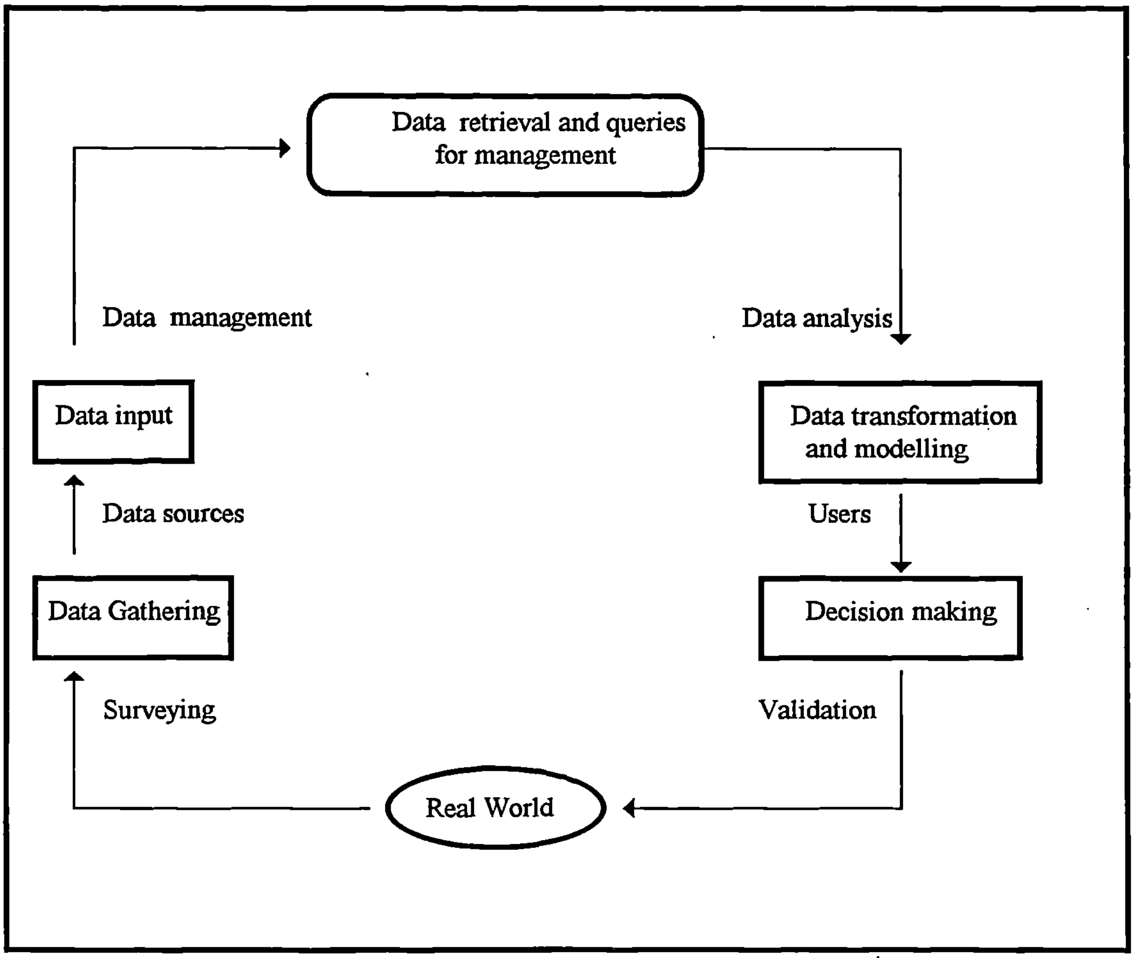
The demand for the storage, analysis and display of complex and voluminous environmental data has led, in recent years, to the use of computers for data handling and the creation of sophisticated information systems. Effective use of large spatial volumes is dependent upon the existence of efficient systems that can transform these data into useable information.

GIS's are used to assist decision makers by indicating various alternatives in development and conservation planning and modelling the potential outcomes of a series of scenarios. They provide planners with a readily accessible source of objective earth science related facts and an inexpensive, rapid and flexible tool for combining these facts with various products to create decision alternatives. Basic knowledge of the location, quantity and availability of natural resources is thus indispensable for more rational planning. Typical GIS applications include the following: cadastral mapping, geodesic mapping, land use planning and management, environmental impact studies, natural resources mapping and management, land information systems, urban and regional planning, mineral exploration etc.

The need for improved methods of resource management and environmental hazard assessment is acute in many large watersheds in Asia. Thus it is useful to prepare a scenario of actual and estimated future land use, taking into account the potential suitability of the land for a range of crops, the existing farming systems, the erosion susceptibility, availability of land and other related data.

In some developing countries, such as Indonesia, GIS has been used to produce land use models. The design principle of such a GIS was to enable interactions between biophysical simulations of crop production, on-site land degradation with related off-site effects and socio-economic considerations. Socio-economic considerations include national policies, trends in population and agricultural production. The use of simulation models (Figure 2-3) to develop different scenarios and provide alternatives to decision makers is one of the advantages of GIS.

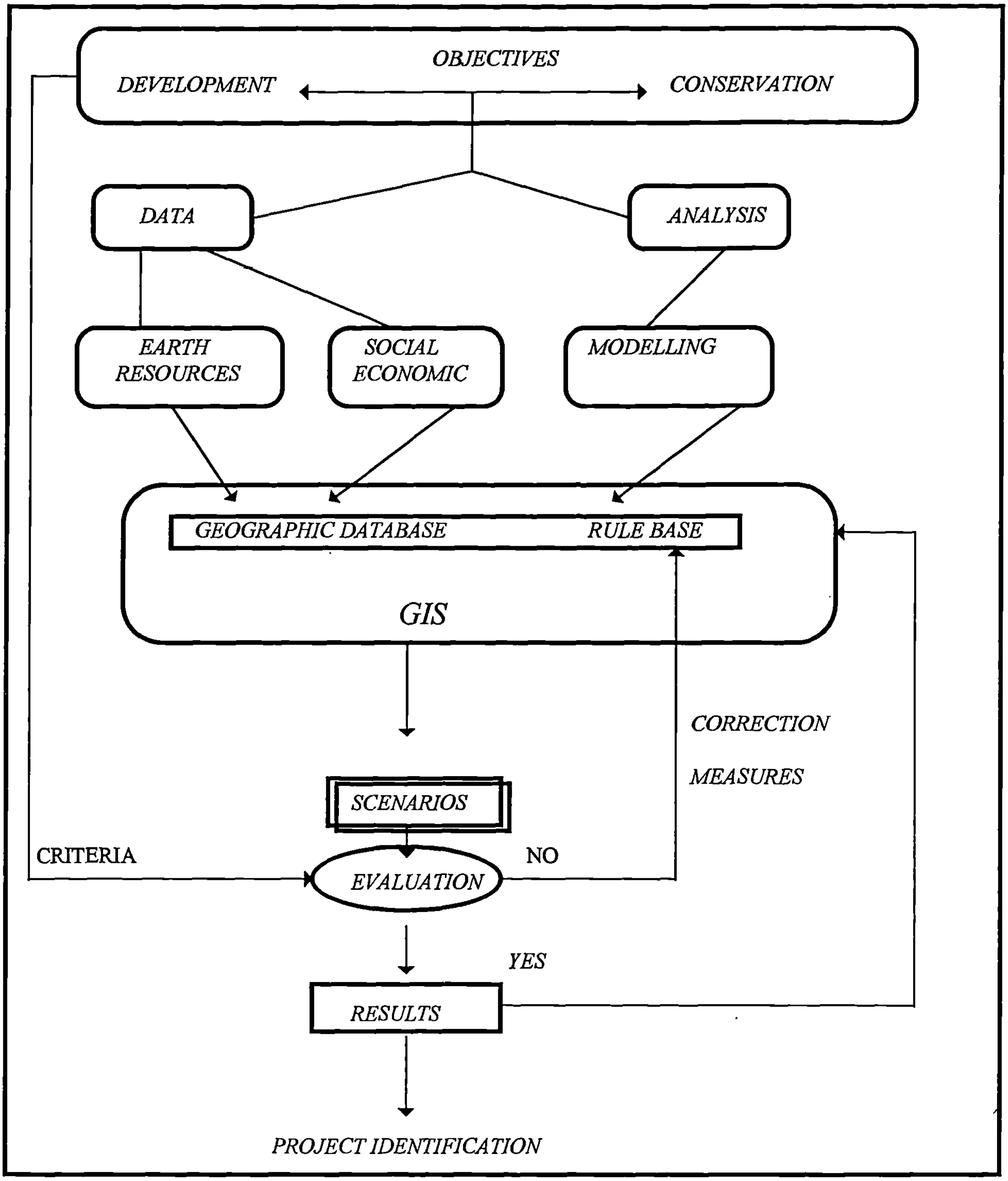
Figure 2-3: Geographic Information System as a Management Tool



Source: Nation Academy of Science (1977).

Figure 2-4 demonstrates how GIS can play an important role in project planning and identification. Development and conservation objectives can be addressed through an

Figure 2-4: The Role of Geographic Information Systems in Planning



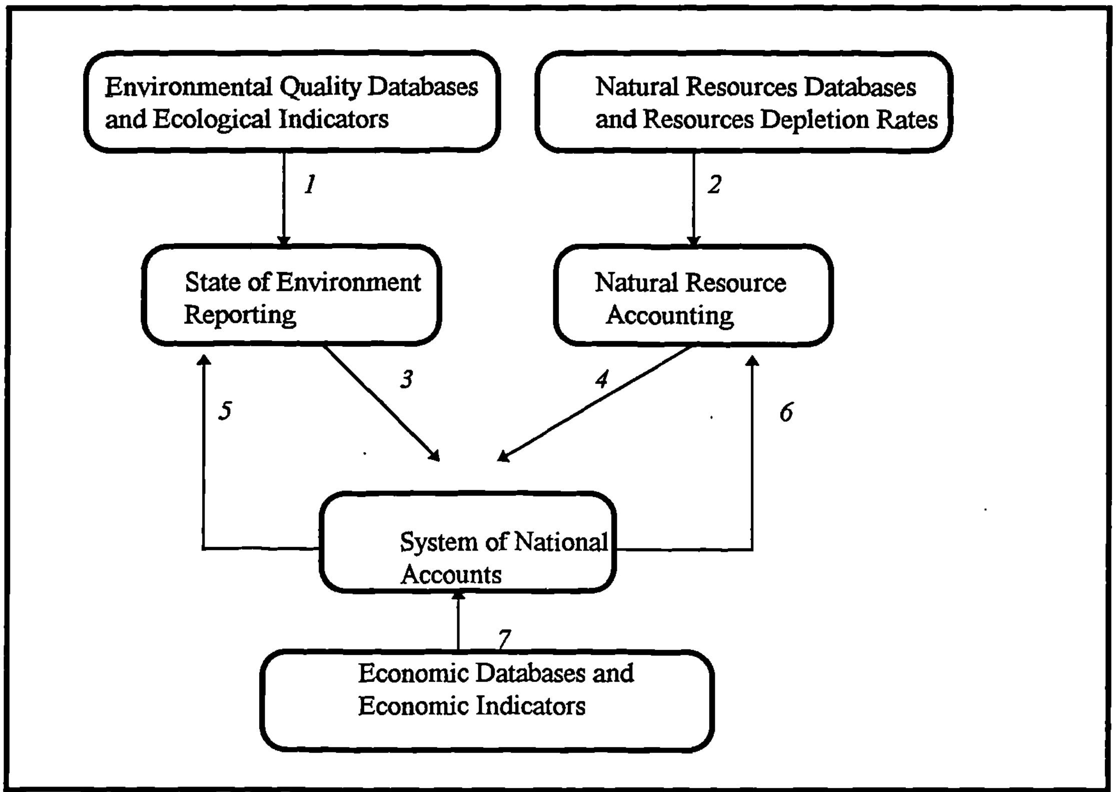
Source: Nation Academy of Science (1977)

analysis and modelling of environmental resources data to obtain different scenarios. These scenarios are then evaluated on the basis of set criteria for the final stages of result presentation and project identification.

2.10.3 State Of The Environment Reporting

The recent rise in environmental awareness has created demands for information on bio-physical data, especially in terms of linkages with environmental and economic parameters. This has become pertinent for monitoring and measuring the contribution of the environment sector to a nation's economy and national wealth. Friend and Rapport (1991), suggest a system of national statistics where the state and change of state of environment and the stock and flow of natural resources are an integral part of the general framework of social and economic statistics. Such a program can be regarded as the '*environmental arithmetick*', a measure of the state-of-the nation. The key elements of this '*arithmetick*' are Natural Resource Accounting (NRA) and State of the Environment Reporting (SOE). The latter focuses on the spatially disaggregated quality state of the environment. The information needed for this reporting should come from environmental monitoring of the changes in the state of the ecosystems and human settlements. State of the environment reporting is a response to the need for national or regional 'environmental audits'.

Figure 2-5: Macro-level Environmental Information System



Source: Friend and Rapport (1991).

The SOE Report should be based on the assessment of environmental conditions and trends by natural geographical units. This makes it imperative to integrate macro-level SOE indicators with indicators of natural economic performance. This makes environmental conditions inseparable from the assessments of economic well being. This is not just an adjustment to GDP but rather an expansion of the system of national accounts. Such broader national accounting should form the basis of sustainable development policies.

Figure 2-5 illustrates the environmental systems information, linkages between NRA, SNA and SOE Reporting. The linkage parameters include (*1*) Indicators of environmental quality and ecosystem health; (*2*) Statistics on the physical stock and flow of natural resources; (*3*) Data on the state of the environment treated in terms of 'damage costs', and/or 'enhancement' in SNA; (*4*) Data on natural resource stocks and flows treated in terms of asset accumulation and depletion in SNA; (*5*) Pollution loading statistics calculated from I/O pollution coefficients in physical quantities; (*6*) Natural resource commodity flow calculated from I/O input coefficients; (7) Expenditure on environmental protection and rehabilitation.

In developed countries attempts have been made to incorporate SOE Reporting in overall public accountability. For example, Canada's first SOE Report in 1986 employed an ecosystem perspective based on assessments of environmental conditions and trends by geographical units (Bird and Rapport, 1986). The experience in developed countries also show that environmental accounting is only in an early phase of development. This practice is not common in developing countries. Data insufficiency, and data gaps make it difficult to support any such an analysis of environmental trends with reliable statistics.

2.11 Environmental Problems, Prospects and Prognosis

The US National Environmental Policy Act (NEPA) of 1969 pioneered the work of environmental policy formulation upon which many countries have built. NEPA places environmental quality on the same priority footing as economic growth. The policy entailed:

(i) the fulfillment of responsibilities of each generation as trustee of the environment for succeeding generations

(ii) provision for all citizens of safe, healthful, productive, and aesthetically and culturally pleasing surroundings

(iii) the attainment of the widest range of beneficial uses of the environment without degradation, risk to health or safety, or any other undesirable or unintended consequences

(iv) the preservation of important historic, cultural and natural aspects of our national heritage and maintenance wherever possible, of an environment which supports diversity of individual choice

(v) the achievement of a balance between population and resource use which will permit high standards of living and a wise sharing of life's amenities; and

(vi) the enhancement of the quality of renewable resources and the maximum attainable recycling of depletable resources (US NEPA 1970 cited in O'Riordan, 1981).

Countries in Europe have adopted measures to preserve environmental quality. The EEC Directive on environmental matters is an embodiment of the preventative approach to environmental protection (Haigh, 1987; Krämer, 1990). The requirements of these Directives charge that before consent is given for certain development projects, mostly large scale industrial or infrastructural, an assessment is to be made of the effects they may have on the environment. Reviewing the general provisions of the Directive, Haigh (1987), observes that projects likely to have significant effects by virtue *inter alia* of their size, nature or location are to be made subject to an assessment of their effects before consent is given. The effects on the following four factors are to be identified, described and assessed, as appropriate, in the environmental impact assessment:

- human beings, fauna and flora;
- soil, water, air, climate and the landscape;
- the interaction between the first two groups;
- material assets and the cultural heritage.

Although the inspiration of the directive comes from the USA NEPA of 1969, the requirements of NEPA are very different from those of the Directive. NEPA applies only to actions by a federal agency and requires the agency, that is the promoter of development, itself to prepare an Environmental Impact Statement (EIS). In the Directive the developer only has to supply information including data required to assess the main environmental effects. The assessment is effectively a procedure involving the provision and publication of information on the part of the developer; the collecting of information from the public and others; and culminating in a process on the part of a competent authority in arriving at its decision to grant or withhold consent for development. Thus the developer will not always have to provide a description of the relationship between the proposed project and existing environmental and land-use plans and standards for the area likely to be affected.

In many developing countries the framework for environmental planning is not well defined. Ad hoc measures are usually adopted to preserve the environment. In some others, however, a more established pattern is emerging (Ramakrishna, 1985).

It is becoming apparent that in the quest for development, Zambia is a potential victim of environmental hazards and ecological degradation. Degradation will eventually feedback in diminishing food supplies in the face of rapidly expanding population, of squalor, poverty, disease and various forms of problems associated with inadequate care and management of the environment. In 1985 the Government adopted the National Conservation Strategy. The scope of the Strategy was to deal with natural resource implications of all major sectors of the economy, those in evidence now and those that may be in the short term (IUCN, 1984). There was recognition that the environmental problems and opportunities associated with mining, energy development and human settlements needed to be tackled, as well as those that follow from agricultural and forestry and wildlife management. The objectives to be pursued were:

- to ensure the sustainable use of natural resources
- to maintain the country's biological diversity and;
- to maintain life support systems including soil protection, nutrient recycling and the availability of clean air and safe water.

However, the main constraints to achieving the above include the absence of definite cross-sectoral guidelines for land and other natural resources allocation and preservation according to productive capacities. There is also inadequate co-ordination between present conservation and development efforts. The other constraints are in the areas of finance, legislation and lack of an information inventory.

2.12 Framework For Environmental Protection

Environmental legislation is important in the pursuit of environmental protection. As O'Riordan (1981) observes, environmental law deals with the very essence of environmentalism. There are two sources of environmental law which can be used to promote environmental protection, namely:

(1) the statutory laws

(2) the common law (O'Riordan, 1981; Ball and Bell, 1991).

Legislative controls protecting the environment are based upon standards of environmental quality. Such standards regulate activities by imposing definite levels of substances which can be emitted into the environment. These levels are often expressed in numerical limits and thus allow for simple enforcement as detection of a breach can be effectively monitored and proper assessment can be made of any discharge (Ball and Bell, 1991). Ball and Bell have summarised the main processes in regulatory decision making as:

a) establishment of general policies

b) setting standards or specific policies in relation to the environmental issue concerned

c) the application of these standards and policies to individual situations

d) the enforcement of standards and permissions; and

e) the provision of information about the law and the regulatory process.

2.13 *Public Awareness*

In the last three decades environmental awareness has been growing in the industrialized nations, whereas the pace in the developing countries has been slow. The public perception of environmental issues has been helped in the developed countries by the generally open and well-informed media. Environmental catastrophes, such as oil spills or nuclear reactor incidents, have helped focus on issues of the environment. The role of environmental pressure groups (e.g. Greenpeace) has been equally important. The public opinion generated by such groups has in many instances forced political decision makers to act, hence raising the political awareness for defining a coherent environmental policy. The public often look to the legislative process to protect the environment now and in the future. However, environmental protection legislation has usually been reactive rather than proactive. In the developing world, there has been a slow development of political awareness. This has resulted in a lack of political commitment to long term policy

CHAPTER THREE

ENVIRONMENTAL TRENDS IN SUB-SAHARAN AFRICA

3.1 Introduction

Many low-income countries of the world are found in a region referred to as sub-Saharan Africa[1]. These poor countries are facing the challenge of sustainable development. The more urgent issues they face include the need to provide for basic human necessities, stabilising population and stimulating economic development that can lessen poverty. All these have to be achieved while conserving natural resources necessary for economic growth. The poverty and deprivation are reflected in the worsening environmental conditions caused by and contributing to poverty. Poverty and environmental degradation are most evident in the rural areas, where 69% of the population live. Agriculture and related activities form the basis of their subsistence. As population swells in the urban centres of these

[1] From a geographic viewpoint, the region encompasses Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Ethiopia, , Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Rwanda, São Tomé and Principé, Senegal, Seychelles, Sierra Leone, Somalia, Swaziland, Tanzania, Togo, Uganda, Zaïre, Zambia and Zimbabwe.

countries, urban poverty and urban environmental problems are becoming increasingly important. The main sections of this chapter discuss the crucial environmental and development issues affecting Africa and the issues affecting prospects for sustainable development.

3.2 Critical Development And Environment Issues For Africa

3.2.1 Population, Food Resources and the Environment

It is clear that the fundamentals of Sub-Saharan African development are rooted in the characteristics of the resource base. The problems related to environmental and resource management issues differ according to the ecological zones of the continent. Environment in Africa can in places be conducive to food production, but over wide areas any productive activity has a special mixture of risks and problems. More and more marginal lands are being brought under cultivation in an attempt to meet food shortfalls. Deforestation has become a widespread phenomenon. One result is that land deterioration is a problem, especially in dry areas. In the last two decades Sub-Saharan Africa has experienced decline in per capita food production. Faruqee and Gulhati (1983) observe that it would be wrong to attribute the growing food deficit of Africa to population pressures *per se*.

They conclude that the population problem in sub-Saharan Africa is manifest not in the form of land unavailability and visible overcrowding but in much more subtle ways. Rapid population growth requires major improvements in the food and agricultural sector. This requires substantial public investment in developing land and improving its productivity. With the poor macro-economic prospects facing the region, it makes such investment highly improbable.

3.2.2 Food Production

Agriculture is central to sustainable development because of the high numbers of people working in the sector and the direct impact that it has on renewable resources and the environment (FAO, 1990a). Land degradation has emerged as the single most serious environmental problem in many developing countries. Soil erosion and infertility are concurrently degrading 30% of all rainfed cropland in Central America, 17% in Africa, 20% in Southwest Asia and 36% in Southeast Asia (FAO, 1987). In many areas the problem of protecting rural resources has several further implications. The first is the inherent fragility of the natural resource base. Farming resources in many poor tropical countries are not as durable as in the industrial, temperate-zone countries because of inadequate rainfall or terrain or soil structure. If these fragile resources are not farmed properly they quickly degrade. Traditional environmental protection techniques like limited cultivation, shifting or rotational cultivation, extensive tree or bush fallow systems have ceased to be effective in many places under the pressure of population growth of people and livestock. It is this combination of fragile resources with rapid population growth that makes the rural resource management a problem in many developing countries. Therefore, it is unlikely to be resolved through the simple application of policies or techniques devised in industrial countries. Policies will have to be tailored to local conditions by local groups (Schmidheiny, 1992).

Africa's food situation has seriously worsened in recent years. In contrast with annual population growth of 2.6%, the continent's food production increased by an average of only 1.6% from 1970 to 1978 ; its degree of self-sufficiency in basic foods fell from 98% in 1962-64 to 90% in 1972-74 (FAO, 1986). This FAO (1986) report concludes that the necessary reversal of this alarming trend will inevitably result in an increase of pressure on natural resources. Land resources do not appear in general to be a major limitation on the expansion of agricultural production in Africa. They are, however, unevenly distributed in relation to the population and in some countries it may already be a limiting factor (FAO, 1986). In such countries agricultural production will have to depend on intensification of production on land already in use rather than on the expansion of the arable area. Furthermore, soil fertility is generally low, and even the fertility of the good soils declines rapidly if relevant measures are not taken to maintain and increase it. A primary problem in Africa is the shortage of capital to bring new lands into production on a sustainable basis. Another is that often the land to be brought into cultivation is already utilized for pasture or for forestry.

3.2.3 Farming Systems and their Environmental Implications

This section will attempt to examine the characteristics of farming systems in Africa and the practices involved. It will enable me to make an assessment of their environmental impacts. This will entail taking into consideration the magnitude and scale of cropping, the different phases of the production process and the impacts associated with such agriculture.

Africa's agriculture can be classified broadly into modern and traditional sectors. The modern sector is generally, though not entirely, restricted to the production of industrial crops (FAO, 1986). The traditional sector produces most of the food and a large proportion of the cash crops. In traditional cultivation, natural fallow is used for soil regeneration. Diverse systems have arisen based on the rotation of one or several years of cultivation, with a longer period of fallow, in which the natural vegetation is allowed to colonize the soil. The length of fallow period varies according to the climate and fertility of the soil. It is generally from 8 to 12 years in tropical rainforests and much longer in the drier areas (FAO, 1986). Problems arise when population growth goes beyond the level the system can support, so that cropping is intensified by reducing the length of fallow. This usually happens when the population density reaches some 30 to 50 per km^2, although the figure varies according to local conditions. It is estimated that the minimum arable area in sub-Saharan Africa would be about 75 million hectares, of which at least 36 million are harvested annually.

These systems have become known as bush fallowing or shifting cultivation and have assumed distinctive features and description in different parts of the continent.

Table 3-1 shows the decline in productivity under shifting cultivation systems. Under the more technically advanced systems of cultivation, there are larger inputs of energy in terms of machinery, pesticides and artificial fertilizers.

Table 3-1: Decline in Productivity under Shifting Cultivation in Africa

Country	Cropping period	Decline during Fallow	Cropping period
	— year —		%
Benin	2-3	3-10	25-60
Congo	2-5	2-10	20-50
Niger	5-6	5	50-60
Uganda	1-2	0-10	30-50

Source: FAO, 1986, p.18

Tables 3-2 and 3-3 show the consumption of fertilizers and pesticides in agriculture. The trend points to an increase in these inputs as agriculture becomes more modernised and developed.

Table 3-2: Consumption of Fertilizers[2], 1966-68 and 1986-88 in Selected African Countries

	Total consumption		Consumption per hectare	
	1966-68	1986-88	1966-68	1986-88
	—thousand tonnes—		——kg——	
Algeria	57	228	8.4	30.2
Angola	7	14	.9	3.0
Botswana	2	1	2.0	0.6
Côte d'Ivoire	13	34	4.7	9.4
Egypt	297	933	106.1	364.7
Ghana	1	10	0.5	3.6
Kenya	32	116	16.6	48.4
Libya	9	83	4.3	38.8
Malawi	.6	46	3.0	19.2
Mauritius	21	29	213.1	269.7
Morocco	78	318	10.6	36.6
Mozambique	5	5	2.0	1.5
Nigeria	8	289	0.3	9.2
Senegal	19	23	4.2	4.3
Somalia	2	3	1.9	2.5
Sudan	37	60	3.3	4.8
Tanzania	9	45	2.0	8.6
Uganda	5	1	0.9	0.1
Zäire	3	4	0.4	0.5
Zambia	15	86	3.1	16.4
Zimbabwe	81	150	36.3	53.9

Source: Adapted from UNEP Environmental Data Report 1992, pp. 167-68

[2] Total of N, P_2O_5, K_2O and per hectare of arable and permanent crops

Table 3-3: Consumption of Pesticides[3], in Selected African Countries, 1975-77 & 1982-84

	All pesticides (ta^{-1}active ingredient)[4]		Insecticides (ta^{-1} active ingredient)		Fungicides (ta^{-1} active ingredient)		Herbicides (ta^{-1}active ingredient)	
Country	1975-77	1982-84	1975-77	1982-84	1975-77	1982-84	1975-77	1982-84
Algeria	16457	21400	2540	4200	13567	16100	350	1100
Burundi	22	59	20	59	3			
Egypt	26970	19567	14876	11967	12093	7600		
Ethiopia	200	993	200	993	200	867		127
The Gambia		67				67		
Kenya	623	1307	623	1307				
Liberia	1223	310	1200	237	23	73		
Libya	870	2017	237	583	633	1433		
Madagascar		1630				1630		
Morocco	1483	3350	417	1183	1067	2167		
Niger	451	106	423	106	34			
Nigeria		2667				2667		
R.S.A[5].	19292	11053	4755	4003	7037	6567		483
Swaziland	5		5					
Tunisia		1330		827		503		
Zimbabwe	557	69	277	27	300	12		30

Source: Adapted from UNEP Environmental Data Report 1992, p. 172

3.2.4 Environmental Impacts of Agriculture

3.2.4.1 Soil Degradation

Soil degradation and erosion are some of the major environmental problems facing Africa. Water erosion is the most widespread cause of soil degradation in Africa. Removal of top soil is accelerated when Man's activities induce the removal of protective vegetation cover. The effects of water erosion encompass reduced permeability and water retention in the nearly exposed soil, and increased

[3] mean annual values

[4] Active ingredients are those chemicals having pesticidal properties. In a formulated pesticide, active ingredients are often mixed with inert ingredients which aid or dilute delivery of active ingredients. Totals may not tally due to rounding.

[5] Republic of South Africa

run-off, which leads ultimately to floods, changes in the depth of river beds, and erosion of the banks of rivers and streams. The cutting of gullies lowers the water table in the surrounding areas, so that dry periods have a more damaging effect on vegetation. Run-off water brings problems of siltation in reservoirs, navigable rivers and ports. This represents additional costs in dredging, especially of the ports. Table 3-4 tells the story of the extent of soil erosion and degradation in selected countries. A significant observation is that many countries are experiencing moderate decline in soil fertility. This may have a significant implication in terms of future food self-sufficiency as more land is taken out of cultivation. Table 3-4 gives an indication of the present status of soil erosion and degradation in selected African countries. A big number of them seem to experience sheet erosion and have degraded vegetation. As a result, a moderate degree of decline in soil fertility seems to be common in these countries. Zambia is one of those countries experiencing decline in soil fertility which can be attributed to soil erosion and vegetation loss.

3.2.4.2 Deforestation

The main cause in Africa has been clearance of forests and woodlands for agriculture. The progressive shortening of fallow period, the annual burning of grass to induce grazing pasture and the urge to produce cash crops without changing cultivation methods lead to the degradation of the ecosystems.

Table 3-4: The Present Status of Erosion and Degradation

	Gully Erosion	Sheet Erosion	Wind Erosion	Desert Encroachment	Declining Soil Fertility	Degraded Vegetation
Botswana	•[6]	• •	• •	• •	• •	• •
The Gambia	•	•			• •	•
Ghana	•	• •			• •	• •
Kenya	•	• •	•	• •	• •	• •
Lesotho	• •	• •			• •	•
Malawi	•	• •			• •	• •
Nigeria	• •	• •	•	•	• •	• •
Sierra Leone		•			•	• •
Swaziland	• •	• •			• •	•
Tanzania	•	•			• •	•
Uganda	•	• •			•	•
Zambia	•	• •		•	• •	•
Zimbabwe	•	• •		•	• •	•

Source: Commonwealth Secretariat (1988). Conservation for Sustainable Development, p. 29.

In some parts of Africa the rate of forest loss is a source of great concern. In central Africa the rate is generally lower, although it is alarming in some parts of Kasai and

[6] Key: Degree of Degradation

• Slight

• • Moderate

• • • Severe

Shaba in Zäire. In east Africa the situation is particularly serious in areas of high population density, like those around Lake Malawi, the Copperbelt of Zambia and western Mozambique (FAO, 1986). Grazing and the use of fire are particularly destructive in the savanna, especially in the dry season. Another source of concern is land fragmentation and degradation of watershed areas by increasing population densities. This is making the upper catchment areas, which are important for protection of water resources, vulnerable. As a result of steep slopes, frequent heavy rains and friable light soils, there has been substantial soil erosion. In the Luangwa watershed in Zambia, erosion is causing increased instability of stream flow. As Table 3-4 illustrates many countries are experiencing problems of degraded vegetation.

3.2.5 Fertilizers and Pesticides

Much of the increase in global agricultural production over the last 30 years has come about through the adoption of high-input agricultural production systems. The development of high-input farming has been both the cause and effect of the increase in agricultural production, and has led to an ever greater production of fertilizers and pesticides to fuel that increase.

Agricultural production can be significantly affected by crop pests and diseases. Adverse effects include insect defoliation or the competition for space, light and nutrients by weed species, or vector organisms carrying crop diseases. An important pest causing widespread crop damage and losses in the African region is the locust. The region has suffered repeated outbreaks of several species of locusts, including the Desert Locust and the Red Locust (UNEP, 1989).

The use of pesticides has helped to reduce crop losses due to pest organisms. However, adverse environmental effects associated with pesticide use, such as food chain accumulation, has led to the phasing out of several of the more toxic and persistent chemicals. Growing awareness of the adverse effects of pesticides has increased demand for more comprehensive data on pesticides. The necessary information includes toxicity assessments, environmental monitoring data, registration and regulatory information as well as production, consumption and trade.

In association with the International Register of Potentially Toxic Chemicals (IRPTC) ten developing countries (Brazil, China, Colombia, The Gambia, Indonesia, Malaysia, Sri Lanka, Tanzania, Thailand and Zambia) have now created their own National Registers of Potentially Toxic Chemicals. These countries intend to collect information such as consumption and production figures and other national data for inclusion in their own registers (UNEP, 1989).

3.2.5.1 Use of Chemical Fertilizers

The use of artificial fertilizers in Africa still remains low by world standards. According to the FAO (1986) the average consumption is only 11.3 kg of plant nutrients N, P_2O_5 and K_2O per hectare of arable land and permanent crops in 1979 compares with 37.4 kg in South America, 61.5 kg in Asia and 228.7 kg in Europe. Damaging results have been observed, arising from excessive use combined with improper soil and crop management. Thus the possible unwanted effects on the environment will be minimised if fertilizers are used with maximum efficiency. The correct choice of fertilizers and the application methods, and their use at the right time and in the required amounts are significant considerations.

3.2.5.2 Pesticides

The use of pesticides in agriculture is increasing in Africa. The increased use of pesticides like DDT, Dieldrin and Endosulfan has given rise to concern about their effects on non-target organisms. In a number of countries such as Botswana, Kenya, Nigeria and Zambia, studies have been undertaken to examine the side-effects of Dieldrin used for tsetse control. The results indicate that most applications of Dieldrin are associated with a high level of deaths in many wild animal species, including insects, fish, birds and certain mammals. Pesticides also present contamination dangers. Those used in Africa still include certain chemicals that have been banned for environmental reasons in some developed countries, but for which cheap substitutes have yet to be developed. Deaths of livestock from eating contaminated feed have been reported in Zambia (Bryden, 1971 quoted in FAO 1986). The direct and indirect contamination of water by pesticides may kill fish, reduce fish productivity and give rise to undesirably high concentration of pesticides in fish tissues. Incidents of pesticide contamination of inland fishery resources have been reported from Burundi, Kenya, Sudan, Tanzania and Zambia (FAO, 1986).

The absence of an effective pesticide registration process and of governmental control in many countries has led to misuse of pesticides. Clearly, there is need to reduce the effects of insecticide and pesticide poisoning of the environment in Africa. This can be achieved by developing new methods based on the principle of integrated pest control, which relies mainly on natural elements including biological control and resistant crop varieties.

3.2.6 Other Impacts

There is increasing evidence that in different regions, noticeably in Africa, excessive demands are being made on limited resources and the carrying capacity of fragile ecosystems. The unsuitable use of these environmental systems upon which life depends is showing up in soil erosion, lack of water, deforestation and desertification (Ahmad and Sammy, 1984).

Environmental Impact Assessment has become an important tool for policy planning in many developed countries. In the developing world this practice is limited to few individual countries and multilateral and bilateral financing institution. Goode and Johnstone (1988) observe that, although EIA has sometimes been applied to programmes and plans but not yet to policies, its main operation is focused on large-scale development projects such as industrial plant, infrastructure projects, agricultural and irrigation projects, housing and urban development, mining and energy plants and oil and gas production. They further observe that the application of EIA in developing countries is often patchy in quality and quantity, a reflection of several major constraints. Numerous constraints to the application of EIA in developing countries have been cited by many studies (OECD, 1986; Ahmad and Sammy, 1984). These include:

(a) Inadequate political awareness of the need for environmental assessment.

(b) Lack of public participation

(c) Deficient or inadequate legislative provisions

(d) Lack of expertise

(e) Lack of data

(f) Financial constraints

Despite all the above-mentioned problems, it is vital for developing countries to identify and establish the important sectors of development activities that should receive protection because of substantial and significant impacts.

Santos (1992) observes that in the developing countries there is limited use of EIA in agricultural activities. Yet the developments in crops and livestock improvements in drainage and irrigation, extensive use of chemical fertilizers, pesticides and increased mechanization in

Man's attempt to increase food production are affecting the environment, sometimes with irreversible consequences. He further notes that the damage to the flora and fauna, the dangerous effects of pesticides and fertilizers and the extent and consequences of soil erosion are some of the most important environmental impacts of agriculture in the context of agricultural development. Therefore any growth in agriculture will be linked to an increase in environmental problems. With agricultural modernization many areas have experienced growing environmental degradation. Some of the resulting impacts on the environment may significantly undermine the very basis of agricultural production.

3.2.6.1 Energy and Environment

Most of the energy needs for the majority of the people in Africa are still met by the use of traditional fuels, especially wood and charcoal. For the rest of this century it seems likely that most rural and many urban people will continue to use wood and charcoal resources for heating and cooking. Table 3-5 shows the relationship between the supply and demand of fuelwood resources. These resources are being depleted as land is cleared for agriculture or their productive capacity is decreased through over-exploitation.

Table 3-5: Fuelwood Supply and Demand 1980-2000 (Million M^3)

Country	1980 Supply	1980 Demand	1980 Balance	2000 Supply	2000 Demand	2000 Balance
Botswana	26.3	0.7	25.6	26.0	2.1	23.9
The Gambia	0.3	0.9	-0.6	0.2	1.7	-1.5
Ghana	36.4	7.1	29.3	1.6	17.8	13.8
Kenya	20.1	24.6	-4.5	19.6	78.0	-58.4
Malawi	2.4	5.5	-3.1	1.8	14.9	-13.1
Nigeria	128.4	70.9	57.5	110.4	200.0	-89.6
Sierra Leone	12.4	7.4	5.0	12.0	13.5	-1.5
Swaziland	-	0.5	-0.5	-	1.3	-1.3
Tanzania	30.0	35.1	-5.1	28.0	102.0	-74.0
Uganda	3.8	22.5	-18.7	3.1	60.4	-57.3
Zambia	20.2	5.0	15.2	19.1	13.7	5.4
Zimbabwe	10.0	7.2	2.8	8.8	21.0	-12.2

Source: Commonwealth Secretariat (1988). Conservation for Sustainable Development, p. 30.

For six countries the demand for fuelwood in 1980 already exceeded what could be supplied on a sustainable basis. Projecting this to 2010 the situation will be very serious as in only two countries will supply exceed demand. This scale of deforestation has serious consequences for the rural poor - who cannot afford alternative fuels - and will lead to significant environmental degradation as they utilize what remains.

3.2.7 Resource Utilization

Over half of the nations designated as "poor", "least developed", or otherwise disadvantaged are found in Africa. The majority of African nations are dependent on exports of animal, mineral and vegetable products. With a few exceptions, African countries are net importers of foodstuffs. All of them depend on agriculture for a major part of their economy. The agricultural sector has to supply both a large part of the food needed for consumption within the nation and provide exports to earn foreign exchange to purchase needed imports. The trend is that the productivity of that resource base is declining and their economies are at best stagnating. The devastating droughts of the 1970s and 1980s have hit these countries hardest.

3.2.8 Population Growth

The 1970s witnessed a significant acceleration in the pace of population growth in sub-Saharan Africa. This growth results from a steady fall in death rates and no fall in the birth rates. The region as a whole had an average annual population growth rate of 3% between 1985 and 1990. Some countries like Côte d'Ivoire, Botswana, Kenya, Tanzania, Uganda, and Zambia had growth rates ranging from 2.1% to 4% (World Bank, 1986; World Resources, 1992). In many countries commitment for comprehensive population policies is lacking. Rapid population growth does not necessarily prevent per capita income rising. In some circumstances, population growth may even contribute to development. But in most cases population growth slows per capita economic growth when capital resources are diverted to provide social services and become stretched far beyond the capacity to invest in productive ventures.

3.2.9 Urbanisation

Urban populations are growing rapidly in sub-Saharan Africa, at an annual rate of 6%. Environmental ramifications are becoming evident as manufacturing increases in urban centres. The rapid growth of many urban areas, along with the shortage of capital investment in basic infrastructure, has resulted in a growing proportion of African cities being comprised of slums. Demands for water supplies are expanding. Water and sanitation services are not able to meet minimal standards in the majority of urban areas. Rapid growth of shanty towns means that there are insufficient supplies to distribute to these areas. This contributes to poor sanitation and an assortment of health problems. Urban poverty and urban environmental problems will become increasingly important in the future.

3.3 *Environment And Development: A Review And Prospects*

Overriding all resource issues for Africa is the dilemma of two, sometimes conflicting needs in the light of rapid population growth: the need for continued economic development and the need for maintaining the resource base. Population growth will continue to exert pressure on existing and new agricultural land. There will continue to be dual pressure for food production and export growth. Great uncertainty exists concerning what will happen politically within most African countries. Clearly, political stability is needed if economic development and environmental maintenance are to be coordinated. We need new levels of understanding and knowledge; we need more fact-finding and research; but most importantly we need new levels of individual governmental and institutional awareness. Unfortunately even the best scenario sees a period of continuing difficulty in issues of resource management in Africa.

The First African Ministerial Conference on the Environment in 1985, recognised the common cause between the environment and development. The conference sponsored by UNEP and the Economic Commission for Africa (ECA) launched the Cairo Programme, a package of co-operative self help efforts to combat the environmental crisis in the continent. One area of priority of the Cairo Programme was to strengthen co-operation through regional networks in the fields of environment and eco-development. However, such noble ideas seem difficult to achieve as few countries are able to devote adequate resources to environmental problems.

3.4 Economic Activities

In the early 1980s many poor countries were severely affected by economic stagnation. Their growing debt burden was coupled with the decline in primary product prices. The resulting scenario was economic distortions and inefficiencies that had become widespread in their production, distribution and financial systems. In an effort to address these problems economic restructuring was imposed by international development agencies.

The policies of stabilisation and structural adjustment have been pursued by the International Monetary Fund and the World Bank in developing countries. Structural adjustment is intended to maintain foreign exchange balances and promote economic modernisation and growth. Adjustment programmes generally include measures to manage demand, improve the incentive system, increase market efficiency, and promote investment (Reed, 1992 ; World Resources Institute, 1992). Specific policy measures include exchange-rate devaluation, wage reductions, trade liberalisation, public sector reform, privatisation of public enterprises, land reform, and the removal of subsidies of inputs and outputs in agriculture and other sectors of the economy.

Extensive and often prolonged economic restructuring, whether initiated by countries themselves or under the supervision of the World Bank, have been received with mixed feelings. They have been widely criticised by other international agencies, developing country governments and active local grassroots organisations for their harmful effects on the poor and the environment. Examining structural adjustment policies, the Economic Commission for Africa (ECA), cites the social consequences of these policies as declining per capita GNP and wages, rising unemployment and underemployment, deterioration in the level of social services, rising malnutrition and health problems and rising poverty levels and income inequalities (ECA, 1989)

One shortcoming of this policy is its failure to address environmental deterioration that threatened to erode economic performance brought about by the restructuring process. The World Bank and other multi-lateral development banks did not view the environment as a priority area at the time.

Secondly, any negative environmental impact was linked to inappropriate macroeconomic policy or a sectoral economic policy failure was a cause. In essence, it was assumed that correct economic policy could address environmental problems.

A third reason for failing to integrate environmental concerns in adjustment lending is that environmental protection seemed to indicate the need for more budgetary outlays. Environmental protection would increase public expenditure, making achieving fiscal balance more difficult.

A fourth reason is that many quarters viewed macroeconomic crisis and environmental degradation as essentially unrelated problems.

3.4.1 Industrial Growth

Much of the industrial development in Africa relies on local raw material as a productive base. But all industry places demands on local resources, the most common being the need for water. This raises two important issues:

a) competition for the use of water in urban areas; and

b) the control of the environmental impacts of industry on the quality of water for the city and its people.

Four interlinked trends are quite pervasive and cause major concern in projecting the pattern of the future.

(1) With a few exceptions, there has been a continent-wide drop in agricultural production per capita.

(2) Stagnation and/or slow growth in cash crop agriculture is widespread.

(3) Major pressures on rangelands is common.

(4) A continuous process of destruction of forests is taking place almost everywhere.

These four pressures on land are creating a major dilemma for African governments in their economic and social planning for the 1990s.

The policies of many African governments since independence have not in general been conducive to good environmental management. Pricing policies have always worked against the rural producer, and the disincentives for crop production have resulted in less effective management of resources. Although major policy statements on resource problems have been a feature of presidential and other senior pronouncements, these have rarely been backed by the monetary support or long-term commitment necessary to reverse environmental deterioration.

3.4.2 Minerals, Mining and the Environment

Within Africa, broad categories of energy fuels, metallic and non-metallic minerals are found. In the African context the production of these resources, more often than not, results in significant pollution. To curtail the pollution would require large investments of capital, which would reduce the amount of income generated from these economic activities. Mining companies have little incentive to control pollution since it would lower their profitability. The pressure must come from the host government, which often is not in a strong position to require pollution controls. In a number of African countries, income generated from mining operations is the largest source of government revenue. Any reduction in this income will have significant immediate consequences, some of which would probably be political. The costs associated with environmental protection are clearly a major reason why minimal environmental controls are found at most mining operations on the continent. Recent low prices for many metals have greatly reduced revenue from some mining operations. If the necessary investment for environmental controls were required, many operations would cease to be profitable and would close. Given that the revenues from mining operations are often a very significant source of "hard" currency for many countries, environmental considerations are secondary to the short-term economic realities.

Issues of development and environment in the Rio Declaration are embodied in the following 'principles'

Principle 3: The right to development must be fulfilled so as to equitably meet developmental and environmental needs of the present and future generations.

Principle 4: In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

> <u>Principle 16:</u> National authorities shall endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment (UNCED,1992).

Biodiversity and Biotechnology - the development and use of genetic and other material is the substance of Biotechnology. The protection of '*intellectual property rights'* means that the poor countries that 'own' the genetic resources have to pay a lot for access and transfer of Biotechnology through patents. The suggestion that Third World countries should have marketing control over wild genetic species, was a sticking point at the UNCED's Rio Summit of 1992 (Middleton *et al.*, 1993). Although trade between North and South could be an engine of development, unfair trading practices and external debt foster terms of trade that remain depressed, making matters unlikely to improve for the poorer countries of the world. Opposition to agricultural proposals of the General Agreement on Tariffs and Trade (GATT) Uruguay Round was an example of the North's protectionist tendencies. Yet the Southern countries are urged to join in the liberalisation of trade by removing import quotas, tariffs and subsidies. The result is that peasant farmers in the developing world will face competition from cheap imports from subsidised producers of the EC and USA. The resulting food dependency seriously undermines their food security.

3.4.3 Population, Environment and Agriculture

The linkages between rapid population growth, agricultural stagnation and environmental degradation in sub-Saharan Africa shows that these phenomena are mutually reinforcing (Sayer *et al.*, 1992). Rapid population growth is the principal exogenous factor which has stimulated the increase in environmental degradation, contributing to agricultural stagnation relative to population size. This is because population growth has been such that Africans have been unable to adapt their traditional agricultural land use fast enough to respond to the pressure of more people. In most of sub-Saharan Africa, land has been abundant until recently and in many countries this is still the case. Given this situation, it has been, and continues to be difficult to stimulate interest in reducing population growth.

3.4.3.1 Shifting agriculture and pastoralism

For centuries shifting agriculture and transhumant pastoralism have been appropriate systems for people throughout most of sub-Saharan Africa. The ecological and economic systems were in equilibrium. The principle was that people moved on to new land when soil fertility declined or pasture vegetation disappeared. Land was left fallow for many years to reconstitute its fertility. In many countries, such as Kenya, Rwanda and Liberia, fallow periods are no longer sufficient to allow fertility to be restored. Many people are forced to remain on the same parcel of land where they maintain their traditional farming methods. Shifting cultivation usually involves the annual burning of vegetation on newly opened up lands. When farmers are unable to open new land, but continue the annual burning before cultivation, soil fertility quickly declines. This forces people to migrate to marginal land in semi-arid areas or into tropical forests to try to establish farms there.

There are important linkages between agricultural production, population growth and environmental protection. Protection of the environment is needed for long-term growth of agriculture and the economy but will be very hard if present rates of population increases continue. Population growth is unlikely to decline unless agriculture and the economies dependent on agriculture grow. Agriculture in turn is increasingly constrained by rapid population growth.

Africa's deepening crisis is characterised by weak agricultural growth, a decline in industrial output, poor export performance, rising debt and deteriorating social indicators, institutions and environment. The crisis is taking a heavy toll in human terms. In several countries expenditures on social services is sharply down, school enrolments are falling, nutrition is worsening and infant mortality continues to be high.

In the face of declining commodity prices, many African countries resorted to heavy external borrowing to sustain levels of expenditure made possible by earlier booms. Sub-Saharan Africa's total debt increased from \$6 billion in 1970 to \$134 billion in 1988. By the end of that period the region's debt was about equal to its gross national product (GNP) and three-and-half times its export earnings. Debt service obligations, the real measure of debt burden, rose in the 1980s to a point that could not be met. They stood at 47% of export revenues in 1988.

3.5 Resource information in Developing Countries

The primary base for the economic development of most developing nations lies in their natural resources. Yet many of these nations do not have thorough knowledge about the nature, quantity and location of their resources to harness them effectively. Traditionally, resource information has been acquired from different sources, gathered by a variety of means, and often maintained by separate agencies (National Academy of Science, 1977). For this reason national planners have rarely incorporated current and accurate resource information and environmental factors in their planning process. The need, therefore, exists for more comprehensive ways of looking at a nation's resource base and for making resource information count in development planning and resource management. Resource inventory and environmental monitoring data serve several purposes - for national resource management and planning, for project feasibility and physical planning studies and for environment-related problem solving.

Concerned traditionally with the allocation of financial resources, central planning authorities tend to base their calculations on broad economic, financial and population variables. The particulars of resource information are attended to at lower levels, especially under data collection units like soil survey, or geological survey. The reasons for this are several. First, there has been a lack of co-ordination between physical planners and economic planners. They tend to apply their arts to different sets of problems at different stages in the planning process. Second, most developing nations have economic plans of five- to ten-year time frames and therefore concentrate on balancing flows of resources and commodities, rather than stocks. No accounting framework has been constructed for natural resources balance sheets comparable to national accounts framework.

Resource management responsibilities are normally lodged in sectoral ministries and departments, gathering data for assigned tasks. This reflects traditional sectoral compartmentalisation. The value of an integrated approach to resource management has been recognised in a few countries. Supraministerial resource data collection, analysis and planning services that incorporate the conventional data collecting units have been established. Sub-Saharan Africa is a region of great variety and rapid change. Rapid population growth and severe land degradation is widespread. Thus the need for accurate, timely information on renewable resources, land use and land ownership patterns is greater in the region than anywhere else; yet in this region such information has been lacking. This information need could be met in part by the production and use of land information. In particular, remote sensing appears to offer a great potential to obtain geographically referenced information using a single, consistent method over a large area with uniform, reliable accuracy, and to repeat the measurement over time so that changes can be detected (Falloux, 1989). However, Sub-Saharan Africa has hardly used such technologies for renewable resource management until very recently. Given the host of problems faced by Africa, including the current debt crisis, is it a priority to promote these tools, and to build or strengthen Africa's capacity in land information and remote sensing?

3.5.1 Satellite Remote Sensing

Monitoring resources for resource management in Africa can be achieved by using remotely sensed data and technology. There are many factors militating against effective use of remote sensing. Aerial photographs have long been used to understand resource issues in Africa, but their utility has been hampered by problems of access, quality and lack of sequential coverage to assess change (Millington *et al.*, 1986). A number of factors have reduced the application of remote sensing in African development. Among these are:

- lack of ground stations in Africa reducing the recorded coverage
- lack of funds for and possible interest in work on resource issues
- lack of technology and resources in many African universities and other concerned institutions
- difficulty of translating findings using remote sensing into useful information at project level

The major contributions of remote sensed data have been in the area of agricultural and water resources surveys. Recent advances in satellite remote sensing techniques have provided means of monitoring land use changes on national, regional and global scales. However, the use of such imagery is extremely limited. The principal barriers to a greater use of satellite monitoring are cost, manpower and legal restrictions. Satellite imagery alone cannot provide unambiguous information on the state of natural resources. It requires a substantial "ground truth" check, in which the interpreted image is compared with reality found in the sample sites on the ground. Consequently, the acquisition, interpretation and checking of satellite imagery requires highly trained personnel. It requires skilled personnel who understand its limitations, the resource topic under evaluation and the area under investigation (UNEP, 1989).

Satellite technology has improved image resolution considerably, from the 80x80m pixel of the first LANDSAT (Land Satellite) to the 10x10/20x20m of SPOT (Systeme Probatoire d'Observation de la Terre) . Results in Africa have not been promising. African agriculture is done by smallholders with fields of tiny size and irregular shape, with varied planting calendars and complex intercropping systems invisible on satellite imagery. Other factors further confuse satellite remote sensing such as corrugated iron roofs in densely populated areas, which act as mirrors and can severely distort the resulting image.

Because of such constraints, satellite remote sensing appears inadequate for land administration and monitoring agricultural land use. Yet it could play an increasing role in renewable resource management, in the following ways:

1. increasing mapping capacity. The high resolution of satellite imagery from SPOT may become a cheap alternative to aerophotogrammetry for establishing or updating maps at scales up to 1:50,000
2. association with other surveys. Satellite imagery can be used effectively to classify or stratify land use patterns, as a first step in guiding ground surveys and making them more cost effective.
3. Monitoring change over time. Satellite imagery has already been used to detect changes in vegetation and other types of land cover in parts of sub-Saharan Africa.

The specific areas in which current satellite remote sensing technologies appear useful include the following:

- forestry; for forest inventory and monitoring forest cover.

— rangeland monitoring; assessing range capacity and biomass production

— mapping and monitoring wildlife habitat

— geological feature mapping, including structure and geomorphology

— soil types, extent and type of soil erosion

— water resources; e.g. flooding, siltation, flow rate changes

— some land use patterns;

— assessing land cover and vegetation degradation.

International financing may have a key role to play in strengthening African capabilities in land information and remote sensing. African countries need to give higher priority to information on land and renewable resources

3.5.2 GIS in Sub-Saharan Africa

The demand for the storage, analysis and display of complex and voluminous environmental data has led, in recent years, to the use of computers for data handling and the creation of sophisticated information systems. Effective use of large spatial volumes is dependent upon the existence of efficient systems that can transform these data into usable information.

Examples in Africa are increasing where GIS has been employed for environmental monitoring. In Tanzania, a panchromatic SPOT image in map sheet format at 1:50,000 was used to collect information on the growth of the city of Dar es salaam. This urban base map will be used to form the basis for strategic environmental planning. In Nigeria the National Information Systems for Environmental Monitoring is being developed. A programme to establish baseline environmental information and environmental data collection and monitoring has been embarked upon. This has been designed with the conceptual framework of a GIS (World Bank, 1993a).

3.6 The Environment in the Southern African Development Community

The SADC region includes the following member countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe. As in many regions the SADC environment is undergoing substantial change. There is undeniable change in people-environment relationship that corresponds to industrialisation and urbanisation. Such trends have increased concern, although there has been little political action to resolve environmental problems. Moyo *et al.*, (1993) have produced comprehensive and up-to-date profiles of the environment of SADC countries. This work provides detailed information on the physical and human geography, environmental problems, resource base, institutional structures for environmental management and issues associated with institutional change.

The central concerns in the region are the depletion of non-renewable resources and the destruction of renewable resources such as water and soil and the reduced capacity of the environment to absorb pollution. There are notable levels of land degradation in the region, especially in the more marginal, communal land. In many cases the environmental problems cannot be satisfactorily addressed until the inequities of land distribution are tackled. Parallel to the land-use issue in rural areas is the issue of urban poverty and pollution. This has direct impact on peoples' health and there is need to combat this increasing problem. At present there is significant under capacity in the environmental sector. Institutional development requires support for policy formulation, research and training.

CHAPTER FOUR

A REVIEW OF ENVIRONMENTAL POLICY IN THE EUROPEAN COMMUNITY AND UNITED KINGDOM

4.1 Introduction

The European Community environmental policy has had a profound impact on law and practice in member states. In some cases the Community compels member states to adopt higher standards in waste management and in the control of air and water pollution than would otherwise be the case. The Community has been responsible for a shift of emphasis from controlling discharges based on quality-objectives approach to technology-based standards for the receiving environmental media. It has also pioneered environmental assessment for new development projects (Lomas, 1991). The general political framework surrounding European Community Environment Policy consists of Action Programmes. The most used legal instrument with regard to environmental policy is the "directive". This chapter examines the various environmental policy issues in the United Kingdom and how they relate to the general framework of EC environmental policy. Examination of such policy will enable me to identify some of the key issues that need to be addressed when considering environmental policy in developing countries like Zambia.

4.2 European Community Environmental Policy

The early 1970s saw the European Community becoming active in the development of environmental policy. What transformed environment policy from an incidental to an essential part of EC's policy programme, was a heightened awareness of the environmental consequences of unregulated economic growth; the trade distortions accompanying uncoordinated pollution standards; industrial disasters at Flixborough in the UK and Seveso in Italy; and increased public sensitivity to environmental issues (Judge, 1993; Hildebrand, 1993). Environmental policy has been characterised by environmental action plans, which set out a programme of action on the environment accompanied by a precise timetable. The first EC Environmental Action Programme (1973-1977), listed the objectives and principles of Community Environmental Policy, emphasised the reduction and prevention of pollution and nuisances and action to improve the quality of the environment. The Second Action Programme (1977-1981), represented a continuation and expansion of the framework of the First Programme. It stressed the preventive nature of Community Environment Policy. The Third EC Environmental Action Programme (1982-1986), reflected the evolution of EC environmental policy and introduced new elements. These elements were concerned firstly, with the need to integrate environmental policy into sectoral policies of the Community. The second aspect underlined the need to reinforce the preventive character of environmental policy. Great importance was attached to the procedure of Environmental Impact Assessment (EIA). Priority areas were established which included *inter alia* reduction of pollution and nuisance at source. The Fourth Programme (1987-1992) had a different conceptual approach to pollution control and prevention. A multi-media , substance directed and pollution source-directed approach was adopted. Greater importance is paid to the implementation and enforcement of EC environmental legislation (Haigh and Baldock, 1989; Johnson and Corcelle 1989; Klatte, 1991). The Fifth Action Programme emphasises the integration of environmental considerations into the formulation and implementation of economic and sectoral policies, alongside the concept of 'sustainable development'. Hence, the approach adopted by the Fifth Action Programme (1993-2000) differs from its predecessors in its emphasis on long-term objectives and its awareness that success is dependent upon an informed assessment of the risks to the environment and the monitoring of Community actions taken to mitigate those risks (Judge, 1993; Murley, 1994).

The objectives of the EC action on the environment as expressed in the Single European Act 1986 were:

1. to preserve, protect and improve the quality of the environment
2. to contribute towards protecting human health
3. to ensure a prudent and rational utilisation of natural resources

The Community's environmental policy is based on the principles that preventive action should be taken, that environmental damage should be redressed at source and that the polluter should pay (Murley, 1994). EC law takes three forms: regulations, directives and decisions. Regulations are binding on Member States in their entirety and take precedence over national legislation. Directives are binding on Member States, who have to put them into effect in their own legislation. Decisions are only binding to those to whom they are addressed - government, private enterprise or individuals. By far the most important are the Directives, which are normally cited with a reference number giving the year it was issued and its position on the list of Directives issued in that particular year.

4.2.1 Community Environment Policy

Community environmental policy encompasses basic sectors of water, air, waste management, noise and preventive action. In our review of EC environmental policy, I shall dwell on two aspects of the policy, namely, water pollution and air pollution. Relevant directives have been important pieces of Community environmental legislation in these sectors.

4.2.1.1 Water

The areas of Community environmental policy incorporate water, air, noise and waste management. Water pollution policy is perhaps the oldest sector of Community Environment Policy. This reflects the historical situation in most Member States, where problems of water pollution have been dominant. The policy refers to a system of "quality objectives", based on the desired quality of the receiving environment, and to a system of "emission standards" which are considered to be more restricting, by fixing the maximum permissible quantities of pollutants to be discharged into the aquatic environment. The first Council directive of 1975 (Directive 75/440) was concerned with the quality of surface water intended for the abstraction of drinking water in Member States. Directive 76/160 covered minimum quality of bathing water by laying down values corresponding to micro-biological and physio-chemical parameters. Another aspect of water quality requirements relates to water for freshwater fish. Member States must designate the waters to which the directive applies. Most importantly, directives have been issued addressing the discharge of dangerous substances into the aquatic environment. The 1976 Directive (Directive 76/464) on pollution by certain dangerous substances discharged into the aquatic environment groups dangerous substances into two categories. The first, called the "Black List" or "List I", includes the substances considered to be the most dangerous due to their toxicity, persistence or bioaccumulation in the aquatic environment. The second category, the "Grey List" or "List II", covers other substances which are considered to have a less harmful effect on the aquatic environment. The general aim of the directive is to eliminate water pollution caused by substances on the "Black List", and also to reduce pollution caused by substances on the "Grey List".

4.2.1.2 Air

Air pollution has become an issue of major concern, and is a priority sector in Community Environment Policy. The considerable damage caused to forests by acid rain in northern countries of the Community has helped galvanise efforts in this area. Directives establishing general quality standards for air have been adopted. The public health criteria have been used for the evaluation of polluting substances. Priority is given to "first category" pollutants which have been identified for their toxicity and significance in the health and ecological fields. Sulphur dioxide and suspended particulate matter in the atmosphere are part of the category. The Directive 80/779 sets "limit values" and "guide values" for sulphur dioxide and suspended particulate matter in the atmosphere. "Limit values" define concentrations of SO_2 and suspended particulate matter which must not be exceeded during set periods, with a view to

Table 4-1: List I Families and Groups of Substances

List I contains certain individual substances which belong to the following families and groups of substances, selected mainly on the basis of their toxicity, persistence and bioaccumulation, with the exception of those which are biologically harmless or which are rapidly converted into substances which are biologically harmless:

1. Organohalogen compounds and substances which may form such compounds in the aquatic environment;
2. Organophosphorus compounds;
3. Organotin compounds;
4. Substances in respect of which it has been proved that they possess carcinogenic properties in or via the aquatic environment;
5. Mercury and its compounds;
6. Cadmium and its compounds;
7. Persistent mineral oils and hydrocarbons of petroleum origin;
8. Persistent synthetic substances which may float, remain in suspension or sink and which may interfere with any use of the waters.

Source: Adapted from Johnson and Corcelle, (1989) Table 3.6, p. 69

Table 4-2: List II of Families and Groups of Substances

List II contains substances belonging to the families and groups of substances in List I; certain individual substances and categories of substances belonging to the families and groups of substances listed below; and which have a deleterious effect on the aquatic environment, which can, however, be confined to a given area and which depend on characteristics and location of water into which they are discharged .

1. The following metalloids and metals and their compounds:

1.	Zinc	6.	Selenium	11.	Tin	16.	Vanadium
2.	Copper	7.	Arsenic	12.	Barium	17.	Cobalt
3.	Nickel	8.	Antimony	13.	Beryllium	18.	Thalium
4.	Chromium	9.	Molybdenum	14.	Boron	19.	Tellurium
5.	Lead	10.	Titanium	15.	Uranium	20.	Silver

2. Biocides and their derivatives
3. Substances which have a deleterious effect on the taste and/or smell of the products for human consumption derived from the aquatic environment, and compounds liable to give rise to such substances in water.
4. Toxic or persistent organic compounds of silicon, and substances which may give rise to such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances.
5. Inorganic compounds of phosphorus and elemental phosphorus.
6. Non-persistent mineral oils and hydrocarbons of petroleum origin.
7. Cyanides, fluorides.
8. Substances which have adverse effect on the oxygen balance, particularly: ammonia, nitrites.

Source: Adapted from Johnson and Corcelle, (1989) Table 3.6, p. 69

protecting human health. The "guide values" are intended to serve as long-term precautions for health and the environment and as reference points for establishing specific schemes by Member States. Other efforts for air quality standards are represented by directives on lead (Directive 82/884) and nitrogen dioxide (Directive 85/203).

4.2.2 Preventive Action

The policy of preventive action forms an important area of priority for Community environmental policy. This policy was aimed at introducing into national administrative measures for authorisation of projects, common rules and principles allowing for a prior evaluation of the effects of the project on the environment. Such prior assessment was seen as essential to a proper understanding of the environmental effects of major projects. The Environmental Impact Assessment Directive 85/337 marks a crucial step in Community Environment Policy in that it means the implementation of a truly preventive approach to environmental problems. The essential principle of the directive is that any developer, public or private, of a project which might have significant effect on the environment, is required to provide information to the appropriate public authorities in the area of the environment. This information has to be taken into consideration by the public authorities responsible for granting the permission of the project in question.

4.2.2.1 Environmental Assessment

The European Directive on environmental assessment (Directive 85/337) was implemented in the UK in 1988. The Directive requires an environmental impact statement to be prepared for all proposed developments which might have significant effect on the environment. Annex 1 of the Directive lists types of projects for which EA is mandatory. These types include large power stations with output of 300MW or more, crude oil refineries, asbestos plants, some roads, long distance railway lines and aerodromes with more than 2100 metres of planned runway. A second list, Annex II is subject to Member States consideration. They include projects in agriculture, extractive, energy, metal processing, glass making, chemical, food , textile, leather, wood, paper and rubber industries.

4.2.3 Pollution Control

Pollution control refers to action taken to prevent or reduce pollution. Pollution in general covers the results of

Man's activities on the physical environment. It includes the introduction of waste matter or surplus energy into any part of the environment, which so changes or will change the environment as to affect its use. Any system of pollution control will include at least four elements.

a) Formulation of pollution control policies.

b) Administration of the scheme of control.

c) Enforcement of controls.

d) Research and gathering of information necessary to any progressive system of control (McLoughlin and Bellinger, 1993).

Within the field of pollution control, there is always a strong case for an integrated system of control. This is a system in which all forms of control are administered by a single authority. This enables the control authority to choose the best environmental option for the disposal of waste. McLoughlin and Bellinger (1993) review other systems of pollution control employed in different countries. This includes a system of internal departmental control, in which a ministry which promotes a particular activity, also controls any pollution therefrom. In the United Kingdom, for example, the Ministry of Agriculture, Fisheries and Food promotes agricultural production, but also exercises controls over the use of pesticides for the protection of consumers and the environment. This offers the advantage of administrative controls being carried out by people who have close knowledge of those involved in the polluting or potentially polluting activity. However, there will be a conflict of interest within the ministry. It has a duty to promote agriculture, and also a duty to control the use of pesticides for the sake of health. The US Federal Environmental Protection Agency represents another type of control system. This authority exercises controls over all sources and forms of pollution and is entirely independent of any department of government which conducts or promotes such activities. The main advantage of this system is that decisions on standards and on enforcement are made by a body independently of any interests in conducting activities which could give rise to pollution. There is, therefore, no conflict of interest within the Agency.

4.2.4 Types Of Controls

These can be classified as follows:

1. Economic and fiscal controls;

2. Administrative controls;

3. Legal controls.

The polluter pays principle (PPP) is a key principle of the EEC's environmental policy. The principle implies that the cost of preventing pollution or minimising environmental damage due to pollution should be borne by those responsible for the pollution. In economic terms, its effect is to internalise the costs in question.

4.2.5 Command-and-Control Versus Economic Strategies

The two principal approaches to pollution control and waste management are the command-and-control and economic strategies. Environmental policies in developed countries have tended to use the former as the predominant strategy in pollution control and waste management. This approach requires a government to set health-or ecology-based ambient environmental objectives and specify the standards or the amount of pollutants that can be discharged or the technology by which polluters should use to meet those objectives. In most cases this approach specifies schedules for meeting these standards, permitting and enforcement procedures for facilities, liability and penalties for non-compliance. The regulating authority has control over where and how resources will be spent to achieve environmental objectives. The major advantage of this approach is that it provides the regulator a reasonable degree of predictability about how much pollution levels will be reduced. It also protects competition among facilities. For example, in the case of air pollution control in the US, all new facilities must adopt uniform abatement technology. Criticism of this approach centres on the amount of detailed information needed concerning production processes and suitability of various pollution control devices. It provides little incentive for innovation in pollution control technology once the standards are achieved.

In recent years economic instruments have been adopted to introduce more flexibility, efficiency and cost-effectiveness into pollution control measures. Most of these measures operate as incentives to polluters who can determine the most efficient and cost-effective means of achieving environmental targets. They incorporate the polluter-pays and user-pays principles. According to the polluter-pays principle, the polluter pays a financial penalty for higher levels of pollution and pays a smaller penalty or receives a financial reward for lower levels of pollution. According to the user pays principle, the user of a resource pays the full social cost of supplying the resource, such as for water and related services including treatment costs (OECD, 1990).

When properly implemented, the economic approach has several advantages. It can:

- promote cost-effective means for achieving acceptable levels of pollution;
- stimulate development of pollution control technology and expertise in the private sector;
- provide government with a source of revenue to support pollution control programmes;
- provide flexibility in pollution control technologies; and
- eliminate a government's requirement for large amounts of detailed information needed to determine the feasibility and appropriate level of control for each plant or product (OECD, 1989).

Economic instruments have certain disadvantages, however, one significant problem being that their effects on environmental quality are not as predictable as those under the traditional approach, since the polluters may choose their own solutions. In the case of charges, some polluters may choose to pollute if the charge is not set at an appropriately high level. From the standpoint of developing countries, another major weakness of economic instruments is that they require sophisticated institutions to implement and enforce them.

4.2.6 Regulatory instruments

4.2.6.1 Standards

These are the predominant means for direct regulation of environmental quality in most industrialised countries. They define environmental targets and establish the permissible amount or concentration of particular substances or discharges into air, water, land or consumer products. Types of standards include: ambient environmental quality standards, effluent or emission standards, technology-based standards, performance standards, product standards and process standards. Standards may also include technological specifications for the performance or design of equipment or facilities and standardisation of sampling or analytical methods. Each of the various types of standards is used to provide a reference for evaluation or target for legislative action and control. Standard setting presupposes the existence of a monitoring agency that oversees polluters' activities and has the power to impose a penalty for non-compliance.

4.2.6.2 Ambient Environmental Quality Standards.

Ambient environmental quality standards are used principally for protecting water and air quality. Ambient water quality standards, for example, specify the minimum conditions that must be met for specific parameters at specific locations in a water body. They are set on the basis of scientific criteria that assess the risk to a given victim and the amount of damage caused by a known dose of exposure to a pollutant. Ambient water quality standards are set for designated use for the water and identify the maximum concentration of various pollutants that would interfere with that use. A broad range of pollutants are covered including oils, solids, faecal coliform, dissolved oxygen and various toxic substances like herbicides and pesticides. Ambient air quality standards are the principal means for direct regulation of air pollution. The two principal types of standards that apply to air pollution control are ambient air quality and emission standards, which are applied to both stationary and mobile sources. In the US there are two levels of National Ambient Air Quality Standards (NAAQS); primary standards set at all levels necessary to protect human health; and secondary standards, set to protect welfare. The latter encompasses air pollution effects on soils, water, crops, vegetation, animals, wildlife etc., as well as effects on economic values, personal comfort and well being.

4.2.6.3 Effluent and Emission Standards

Effluent or emission standards are mean or maximum values for allowable concentrations or quantities of pollutants that may be discharged into a water body or emitted into the atmosphere; they must be achieved by an individual source at the point of discharge. Limitations may be applied to the entire plant or to each pipe discharging from the plant. Special effluent standards may be set for particular industries. In some cases, a distinction is made between standards applicable to all industries and standards specific to particular industries. Generally, ambient and effluent standards are complementary components of a regulatory scheme to control water or air pollution. For air quality emissions standards are limits set for the discharge of pollutants from individual sources. In the US the most important controls over stationary sources of air pollution are known as new source performance standards (NSPPs). NSPPs set maximum emission levels determined by the "best technological system of continuous emission reduction", taking into account affordability to affected parties (Portney, 1990).

4.2.6.4 Product and Process Standards
These establish a legal ceiling on the amount of polluting products that can be discharged into surface water, ground water, and the atmosphere. An example of a process standard is the removal of phosphates from detergents or prohibiting the addition of lead to petrol to eliminate lead discharges from cars.

4.2.7 Economic instruments

4.2.7.1 Effluent and Emission Charges
These are fees levied by a government authority based on the quantity and/or quality of pollutants discharged into the environment by an industrial facility. Generally, effluent and emission charges are used in conjunction with standards and permits and allow ambient air and water quality standards to be achieved at the least possible cost. An effluent or emission charge is based on some measure of the

pollution dispensed in the environment. To control water pollution, for example, the charge can be based on: water quality objectives, the costs of financing a pollution abatement scheme, or effluent standards.

4.2.7.2 User Charges

User charges are direct payment for the costs of collective or public treatment of pollution. They are used most often in the collection and treatment of municipal solid waste and for discharge of wastewater into sewers. With respect to water pollution control, user charges are fees paid to water authorities to allow discharges of industrial wastes in public sewers.

4.2.8 Institutional Requirements

In many instances, existing laws provide sufficient authority for carrying out environmental policies through various regulatory and economic instruments. The effective implementation and enforcement of regulatory instruments will require responsible institutions to carry out a range of activities that will induce compliance and achieve improved environmental quality. Regulatory institutions may need to:

- develop and issue ambient environmental quality and effluent/emission standards for air and water quality parameters and specify and carry out monitoring programs and facility inspections;
- prohibit certain polluting activities and monitor compliance;
- require environmentally protective practices and procedures (e.g., pre-treatment of industrial waste before discharge into municipal treatment plants);
- establish design, process and operation specifications applicable to industrial and municipal sources of pollution and develop and carry out procedures for inspection and issuing licences and permits; and
- establish and impose fines and other sanctions for non-compliance.

Effective enforcement mechanisms and institutions are crucial to the success of any command-and-control as well as economic strategy to improve environmental quality and management of wastes.

4.2.9 Monitoring of Environment Directives

The European Commission is responsible for monitoring the performance of Member States in complying with Directives. Where a Member State is in breach of EC legislation it can initiate action in the European Court of Justice. Individuals in Member States may also complain to the Court if they feel EC legislation is being breached.

4.3 Environmental Policy In The United Kingdom

4.3.1 Integrated Pollution Control

The continued proliferation of environmental policies and regulations in many countries has given rise to the need for the integration and coherence of institutional structures dealing with the environment. Since environmental issues are inherently difficult to compartmentalise there has been a shift from legislation focused on individual media. Environmental legislation is being worked out that attempts to minimise impacts of developments on the environment as a whole. This addresses the institutional and legislative structures which dealt with the environment in an ad hoc, incremental and ineffective way (McCormick, 1991; Ball and Bell, 1991).

In the United Kingdom, the Environmental Protection Act 1990 addresses pollution control, waste on land, statutory nuisances and clean air. Other issues covered include litter, radioactive substances, genetically modified organisms and nature conservation. It provides for improved pollution control from industrial and other processes and re-enacts the provisions of the Control of Pollution Act 1974 relating to waste on land. Modifications with respect to the functions of regulatory and other authorities concerned with the collection and disposal of waste have been made. It also provides for the extension of the Clean Air Acts to prescribed gases.

The fifth report of the Royal Commission on Environmental Pollution in 1976 made proposals for an integration of pollution control. The report drew attention to the cross-media movement of pollution (Murley, 1994). Part 1 of the Act makes provision for two systems of pollution control. The practice of Integrated Pollution Control (IPC) is administered by Her Majesty's Inspectorate of Pollution (HMIP), and the Air Pollution Control (APC) by local authorities. IPC covers all major solid, liquid and gaseous emissions to air, land and water from the most polluting and complex industrial processes. Integrated Pollution Control is a system of authorisation, control and enforcement of processes capable of causing pollution to the environment (Garbutt, 1992). A process falls into this category if it discharges to air, water or land substances which are detrimental to Man or any other living organism supported by the environment. The IPC is intended to prevent and minimise pollution of the environment due to the release of substances into an environmental medium. By contrast Local Authority Air Pollution Control is exercisable for the purpose of preventing or minimising pollution of the environment due to release of substances into the air. IPC introduces two key concepts of Best Available Techniques Not Entailing Excessive Cost (BATNEEC) and Best Practicable Environmental Option (BPEO). IPC requires operators of processes to show to the HMIP that they use BATNEEC to prevent, minimise, or render harmless the release of prescribed substances. Where a process may involve releases into more than one environmental medium, the use of BPEO to minimise pollution to the environment as a whole should be demonstrated by operators. The use of technology-based emission standards, based on BATNEEC, was necessary for discharges to water of substances representing the greatest threat because of their toxicity, persistence and their capacity for bio-accumulation (Tromans, 1991).

In the main, Part 1 of the Act provides an integrated approach to pollution of all three media. Its concentration is on the likely hazardous processes and substances. The control is by prior consent, combined with duty of care and the use of best available technology. This has to be achieved within the framework of E.C requirements.

4.3.2 Quality Targets

Section 3 of the Act provides the basis for targets at which the Secretary of State will aim. Standards, objectives or requirements are established in relation to the prescribed processes of particular substances. The Secretary of State will:

1. limit the concentration, the amount or the amount in any period of a substance to be released from a prescribed process;
2. limit any characteristic of the substance to be released;
3. prescribe standard requirements for measurements

4. prescribe other standards or requirements as to any aspect of the process.

4.3.3 Water Pollution

Statutory water quality objectives were introduced under the Water Act 1989. Since the water industry has been placed in the private sector, only legal standards would ensure that public policy aims are pursued. The Environmental Protection Act 1990, in relation to integrated pollution control, goes much further by providing extensive powers to the Secretary of State to set a range of various types of standards (Lomas, 1991). Whilst the water companies are suppliers of water and sewerage services, the regulatory function devolves to the National Rivers Authority (NRA). The prevention of water pollution in England and Wales derives from the Water Resources Act 1991, which replaced the provisions of the Control of Pollution Act 1974 and the Water Act 1989. There are three components to the Water Resources Act 1991, namely, "controlled waters", "water quality objectives" and the achievement of those objectives. "Controlled waters" as defined in Section 104 includes lakes and ponds, rivers, estuaries, underground water and certain coastal waters. Sections 82-84 mandates the Secretary of

State to categorise the quality of controlled waters and to specify water quality objectives, which the NRA has to achieve and maintain. Under Section 85, offences are committed if:

(a) any poisonous, noxious or polluting matter or any solid waste is permitted to enter any controlled waters;

(b) any matter other than trade effluent or sewage effluent is allowed to enter controlled waters through discharge to a drain or sewer in contravention of a relevant prohibition;

(c) any trade effluent or sewage effluent is permitted to be discharged to any controlled waters or into the sea outside controlled waters;

(d) generally any trade effluent or sewage effluent is discharged in contravention of any relevant prohibition from any building or plant onto land or inland water.

The discharge of prescribed substances into water falls within the IPC system of control. Before granting consent for discharge, the HMIP must consult with the National Rivers Authority. The NRA can grant conditions which the HMIP must include in the authorisation to the person carrying out prescribed processes. As well as having powers to take preventative action, the NRA can take action to clean up the site and recover the cost from the person who caused, or permitted the pollution.

Table 4-3 shows the list of IPC Processes that are subject to Her Majesty's Inspectorate of Pollution Control, and Table 4-4 is a list of processes subject to Local Authority Pollution Control.

4.3.4 Agriculture And The Environment

Increased consideration has been paid to environmental protection in agriculture. Agriculture has a direct and profound impact on the environment. Concern has increased as a result of the technological changes that have radically changed farming practices. Concern has been expressed with regard to environmental problems associated with intensive livestock units, and with excessive use of artificial fertilisers and pesticides.

The Food and Environment Protection Act 1985 addressed the issue of hazardous substances, such as pesticides, in the agricultural sector. Pesticides are toxic chemicals intended to control insect, rodent and other pest infestations. Their

Table 4-3: List of IPC Processes Subject to Her Majesty's Inspectorate of Pollution Control

Fuel and Power Industry	Metal Industry
Gasification	Iron and steel
Carbonisation	Smelting
Combustion	Non-ferrous
Petroleum	
Waste Disposal Industry	
Incineration	
Chemical recovery	
Chemical waste treatment	
Waste-derived fuel	
Mineral Industry	**Other Industry**
Cement	Paper pulp
Asbestos	Di-isocyanate
Fibre	Tar and bitumen
Glass	Uranium
Ceramic	Coating
	Printing ink and coating
	Animal and plant treatment
Chemical Industry	
Petrochemical	
Organic chemical	
Chemical pesticide	
Pharmaceutical	
Acid manufacturing	
Halogen	
Chemical fertiliser	
Bulk chemical storage	
Inorganic chemical	

Source: Tables 4-3 and 4-4 taken from Tromans, (1991) Environmental Protection Act. Text and Commentary

Table 4-4: List of Processes Subject to Local Authority Air Pollution Controls (LAAPC)

1.3	Combustion	3.5	Glass	6.8	Animal & Plant Treatment
a.	Boiler 20-50MW	a.	Glass Manufacture	a.	Animal Rendering
b.	Gas Turbine 20-50MW	b.	Lead	b.	Fish Meal & Fish Oil
c.	Compression Engine	c.	Polishing	c.	Maggot Breeding
d.	Waste Oil<0.4MW	d.	Skins & Hides		
e.	Waste-derived fuel	3.6	Ceramic	e.	By-Product Dealers
f.	Tyres			f.	Animal Feed
g.	Straw	5.1	Incinerators	g.	Edible Sausage Casings
h.	Wood	a.	Containers	h.	Pet Food
i.	Poultry litter	b.	General Waste	i.	Fur Breeding
j.	Waste Oil 0.4-3MW	c.	Sewage Sludge	j.	Composting/Fertiliser
		d.	Clinical Waste Manufacture		
2.1	Iron and Steel	e.	Crematoria	k.	Other Edible By-products
a.	Cupolas	f.	Animal Crematoria		
b.	Electrical and Rotary				
c.	Foundry Operations	5.2	Solvent & Oil Recovery		
2.2	Non-Ferrous Metals	6.2	Di-isocyanates		
a.	Aluminium				
b.	Copper/Brass	6.5	Coating		
c.	Zinc	a.	Metal Containers		
d.	Scrap	b.	Respraying		
e.	Galvanizing	c.	Vehicles		
f.	Foundry Operations	d.	Appliances & Others		
g.	Other Non-ferrous	e.	Fabric		
h.	Metal decontamination	f.	Printing		
		g.	Coil		
3.1	Cement and Lime	h.	Adhesive		
a.	Cement	i.	Paper		
b.	Lime	j.	Film		
		k.	Powder		
3.2	Asbestos				
		6.6	Coating Manufacture		
3.4	Mineral	a.	Ink		
a.	Coal	b.	Paint		
b.	Crushing/Quarrying	c.	Adhesive		
c.	Roadstone	d.	Powder and Resin		
d.	Plaster	e.	Metal Powders		
e.	Sand Drying				
f.	China Clay	6.7	Timber		
g.	Clay Drying	a.	Manufacture		
h.	Perlite	b.	Chemical Treatment		
i.	Vermiculite	c.	Chipboard		
j.	Sintered Aggregates				
k.	Others				

use in agriculture provide benefits which include reduction of disease and increased yields. Their overuse and misuse, in some instances, has resulted in various pests developing resistance to certain pesticides; the widespread use of pesticides can also mean that some crops may receive multiple applications; and workers may risk occupational exposure. Pesticide use can also result in environmental damage to rivers, wildlife and vegetation (Pimentel and Edwards, 1982; Mhlanga and Madziva, 1990; Buffin and Dudley, 1992).

Regulations regarding the use of pesticides have been formulated:

a) to protect the health of human beings, creatures and plants;

b) to safeguard the environment;

c) to secure safe, efficient and humane methods of controlling pests; and

d) to provide information on these subjects. The powers include rights to impose prohibitions, and approve pesticides for specified uses.

The control of water pollution from agricultural practices, in particular the use of nitrates and pesticides, has been a source of great concern. A Code of Practice for the Safe Use of Pesticides on Farms and Holdings 1990, deals with the disposal of waste pesticides and containers and the aerial application of pesticides. Codes of Good Agricultural Practice for protection of air (MAFF, 1992) and water have been published. The Codes summarise the various pieces of legislation which farmers should be aware of. With regard to air pollution, the Code gives practical guidance on reducing problems of odour from livestock systems, slurry and manure storage, land spreading of livestock wastes and emissions of ammonia and greenhouse gases. The Code dealing with protection of soil suggests ways of preventing soil erosion and loss of organic matter. It also gives a reminder that wastes and pesticides should not be applied in quantities that are likely to accumulate in the soil.

In 1991 a joint panel of FAO/UNEP experts finalised the initial Prior Informed Consent (PIC) list of chemicals: 17 pesticides and 6 industrial chemicals. A further 24 pesticides have been earmarked as "candidates" and are likely to be included in the list. The system of PIC should provide governments with information regarding chemicals which have been banned or severely restricted in some countries for health or environmental reasons. The FAO and UNEP have adopted codes to set down guidelines and ethics for the distribution and use of chemicals, including pesticides. The two codes have adopted a common approach to PIC (FAO, 1990b; *Pesticide News*, 1991). In Africa 76 percent of the countries have no legislation enabling governments to restrict the pesticides that can be marketed or to limit their availability. Yet even where adequate legislation exists, regulatory agencies are often unable to assess pesticide hazards in the light of local conditions and enforce the findings (Loevinsohn, 1991). Environmental and health hazards created by the expanding use of pesticides in developing countries stem from the weakness of national regulatory agencies. The trend in many industrial countries is towards the reduction of the amounts of pesticides used. Programmes to reduce pesticide use are in place in Sweden, the Netherlands and Denmark. This is a result of proposals

Table 4-5: THE "RED LIST"

The Initial Priority Red List Comprises The Following Substances:

Mercury and it's compounds	1,2-Dichloroethane
Cadmium and it's compounds	Trichlorobenzene
Gamma-hexachlorocyclohexane	Atrazine
DDT	Simazine
Pentachlorophenol	Triburyltin compounds
Hexachlorobenzene	Triphenyltin compounds
Hexachlorobutadiene	Trifluralin
Aldrin	Fenitrothion
Dieldrin	Azinphos-methyl
Endrin	Malathion
Polychlorinated biphenyls	
Endosulfan	
Dichlorvos	

Source: Ministry of Agriculture Fisheries and Food Publications

Table 4-6: THE DIRTY DOZEN

Aldrin	**To be added if still in use**
Chlordane	Camphechlor (toxaphene)
DDT	Endrin
Dieldrin	DBCP
EDB	**On Candidate PIC List**
HCH/BHC (mixed isomers)	Aldicarb
Heptachlor	Lindane
Paraquat	Pentachlorophenol
Parathion ethyl/and methyl	
2,4,5-T	

Source: *Pesticide News* 12:13 July 1991

Table 4-7: PESTICIDES AND INDUSTRIAL CHEMICALS ON PIC LIST AS AT 7TH JUNE 1991

Initial PIC List

Pesticides	**Chemicals**
Aldrin	Crocidolite
Chlordane	Polybrominated biphenyls
Chlordimeform	Polychlorinated biphenyls (except mono & di)
Cyhexatin	Polychlorinated terphenyls
Dieldrin	Tris(2,3 dibromopropyl) phosphate
Dinoseb	Tris-aziridinyl-phosphate
Fluoroacetamide	**Pesticides to be added**
HCH (Mixed Isomers)	**if still produced and in use**
Heptachlor	Chlordelone
Mercury-Inorganic	DBCP
Mercury-Organic	Endrin
Paraquat*	Kelevan
Parathion ethyl*	Leptophos
Parathion methyl*	Nitrofen
2,4,5-T	Schradan
	Strobane
	Telodrin
	Thallium Sulphate
	Toxaphene

Source: *Pesticide News* 12:13 July 1991

and conclusions that it is possible to reduce pesticide use without reducing crop yields, and the fear that some countries may be overusing pesticides (Pimentel *et al.*, 1991).

In 1989 the government of the UK announced an initial list of 23 substances (The "Red List") to be subject to stricter controls for both direct and indirect discharges to water. These substances are included on the EC "Black List" (i.e.

List I) which is annexed to EC Directive 76/464 concerning the discharge of dangerous substances to the water. All these are prescribed substances under Part I of the Environmental Protection Act 1990 and are subject to controls based on BATNEEC.

4.3.5 Strategic Environmental Assessments

Strategic Environmental Assessment (SEA) is a formalised, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or programme and its alternatives (Therivel *et al.* 1992). The findings of such an evaluation are used in publicly accountable decision-making. SEA is considered to be an improvement over the project oriented EIA. EIA at strategic level allows for a more proactive approach to be taken and also considers the cumulative impacts of more than one project. Therivel *et al.*(1992), argue that project EIA cannot in itself lead to a comprehensive protection of the environment for the following reasons. First, it reacts to development proposals rather than anticipating them. Second, it does not adequately address the cumulative impacts of more than one project. This limitation is caused by lack of knowledge concerning other development proposals. Third, project EIA only addresses alternatives to the proposed project in a limited manner.

Geographical Information Systems (GIS) can be particularly useful in modelling and predicting changes to the environment. GIS files could be used as part of the SEA report to allow alternative options to be compared. This requires that government or management authorities have the organisational structures to enable GIS to play an integral role in decision making. GIS has proved valuable in Integrated Forestry Strategies in Scotland. These identify areas of forestry potential and suggest areas unsuitable for planting (Davidson, 1992).

4.3.6 Environmental Management Systems

This forms part of the European Community's Eco-Management and Audit Regulation of 1992. In 1992 the British Standards Institution published *Environmental Management System, British Standard BS 7750*. This describes a system of management which companies can use to ensure that:

1. they comply with environmental legislation
2. their products or services are produced, delivered and disposed of in an environmentally friendly manner;

3. expenditure on environmental protection is timely and effective, and that planning for future investment and growth reflects market needs on the environment (British Standards Institution, 1992).

4.4 Environmental Strategies in Developing Countries

In most developing countries, institutions at all levels of government have not established effective pollution control and waste management programs that take into account country-specific problems, nor have they had the capacity to adequately develop and implement standards, regulations and charging systems. The implementation and enforcement of regulatory and economic instruments has been constrained by: inadequate expertise, funds, and equipment; lack of political will; limited public support and participation; unclear or overlapping and uncoordinated institutional responsibilities; and lack of effective financial management for collecting charges. Local institutions in developing countries will require substantial strengthening in terms of human resources, organisational structure and financial resources for effective pollution control and waste management strategies.

Based on a review of literature addressing pollution control and waste management, there are few reports providing in-depth evaluations of the application of regulatory and economic instruments in developing countries. Most reports provide information on the existence of standards or other regulatory or economic instruments and highlight the inadequacy of existing institutions and personnel to carry out effective monitoring and enforcement activities. Experience in the developed countries points to a number of considerations that should be taken into account when planning environmental strategies and selecting policy instruments in developing countries. Firstly, economic instruments cannot be successfully implemented without pre-existing appropriate standards and effective monitoring and enforcement capacities. Secondly, economic instruments are not likely to replace the traditional regulatory instruments, even if effective monitoring and enforcement capacities could be established. Lastly, among various economic instruments, charges have the most potential for contributing to the achievement of pollution control and waste management objectives in developing countries, given adequate enforcement mechanisms. In designing new environmental programs in developing countries, the fundamental problem will be to determine the most appropriate mix of instruments taking into account the practical, economic and political realities. What is needed is to establish approaches that take into account cross-media pollution effects and appropriate standards for developing countries together with means for building appropriate monitoring and enforcement capabilities.

CHAPTER FIVE

SECTORAL CASE STUDY I - THE MINING INDUSTRY

5.1 Introduction

This part of the study looks at three sectors of the economy and their implications for the environment. The sectors of mining, agriculture and tourism have been selected on the basis of their dominance in Zambia's development strategy and their impact on the environment. This chapter introduces the mining industry as the first sectoral case study.

Mining in Zambia remains the dominant component of the Country's economy, with copper earnings contributing more than 50% of foreign exchange. The mining activities are concentrated in a Northwest-Southeast belt through central Zambia and especially around Kitwe.

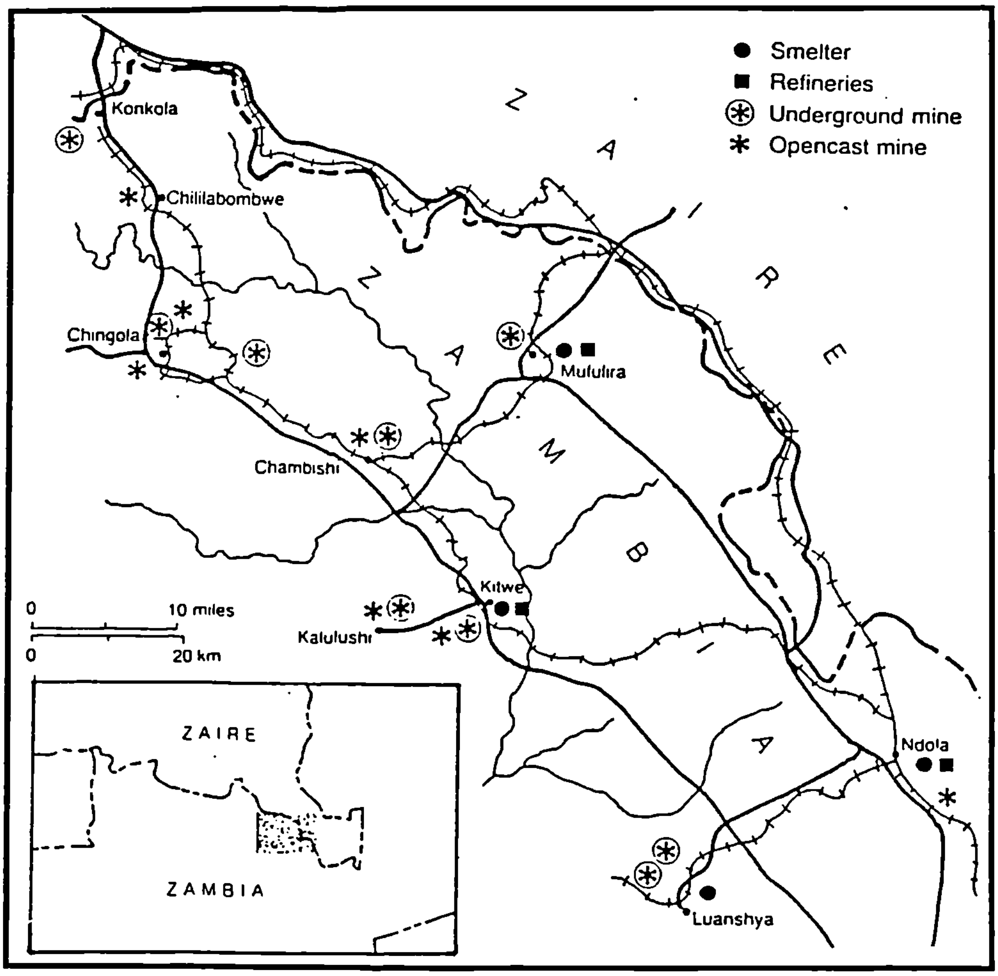
Zambia's Copperbelt province sustains the country's main source of foreign exchange earnings and emplovment through mining activities. The area contains the world's largest open cast mine at the Nchanga Division of the Zambia

Consolidated Copper Mines at Chingola and possibly the world's wettest mine at Konkola.

The immense scale of the mining industry has contributed to considerable environmental pollution, including the formation of waste rock and tailings dumps, silt and effluent discharges into the Kafue river system. These effluents contain a large range of metallic and other chemical substances, including cyanide, as solid or dissolved pollutants. Suspended solids will settle and may undergo chemical change in anaerobic sediments. These polluting substances may be released when the sediments are disturbed.

The mining sector has influenced the establishment of other industries in the country, such as construction, transport and communication. Collectively these industries have had a great impact on the environment. The most obvious physical damage to the environment caused by mining is open pit mining and excavation and the slag heap and slimes dam landscapes which it creates. The areas most susceptible to air pollution are also those in the copper mining region, the Copperbelt and coal mining areas in Maamba. The presence

Figure 3-1: The Copperbelt Mining Region of Zambia



Source: Lewis and Berry, (1988)

of lead particles in the atmosphere from the metallurgical plant and lead particles blown into the atmosphere by wind acting on dumps, could subject miners and the local population to lead poisoning in Kabwe. Sulphur dioxide emissions are responsible for some local vegetation damage which is already evident where sulphur compounds and acid rain are generated by copper smelting. The long range transport of sulphates threatens agricultural and forestry land and commercial plantations and affects fisheries within and beyond the Copperbelt. Some effects on health have also been observed. Currently about 20% of out-patient morbidity conditions in children under 15 years are caused by upper respiratory tract infections, indicating high exposure to air pollution (GRZ 1992b). This is particularly evident during overcast atmospheric conditions in Kitwe, Mufulira, Chambishi and Luanshya. The other mining processes of smelting and the ultimate effluent discharge into waterways pollute water resources. Water pollution resulting in cattle mortality, dying fish, outbreaks of gastric disorders and diarrhoea were observed on the Copperbelt between 1981 and 1985. This mortality has been linked to water pollution by copper and cobalt. In other parts of the country, liquid and solid effluents from coal washing plants, mine dumps and pit workings at Maamba have very low pH values, indicating high acidity. In the absence of research, their impact on plants and animal life has not yet been established, although their impacts are well documented elsewhere in the world.

Although water pollution effects from copper smelting appear to be highly localised, current constraints to reduce production costs could increase the discharge of toxic effluents into the Kafue river basin with repercussions outside the Copperbelt, especially on the irrigated lands of the south. Other industrial areas of Kafue already exhibit pollution problems, for instance eutrophication of the Kafue River by effluent from the Nitrogen Chemicals of Zambia's fertiliser industry. This is probably contributing to the decline of local fish stock in the area.

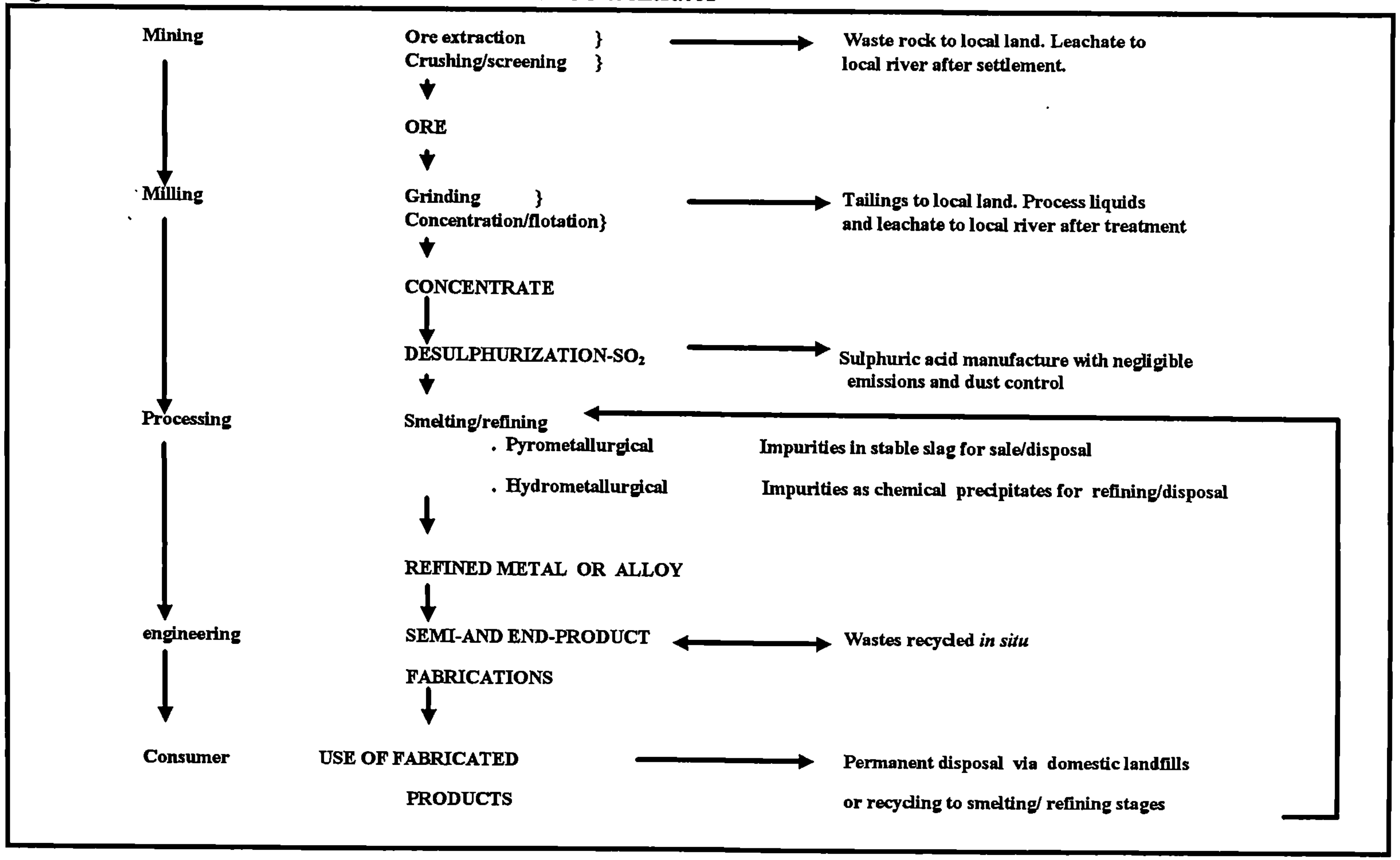
The Kafue river basin has been subjected to damage arising from activities of the mining operations. This region is one of the most densely populated areas in the country and also one of the most economically developed.

5.2 The Mining Process

5.2.1 Extraction and Concentration (Mining and Milling)

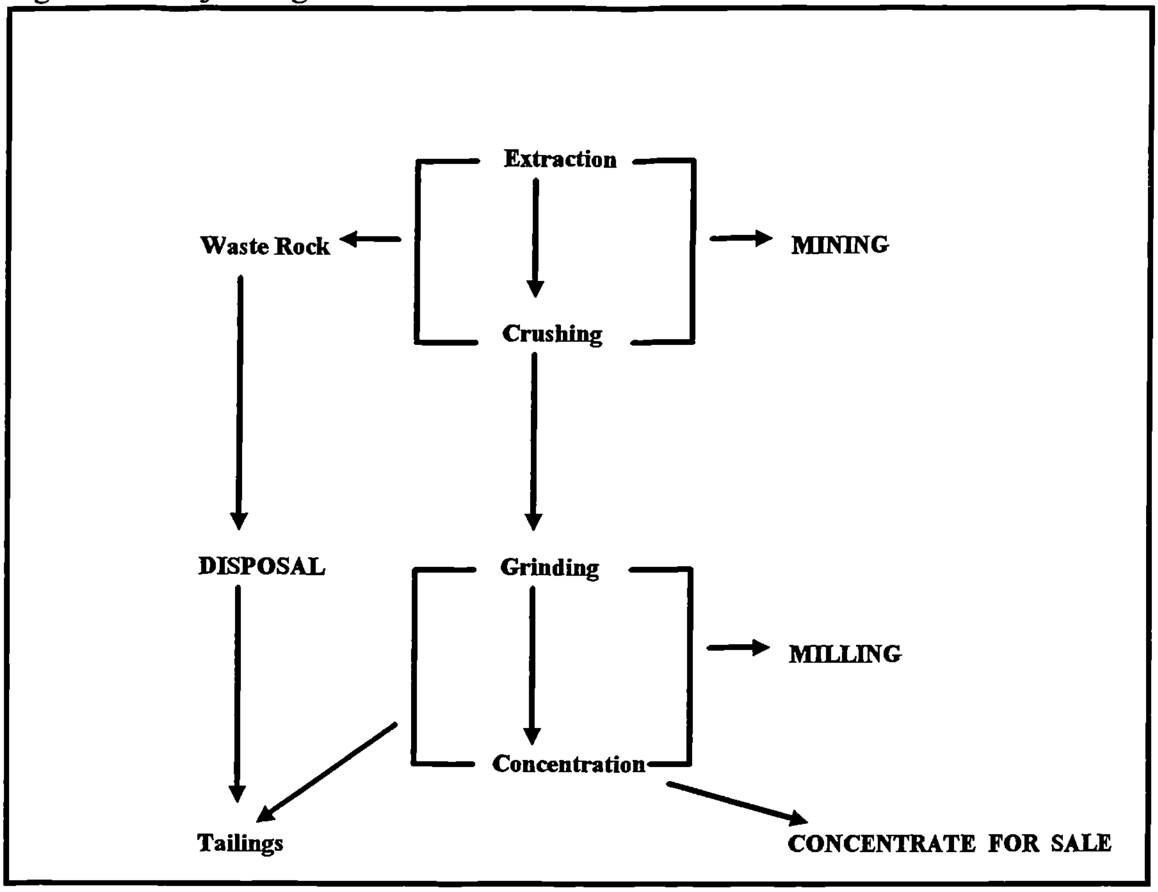
Natural concentrations of non-ferrous metals are very low and always contain unwanted impurities. Hence the tonnages of waste products in form of tailings and overburden can be very large, amounting to many million tonnes per annum from an individual copper mine.

Figure 5-1: Production Process of Non-ferrous Concentrates



Source: Hester and Harrison (1994).

Figure 5-2: Major Stages in the Production of Non-ferrous Concentrates



Source: Hester and Harrison (1994).

Non-ferrous ores are extracted from both open-pit and underground mines. The production process and stages of non-ferrous concentrates are in Figures 5-1 and 5-2.

5.2.2 Impacts on the Environment

In a study of environmental impact assessments of open cast coal mining, Walsh *et al.*, (1991) identified a number of impacts not only associated with coal but extending to other mineral exploitation.

Table 5-1: Environmental Impacts Associated with Mining Operations

On-site Activity	Impacts
Overburden removal and stockpiling	Dust; noise; blasting; vibration; visual intrusion; effects on ecology; water table effects
Mineral ore removal	blasting; vibration; noise; dust; water table effects; water pollution; effects on aquatic ecology
Waste water treatment	Discharge of liquid effluent; water pollution; effects on aquatic ecology.

Source: Walsh *et al., 1991*

They include noise, effects on hydrology, local ecology and cumulative impacts. These are discussed briefly below:

5.2.2.1 Noise

Noise is one of the most serious sources of nuisance arising from open pit mining. Most of the noise problem is associated with on-site activities due to use of heavy plant and machinery for soil and overburden removal and movement. However, the degree to which a given noise level affects any individual is subjective (Walsh *et al., 1991*).

5.2.2.2 Effects Of Mining On Ecology

Both aquatic and terrestrial biota may be adversely affected by pollutants originating from open pit mining including:

1) Sediments. Increased levels of sediment in a water body result in changes to the structure of aquatic flora and fauna in sediment: i.e. increases in water turbidity and biological oxygen demand (BOD); reduction in primary productivity (photosynthesis); alteration to the water flow regime; nutrient enrichment of the water; fish spawning is affected as clean gravel is covered by silt; and possible introduction of potential toxic substances to the water body.
2) Leachates such as iron, manganese and zinc are very toxic to aquatic biota if present in sufficiently high concentrations. These have long-term impacts by damaging or eliminating plant and animal species from water bodies.
3) Acid producing substances which are leached from the mineral ores lead to changes in the pH of the stream water.
4) Plant and soil damage due to acid rain

Table 5-2: Potential Effects of Mining Operations on the Environment*

	Surface Water Pollution	Underground Water Pollution	Air Pollution	Solid Waste	Excavation	Noise and Vibration
Human health and activity	Soluble contaminants in domestic and/ or agricultural use waters Deposition of solids on agricultural lands, in sea shallow zones Withdrawal of water for industrial purposes	Soluble contaminants in wells, springs, etc. Natural water sources drying up as a result water table lowering	Dust blown on Inhabited, agricultural lands	Hazards related to lack of stability of waste deposits		Effects of noise on human health Damage to buildings due to blasting vibration
Fauna	Alteration of aquatic fauna including destruction of fish species, accumulation of toxic elements by fish			Loss of habitat		Disturbance of habitat features
Flora	Alteration of aquatic flora	Accumulation in plants of toxic elements carried in dust		Loss of habitat		
Land use	Sand deposition in river channels			Withdrawal of agricultural land due to mining	Land disturbance	Land subsidence

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* Source: Table 5-2 adapted from UNEP (1991b)

5.2.2.3 Cumulative Impacts

These arise when a number of impacts from a single mine interact or from the interaction of impacts arising from mining with other developments within the same area. The most important of these are the interactive or synergistic impacts of several pollutants all entering the same environmental `compartment', for instance the synergistic effect of toxins, sediment and mine effluent discharge on a local water body.

The use of effective mitigation measures used to reduce or eliminate these impacts should be taken into consideration.

5.2.2.4 Hydrology

A number of measures have been devised to reduce and/or mitigate the impact of mining on the quality and quantity of water resources. Generally the most effective mitigation measures are those which involve the pre-treatment of mine waste water before it is discharged to receiving water bodies so that acidification, siltation and other pollution problems are avoided. The magnitude of the impacts on surface water can be obtained by the changes in the water quality and quantity parameters from the mining operations; for example if the level of dissolved oxygen falls because of a waste water discharge. In addition there are effects of effluent discharge on streams; the effects of run-off on receiving waters; and the effects of soil erosion and sedimentation on water quality. Table 5-2 summarises some of the potential effects of mining on the environment.

5.2.3 Environmental Impact Assessment

The cataloguing and evaluation of all environmental impacts likely to arise from mining and mineral development, in the form of detailed EIA before a licence is granted, is now obligatory in almost all developed countries and in increasing numbers of developing countries. In a review of mining of non-ferrous metals, Hester and Harrison (1994), recognise that some issues require detailed analysis and need an outline of ameliorative or mitigation procedures.

They observe that, particular attention be paid to areas selected for the deposition of waste rock so as not to encourage contamination of local streams by run-off nor hinder the restoration plan. The kind and situation of tailing areas will also justify a major study for dump stability, rainfall run-off during storms and dust- blows if high winds occur during dry seasons. Erosion of waste-rock dumps can cause problems where streams subject

Figure 5-4: Potential Emissions and Effects Matrix

PROJECT ACTIVITIES / EMISSION & DIRECT EFFECTS	OPERATION: Operational Failures	Sewage Disposal	Traffic Movement	Rock Dump	Roadways	Tailings Pond Discharge	Tailings Disposal	Floatation	Ore Milling	Ore Crushing	Ore Breaking	Ore Extraction	Mine Drainage	Mine Ventilation	DECOMMISSIONING: Tailings Area	Tailings Rehabilitation	Site Rehabilitation	Plant Dismantling	Mine Drainage
Gaseous/Particulate emissions			m											m					
Liquid effluent	M	m		m		M	m						m		M		m	m	M
Solid Waste	m			m			M	M										m	
Dust	M		m	m	m		M		m	m	m			m	m			m	
Noise			m	m	m				m	m	m	m		m		m	m	m	
Vibration										m									
Visual Intrusion			m	m	m		M		m	m	m					m	m	m	

Source: Matrices in Figures 5-4 and 5-5 adapted from Ricks and Moynan (1992)

m minor
M MAJOR

Figure 5-5: Potential Impact Matrix: Liquid Effluent

PROJECT ACTIVITIES / ENVIRONMENTAL RESOURCES	OPERATION														DECOMMISSIONING				
	Operational Failures	Sewage Disposal	Traffic Movement	Rock Dump	Roadways	Tailings Pond Discharge	Tailings Disposal	Floatation	Ore Milling	Ore Crushing	Ore Breaking	Ore Extraction	Mine Drainage	Mine Ventilation	Tailings Area	Tailings Rehabilitation	Site Rehabilitation	Plant Dismantling	Mine Drainage
PHYSICAL FEATURES																			
Surface Runoff	M			m	m		m											m	m
Groundwater	M						m												
Soils	M						m												
HABITATS																			
Freshwater	M					m							m		m				M
Agricultural Land	m						m												
ORGANISMS																			
Plants	m						m												
Fish	M					M	m						m		m				M
Mammals	m						m												
Aquatic Invertebrates	M					M	m						m		m				M
Terrestrial Invertebrates	m						m												
Livestock	m						m												

to serious erosion are used for cattle watering. Run-off problems can be more serious where sulfudic (pyritic) deposits are being worked. Figures 5-4 and 5-5 illustrate impact matrices of mining on the environment.

In assessing the impact of, and ameliorative measures for, acid generation the following factors would usually require analysis in the EIA:

1. location of waste rock and tailings disposal areas;
2. contribution of each source to the total generated, e.g. waste rock, tailings, mine, processing, etc.,
3. practicability of collection by interceptor drains followed by sedimentation and neutralisation together with a disposal policy for the solids produced;
4. environmental effects and significance of a non-treatment policy.

5.2.3.1 Liquid Effluent From Milling

Milling is the second stage in the processing of metal ores. It involves the grinding of extracted ore into particles which can be subjected to a recovery process which separates the valuable materials (concentrate) from the valueless (gangue). After classification, the ground material goes into floatation units where a variety of reagents may be used. The type and amount of reagents will depend on the characteristics of the mineral being concentrated, such as chemical composition, density, etc. Froth floatation, the most commonly used concentration process, is based on conferring hydrophobicity to the individual particles and hence helping their attachment to air bubbles. Particles with higher mineral content then rise to the surface of a froth which is skimmed. The remaining waste particles become tailings. Leaching is another concentration method favoured in some operations, sometimes in combination with flotation. The process entails use of sulphuric acid to acid-leach copper oxide ores. The end-product of the milling or leaching process is the concentrate of the required metal or metals. The waste slurry contains the discarded process water, unwanted gangue, and the reagents, frothers, collectors, etc. which are added during the floatation stage. This slurry is then channelled to the tailings impoundment area.

5.2.3.2 Liquid Effluents From Tailings Area.

Tailings management in most non-ferrous mining operations, is a subject of major environmental significance. Tailings can be transported as aqueous slurries through pipes or culverts. Chemical aspects have a major influence on the levels of toxicity of tailing water on receiving streams and other water bodies. Attention is usually focused on the obvious parameters such as heavy metals (including arsenic) on chloride sulphate, nitrate, suspended solids, and on pH, together with the flow characteristics and uses of the receiving bodies of water. Great reliance is usually placed on utilising the dilution and absorptive powers of the receiving bodies of water. The use of lime to precipitate heavy metals, for pH adjustment, where it is necessary to preserve existing uses of the receiving body is common.

5.2.4 Air Pollution

Air pollution represents a significant impact of the mining and metal processing industries. The type of source, number and spatial distribution of sources are important aspects of the overall impacts that air pollution will have on the environment. Sources of air pollution can be classified as:

- single and point sources
- area-wide or multiple sources
- line sources

The characteristics and type of emissions from these industries will determine the scale of the impact on the environment. The following are important aspects of emitted pollutants:

- physical, chemical and biological properties
- rate of emission

There are three types of exposure to air pollution:

- endemic - this is a single large dose to a limited population
- catastrophic - this represents a significant dose to a large population
- concomitant - small dose to a whole society

Specific air pollutants have been associated with human ill-health effects. The following pollutants have been singled out:

CO - reduction in ability of blood to transport oxygen

- impairment of performance on tasks requiring vigilance
- aggravation of cardiovascular disease

NO_2 - increased susceptibility to respiratory pathogens

O_3 - decrease in pulmonary function

- coughing, chest discomfort

- increased asthma attack

PAN (peroxyacetyl nitrate), aldehydes - eye irritation

SO_2 and particulate - increased prevalence of chronic respiratory disease

- increased risk of acute respiratory disease

Table 5-3: Impacts of SO_2 on Humans

Concentrations (ppm)	Effect
6 - 12	immediate irritation of nose and throat
0.3 - 1	detectable by taste
3	noticeable odour
>20	irritating to eyes

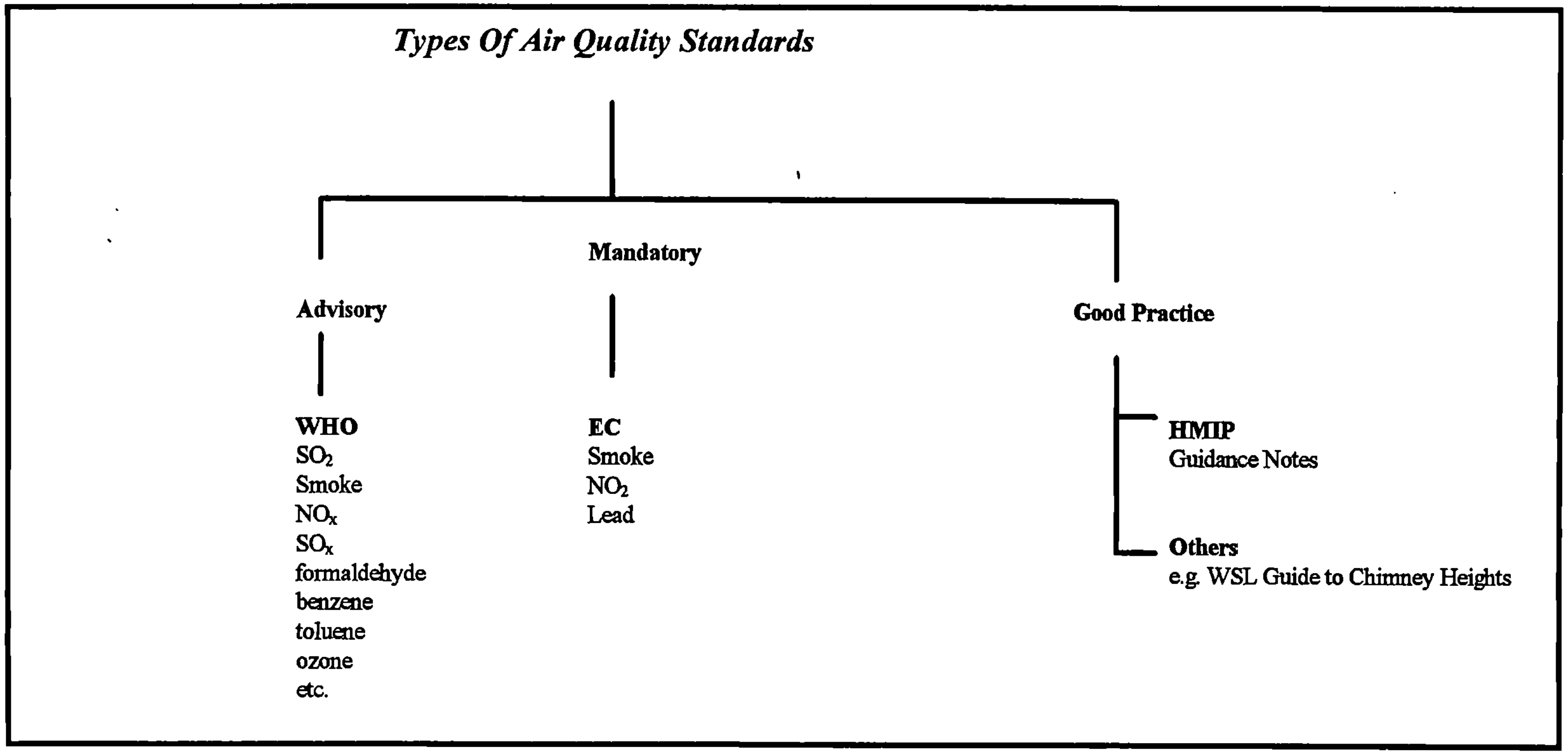
Source: Institution of Chemical Engineers (1993b), Air Emissions Vol. 1

Table 5-4: WHO Air Quality Guidelines

Substance	Time-weighted average	Averaging time
Lead	0.5-1.0μgm^{-3}	1 year
Nitrogen dioxide	400μgm^{-3}	1 hour
	150 μgm^{-3}	24 hours
Ozone	150-200 μgm^{-3}	1 hour
	100-120 μgm^{-3}	8 hours
Sulphur dioxide	500 μgm^{-3}	10 minutes
	350 μgm^{-3}	1 hour

Source: Institution of Chemical Engineers (1993b), Air Emissions Vol. 1

Figure 5-5: Air Quality Standards



Source: Institution of Chemical Engineers (1993b), Air Emissions Vol. 1

Table 5-4 shows air quality guidelines set by the World Health Organization. Many WHO standards tend to be advisory in nature (Figure 5-6).

5.3 Environmental Impacts of Copper Production in Zambia

Mining and its related activities can be a source of significant environmental damage. Pollution of surface water and subsurface water, damage to land and habitat destruction are some of the impacts that have been documented in the past. Health and safety risks may also be considerable for people working in the mine, or living near by. It is important, therefore, that mining should be carried out so as to minimise to the fullest extent possible these harmful impacts. It has now been argued that, with careful planning, modern technologies and sensitive management, it is often feasible to pursue mining at an acceptable environmental cost (UNEP, 1991b).

Copper is one of the most common non-ferrous metal ores, others being lead, nickel, zinc and gold. Copper mainly occurs as compounds of other elements in metallic ores. It occurs as sulphides and to smaller extent as oxidised ores. The following are the mineralogic species of copper:

Table 5-5: Copper Ore Minerals

Metals	Sulphides		Oxidised Minerals	
Copper	chalcopyrite	$CuFeS_2$	malachite	$Cu_2(OH)_2\ CO_3$
	bornite	Cu_5FeS_4	azurite	Cu_2O
	chalcosite	CuS	cuprite	$Cu_3(OH)_2\ (CO_3)_2$
	tetrahedrite	$(Cu; Fe; Zn; Ag)_{12}$ $(Sb, As)_4S_{13}$		

Source: UNEP, (1991b)

Concerning the impact of metal mining on the environment, an important case is that of sulphide ores, in which iron sulphides represent a large portion of the gangue. Such harmful sulphides are the essential cause of acid mine drainage.

5.3.1 Potential Impacts Of Mining On The Environment

5.3.1.1 Potential Contaminants:

Water contaminants may include:

- acids;
- mercury;
- metals as ions or complexes, from copper, lead, zinc, nickel, iron, arsenic, cadmium;

- thiosulphates, polythionates also resulting from acid mine water;
- process reagents, directed to various process effluents;
- suspended solids: mine water, surface drainage, and process effluents containing suspended solids.

Contaminants in the atmosphere include:

- dust elements, whose nature is similar to the elements composing suspended solids in liquid effluents;
- gases produced by combustion processes: carbon monoxide, carbon dioxide, nitrogen oxides, sulphur dioxide;
- noise and vibrations produced by blasting, processing plant operations etc.

While damage to human health due to mining water pollutants is rare, in some places lethal pollution levels are experienced by aquatic organisms. Heavy metals can be lethal to fish. Cyanides are lethal to fish at very low concentrations, as little as 0.04 mg/l CN for trout.

Documented data regarding direct environmental impacts of African industry are even scarcer than those related to mining activities. Few government agencies collect data specifically related to environmental issues. Where national ministries of the environment are established, they are almost without exception under-staffed and weak. They are thus of little use in providing documentation of the environmental situation in their countries.

In Africa, several industries have environmental linkages. These include textiles and footwear, chemical and pharmaceutical, metals and light industry, and heavy industry. The manufacture of footwear involving leather, often results in water pollution due to lack of water treatment during the tanning of hides. The release of tanneries' untreated wastewater into river systems is a wide spread phenomenon on the continent. The tannic acid released into rivers, especially during the dry periods when the acid cannot be sufficiently diluted, kills most aquatic life in the affected reaches of the river and restricts the use of waters downstream from the pollution sources.

The dominant position of the copper industry in the Zambian economy is reflected by the following information: approximately 30% of its gross domestic product comes from copper production; from 50% to 60% of total government revenues and over 90% of its foreign exchange are derived from copper; cobalt, gold, lead, selenium, and silver (all by-products of copper mining) contribute additionally.

The Zambian Copperbelt is situated in northern central Zambia along the border of Shaba Province. The Kafue River enters the Copperbelt near Chililabombwe. Downstream from Chililabombwe, major environmental changes have occurred since the 1930s (Lewis and Berry, 1988). These changes are as a result of the direct impacts of copper mining. Important direct impacts of the mining operations are land-surface changes, including huge open pits and tailings; air pollution from copper-and lead-refining operations; and water contamination, also associated with the refining process.

At the Chingola mine, midway between Chililabombwe and Chambishi, each day thousands of litres of water are pumped out of the mine directly into the Kafue River. To summarise all the environmental impacts of copper mining in Zambia would require a scale of documentation that does not exist. But it is clear that since the start of mining numerous significant changes have occurred. Clearly a wide range of contemporary environmental problems that exist in Zambia are a result of the dominance of copper in the nation's economy.

The Kafue is the fourth largest river in Zambia. Its basin is a major sub-catchment of the Zambezi river basin. It covers an area of 154,000 km^2. Most of the basin lies on a plateau which varies in elevation from 1350 metres to 1050 metres. Dambos (wetlands) are a characteristic feature in the upper part of the basin while the lower part is dominated by the Kafue flats.

Most of the land in the basin is suitable for cropping and grazing. A substantial portion of the land around the mining areas is occupied by mining dumps. The Kafue fishery at the Kafue flats and Lukanga swamps cover 7,000 km^2 and 3,200 km^2 respectively. Much of the flats is also designated as a game management area.

The mining industry brought most of the early infrastructural development in the basin. Minerals produced include copper, zinc, lead and cobalt. Sulphuric acid is also produced. The production processes currently used are pyrometallurgical and hydrometallurgical. The total estimated ore mined is 26 million tonnes annually. The impurities in leach solution are mainly iron, cadmium, lead, zinc and oximes.

The disposal of waste rock from underground, overburden and tailings, results in obtrusive dumps which currently occupy an area of over 10,000 hectares. Where tailings have not been rehabilitated, they are a source of pollution. These dumps can alter subsurface drainage, and when it rains can revert to an amorphous slurry which spreads to surrounding areas. Valley fill dams are used for disposal of tailings. These allow the settling, precipitation and reduction of potential pollutants. Valley fill dams are sources of streams on the Copperbelt. These discharge water which has a high content of dissolved solids.

In a study of the Kafue basin by Kasonde (1991), grab samples were collected for analysis using standard methods according to the GEMS Water Operations Guide. The following section shows the results of his study regarding trace elements, suspended solids, dissolved solids and nutrients.

5.3.1.2 Trace Metals.

Trace metal elements in the Kafue river reported at Sawula in 1984 were up to 35 mg/l copper, 2.7 mg/l zinc, 20.88 mg/l iron and 0.60 mg/l cobalt. The survey in 1991 obtained values for iron, manganese, copper, and zinc in the range of 6.6, 1.2, 4.1 and 0.34 mg/l, respectively.

5.3.1.3 Suspended Solids

The suspended solid levels in natural water, especially in the dry season, are in the range of 3-14 mg/l. In mining areas, the level of suspended solids rises to as much as 262 mg/l. These solids are predominantly tailings. Another source of suspended solids is the water treatment sludge which is disposed of in the river.

5.3.1.4 Dissolved Solids

The concentration of dissolved solids is in the range of 100 mg/l upstream of the mining area to 40 mg/l after the Kafue river has entered the area. The major ions are sulphate, chloride, calcium and magnesium. Mine-effluent-carrying streams like the Ichimbe discharge as much as 1,200 mg/l of dissolved solids into the Kafue river. Other sources of dissolved solids include the industrial-effluent-carrying Kafironda stream and the sewage-carrying Mindolo stream. The average total hardness in natural water is between 50 and 80 mg/l, in the mining and urban areas the value reaches 300 mg/l.

5.3.1.5 Nutrients, Chlorides and Sulphates

Sources of nitrates and phosphates identified are mining, industry and sewage. There is a substantial input of sulphate into the river around the Copperbelt from mining activities. Nitrate-nitrogen in the Kafue are generally below 0.2 mg/l but the concentrations increase to around 2 mg/l in mining and urban areas. Table 5-6 summarises the environmental effects of the various mining operations which have been discussed in the above sections.

In Zambia municipal disposal sites are not controlled, and industrial wastes are dumped at the nearest convenient site without any regard to water resources within the surroundings. The Kafue river receives polluted sewage and industrial effluents from both the Copperbelt area and Kafue town. With the growing water demand for agricultural, industrial and domestic use natural dilution cannot suffice. It is therefore, hoped that the implementation of the Environmental Act will compel industries and local authorities to invest in pollution control.

Table 5-6: Environmental Effects of Mining In Zambia

Operational Processes	Environmental Effects
Ore Extraction	Waste rock and overburden to local land
	Leachate to local river after settlement
	Noise and vibrations due to blasting
	Damage in buildings due to blasting vibrations
	Land disturbance/loss of habitat
	Land subsidence
Concentration	Tailings to local land
	Process liquids and leachate to local river
	Soluble contaminants in domestic and agricultural use waters
Smelting and Refining	
	Contaminants in atmosphere
	Air pollution by dust elements; gases produced by combustion processes: carbon monoxide, carbon dioxide, nitrogen oxides, sulphur dioxide
	Contaminants in water
	Water pollution by suspended solids; dissolved solids; acids; mercury; metals as ions or complexes from copper, lead, zinc, nickel, iron, arsenic and cadmium
	-alteration of aquatic flora; accumulation in plants of toxic elements
	-alteration of aquatic fauna; accumulation of toxic elements in fish
	-destruction of fish species
	Solid wastes
	Impurities in stable slag for disposal
	Impurities as chemical precipitates for disposal

5.3.2 Legislation

Legislation affecting the environment associated with mining consists of:

1) The Mines and Minerals Act 1976 and Regulations enacted under this act;
2) The Actions for Smoke Damage (Prohibition) Act of 1961;
3) The Environmental Protection and Pollution Control Act 1990.

Under the Mines and Minerals Act the Chief Inspector of Mines is responsible for enforcing provisions relating to land reclamation and control of effluents discharged into the environment by mining and metallurgical operations and regulations intended to control air pollution. The Mines Safety Department monitors and controls emissions of SO_2 and SO_3 and monitors and controls effluents discharged into water bodies from mining and metallurgical operations.

The Actions for Smoke Damage (Prohibition) Act of 1961 indemnified the then mining companies of the Anglo-America Corporation and the Rhodesia Selection Trust and whoever might be their successor, against any liabilities arising from environmental damage caused by sulphur dioxide fumes from copper production. This Act gave licences to the mining companies to vent SO_2 to the atmosphere in any quantities. The only restriction was the height of the stack at which gases could be vented.

The effects of copper processing are felt on particular days when a temperature inversion occurs and the gases are not easily dispersed.

The Environmental Protection and Pollution Control Act of 1990 does not contain any reference to earlier Acts having an effect on pollution. The Action for Damage (Prohibition) Act still remains on the statute books, although unregulated SO_2 emissions are punishable by the 1990 Act.

5.3.3 Control of Pollution

Pollution control has been erratic and the following uncoordinated legislation is relevant:

The Water Act Cap. 312. This states "any person who willfully or through negligence, pollutes or fouls any public water so as to render it harmful to man, beast, fish, or vegetation, shall be guilty of an offence".

The Local Government Act 480. Under this Act Local Councils are required to take measures for the prevention and control of pollution. Under statutory instrument 161 of 1985, the standards are set for disposal of sewage and industrial effluent to sewers and any receiving water body.

The Mines and Minerals Act 329 limits the production of carbon monoxide to 0.01% by volume, and states that there shall be no traces of oxides of nitrogen; and that water containing cyanide or injurious solutions shall be fenced off, and in no case should such water be permitted to flow off without being rendered innocuous. This act also provides for the inspection of dumps, the operation of the rehabilitation plan, and taking of steps to abate nuisance and prevention of pollution.

The Town and Country Planning Act 475 prohibits, restricts and controls the disposal, deposit of waste materials and pollution into rivers, ponds and lakes. The planning authorities, supposed to enforce this legislation, are the Local Authorities and the Natural Resources Board.

5.3.4 Implementation of the Acts

Tardy implementation of these acts has led to gross pollution in Zambia. This has been attributed to lack of finances, community awareness and participation and manpower. In order to improve the situation, an all encompassing Act - the Environmental Pollution Control Act 1990 - has been passed. This Act provides for the establishment of the National Environmental Council which, through inspectorates, would coordinate environmental programmes.

5.3.5 Water Pollution - Effluent Discharge

The Mining Regulation 2107 requires mine management to ensure effluent escaping from their plant into surface water sources is deemed safe - maximum limits are set up. These limits, however, are not always observed and the resulting pollution has on occasion led to the public and to farm animals drinking unsafe water. The major offender is the Tailings Leach Plant at Nchanga. The effect on the water in the Kafue is substantial (Bari, 1992).

Other hydro-metallurgical plants and concentrators also produce effluents some of which find their way into the public water system. Since the Mines Safety Department is not in a position to set up its own laboratory, it has to depend on the mines management themselves to report what the concentrations of the various toxic constituents are in their discharge. Figures thus obtained have to be treated suspiciously. Although the maximum stipulated figure is 500mg/l, values reported can sometimes reach as high as 2000mg/l.

5.3.6 Air Pollution - Sulphur Dioxide

To obtain copper from copper sulphide and oxide ores the mining companies employ both hydro-metallurgical and pyro-metallurgical processes. The former is used during roasting and also employs sulphuric acid in leaching oxide ores. The latter process is used during smelting. From June 1990 management at the various SO_2 producing plants have been instructed to provide the Mines Safety Department with data to enable it to calculate how much SO_2 the company is venting to the atmosphere. Table 5-7 shows the scope of the problem.

Table 5-7: Amount of $S0_2$ Discharged (Tons) to Atmosphere 1991

	SO_2 Produced	**SO_2 for Acid Making**	**SO_2 Vented**	**Average Daily SO_2 Vented**
SITE				
Kitwe	269 168	120 018	149 150	409
Mufulira	52 440	-	52 440	437
Luanshya	64 044	-	64 044	175
Kabwe	1 308	-	1 308	4

Source: Mines Safety Department Kitwe, 1991

5.3.7 Impact Mitigation

To examine these problems in detail is beyond the scope of this study. However, to illustrate some of the environmental problems associated with mining, a case study examining copper production in Zambia will be used.

5.3.7.1 Production Efficiency and Environmental Performance

In the older on-going operations, environmental performance correlates closely with production efficiency, and environmental degradation is greatest in operations working with obsolete technology, limited capital and poor human resource management.

5.3.7.2 Economic And Environmental Limitations Of Regulation

Environmental performance of a mining enterprise is more closely related to its capacity to innovate than the regulatory regime within which it operates. Although international standards and stricter environmental regulation may not pose problems for the economics of new mineral projects, there could be major costs and challenges involved for older, and particularly inefficient ongoing operations. Controlling pollution problems in many of these cases requires costly add-on solutions; water treatment plants, strengthening and rebuilding tailings dams, scrubbers and dust precipitators, etc. In some instances such obligations may lead to shut-downs, as well as reduced competitiveness.

5.3.8 Environmental Management Policy

To safeguard competitive and sustainable environmental management practices in metal production, governments need to embrace public policy which goes beyond traditional incremental, and punitive environmental regulation. The latter, in the old 'environmental protectionist' mode, tends to deal with the symptoms of environmental mismanagement (i.e. pollution), not the causes (i.e. lack of capital, skills, and technology and the absence of the ability to innovate). The challenge will be for governments to ensure that companies operating within their national boundaries remain sufficiently dynamic to be able to afford to clean up, to innovate and to improve economic efficiency and environmental management. Policy mechanisms need to be developed to promote technical change and to build up the technological and management capabilities to innovate and manage the absorption and acquisition of clean technology. The privatization of the state sector and the liberalisation of investment regimes in many developing countries, provide new opportunities for the diffusion of both competitive and environmentally sound best-practice in metals production. Public policy to promote technical change and, complementary to that, to improve economic efficiency, respects the interplay between the environmental and economic factors that constitute a sustainable development approach to the long-term environmental management of our non-renewable natural resources. Environmental regulation at best provides only one element of a public policy for environmental management.

5.3.9 Limitations Of Environmental Regulation

The norm in environmental regulation is that governments set maximum permissible discharge levels or minimum levels of acceptable environmental quality. Environmental regulations designed for mining and mineral processing have been uncommon in developing countries, although most countries now have in place basic standards for water quality and air quality. A few developing countries have recently adopted extensive regulatory frameworks, sometimes replicas of US models. This, for example, has been the case in Chile. This growing concern about environmental degradation is occurring during the period of rapid liberalisation in developing countries, which finds expression in new policies to promote foreign investment and privatization schemes. These conditions also influence the regulatory regime of developing countries. An important consideration is whether the developing country should pose less onerous environmental burdens on the potential investor to improve the terms of the investment by implying lower compliance costs associated with minerals development projects.

However, environmental regulation alone is unlikely to solve environmental problems in developing countries due to endemic production inefficiencies. The approach of state-owned enterprises towards the environment mirrors inefficient operating regimes, excess capacity, breakdowns and shutdowns, and poor management procedures. These contribute to worsening the polluting nature of effluents and emissions. Such inefficiencies make it very unlikely that environmental controls will be incorporated effectively. Production inefficiency is endemic among many mining enterprises in developing countries and problems of environmental degradation cannot be viewed independently of it. Moreover, obsolete technology is widely used without the essential modern environmental controls and safeguards. For example, new concentrators and roasting plants tend to be totally computerized. Automatic assaying techniques give chemical composition of the ore feed which has implications for fine-tuning of pressure, heat, cooling and specific environmental control systems. This in turn will facilitate the accurate prediction and monitoring of emissions. It might be further contended that command and control regulatory instruments are unlikely to result in a reduction of pollution since they cannot affect the capacity to implement change of a debt-ridden and obsolete mining enterprise in the developing country context. Environmental regulations tend to be of blanket-type which specify maximum levels of emitted substances, minimum levels of environmental quality and best technology standards. They do not reflect the propensity of a particular operation to pollute, which in part depends on local site-specific conditions - such as geology, geography and climate - as well as economic infrastructure and technology-related constraints. Since developing country regulations are often copied directly from the statute books of the developed countries whose regulations are adapted to suit their circumstances, they may not be appropriate for the site specific characteristics of mines in tropical countries. They may result in nonessential and costly adaptations on one hand, or the lack of necessary control on the other. The enforcement of command and control regulations rests on a system which admonishes fines and imprisonment. Compliance is also limited since fines are generally a fraction of costs involved in remedial treatment and abatement technology. Inflation and local currency devaluation, which are endemic in developing countries, erode the value of such fines. Since different site-specific mining contexts often require individual regulation, perhaps for permit approval, this provides opportunities for bribery which is prevalent in bureaucracies and industry in many developing countries.

5.3.10 Policy Implications for Zambia

5.3.10.1 Environmental Trade-off and Technical Change

The imposition and strict regulation of international environmental standards could make some developing countries' mineral production uneconomic, thus replacing one social cost (environmental pollution) for another (unemployment, poverty and clean up). This illustrates the complexity of the process by which the underlying power structure of the industry can help to decide the environmental agenda. After a period of mineral production controlled by state-owned mining companies, many developing countries are now embarking upon a phase of liberalisation and have promulgated a number of laws and incentives to encourage foreign investment. The end result is that this trend in technical change may reduce the trade-off between higher environmental costs and lower production costs.

5.3.10.2 Technology Policy

Environmental behaviour correlates most closely with a company's capacity to innovate. An informed technology policy is needed to guide and encourage those companies along the fastest, more efficient route to achieve those goals. The ability to determine corporate environmental strategy as a response to regulation is important. This can be plotted against changing thresholds of economic competitiveness and environmental compliance over time.

5.3.10.3 Technology Transfer

This is required to deal with new and emerging technologies and human resource development in environmental management strategy in developing countries. In this regard what is relevant to the policy of technology transfer is the combination of technology, managerial approaches, work-place practices and regulatory and monitoring frameworks.

The public policy challenge is, therefore, how to keep corporations sufficiently dynamic to be able to afford to clean up their pollution and create economic wealth through innovation and sustainable environmental management practices. Environmental regulation would be one element of that policy and would provide goal posts for site-specific best practice in environmental management. Technology policy would promote technical change through technology transfer and human resources development would lie at its heart.

It is quite clear that a reference system is needed to address the problems resulting from mining operations. This would require ambient quality standards and effluent standards. Enforcement of these will reduce the ecological effects on terrestrial and aquatic species and habitats.

5.3.11 Environmental Control Procedures

5.3.11.1 Environmental Control Policies

The most cost-effective environmental approach is one that:

- systematically integrates environmental issues into the project planning phase
- considers all environmental media - water, air, soil;

- prefers to reduce waste at its source rather than install expensive treatment afterwards;
- makes maximum re-use of waste components

This approach depends on an effective mobilisation of technical and human resources. Two actions which can help a company achieve such organisation are:

a) a corporate environmental policy with clear goals, responsibilities, actions and targets;

b) establishment of a proper environmental management structure to ensure implementation of the policy to allocate adequate resources and to monitor the results.

This should be initiated at the highest level in a company. Assigning environmental responsibility to lower level staff without senior level back-up is generally unsuccessful.

5.3.11.2 Regulatory Framework During Mining

For existing mines, environmental management tools such as environmental auditing are coming into more widespread use, especially in industrialised countries. Assessments and auditing are essentially review instruments. The actual environmental performance to be achieved is commonly set by regulatory instruments such as regulations, standards and licences which are established under a variety of different laws. Such instruments are:

- mining laws;
- environmental legislation;
- other legislation on health, safety and chemicals.

The mining laws in Zambia as they exist do not provide a sound basis for broad environmental control programmes. McDonnell and Warhurst (1992), give examples of countries with similar problems with regard to adoption and implementation of mining legislation. In Ghana, in spite of the existence of the Environmental Protection Council, the mining industry has largely been governed by economic objectives. The EPC was underfunded, lacked skills and had little implementation powers. As a result a growing extent of mining pollution has been reported and forest defoliation due to the gases from roasting sulphide-rich gold ores. In 1988 with the prompting of the World Bank, the government asked the EPC to prepare an Environmental Action Plan. Subsequently, a regulatory framework and company guidelines have been adopted which will minimise any adverse effects of mining on the environment. The Government now requires that a new project includes an environmental impact assessment. In Papua New Guinea the history of large-scale mining began in the late 1970s with the development of the giant Panguna copper mine in Bougainville and the subsequent discovery of OK Tedi gold and copper deposit. The former was developed and operated in an atmosphere of regulatory *laissez faire* towards environmental issues, while, partly as a result of detrimental environmental effects from Panguna, the OK Tedi mine has a far stricter agreement (McDonnell and Warhurst 1992).

5.3.11.3 Environmental Quality Standards and Criteria

Environmental criteria, standards and norms are a form of subordinate legislation. These provide numeric limits to which industrial operations must be designed and managed. They include:

- water quality in streams, or effluent discharge standards
- air emissions, or exposure
- waste disposal
- human exposure to dust, toxic chemicals, radioactivity;

There are no international environmental standards which apply around the world. Each region has its own needs and must set its own standards accordingly. The exception is where international norms have been suggested for human health e.g. drinking water.

5.3.12 Environmental Management Systems

One question which immediately arises is whether the cost of environmental protection is prohibitive for developing countries. Secondly, what sort of trade-offs must developing nations make between the costs of preservation of the environment and the benefits of mining development. Often developing countries are faced with the need to undertake measures in a much shorter time than they are able to afford. In many cases it means that these countries have to leapfrog technologies and bring their industries in line with standards evolved by developed countries. The main problem is likely to concern existing installations and the medium- and small-scale mining industry. For most developing countries government subsidies for the rehabilitation of these operations are unlikely. On the other hand, in the absence of improved minerals and metal prices, forcing owners of installations concerned to undertake the necessary investment is unlikely to succeed.

Regulations alone will not solve the environmental degradation problems of developing countries, principally because production efficiency is a precursor to achieving environmental efficiency. Enforcing regulations requires skills and resources beyond the budget and capacity of many developing countries. Whereas the development of new lower cost, less hazardous technologies may also be to the advantage of developing countries, such investments could herald another wave of technology dependency - the swapping of one social cost for another to the benefit of foreign capital (Warhurst, 1992).

Warhurst, (1992) observes that production inefficiency is endemic amongst many mining enterprises in the Third World, and problems of environmental degradation cannot be viewed independently of it. In the industrialised countries, for example, new concentrators and roasting plants tend to be totally computerised, and automatic ore assaying techniques give an accurate picture of the chemical composition of the ore feed. This degree of control enables an accurate prediction and monitoring of emissions. Environmental regulations tend to be of the blanket type which specify maximum levels of emitted substances, minimum levels of environmental quality, and the best available technology standards. They do not tend to reflect the tendency of a particular operation to pollute, which in part depends on local site-specific conditions such as geology, geography, and climate, as well as economic, infrastructure and technology-related constraints. Therefore, the industrial strategy and environmental policy of developing countries need to be developed in parallel, shaped by the economic, social and political processes. Second, achieving and sustaining production efficiency in the developing country context will be an important prerequisite to achieving environmental efficiency. Third, environmental degradation from mining and mineral processing activities could be reduced and prevented through designing country-specific flexible regulatory frameworks.

Traditional industry response to environmental matters has been to await sanction of new regulations or development crisis situations. The stating of corporate and industry environmental policies requires that industry attempt to go beyond regulations with a program of voluntary self-improvement. This calls for new and improved procedures, involvement of all employees, consultation with regulatory authorities and measures to avoid or minimise the adverse effects of spills and emissions of all kinds. Increasing need for improved environmental performance in an expanding area of corporate activity has led to the creation of an 'environmental management' function. Environmental management is responsible for finding ways of effectively meeting, reconciling regulatory, technical, operational requirements and public needs, demands and pressures for environmental improvement. These systems relate to innovation, information and risk management. The function of innovation management is concerned with measurement and evaluation of environmental effects and with developing techniques for improved material handling, waste minimisation and recycling under the broad heading of 'product stewardship'. Information management is necessary to respond to regulations when passed and to ensure systems are in place for assembling and reporting compliance. A third environmental management system is in the area of risk and liability control, from hazard analysis, through spill prevention and emergency response to product stewardship (Sudbury, 1992).

CHAPTER SIX

SECTORAL CASE STUDY II - THE AGRICULTURAL SECTOR IN ZAMBIA

6.1 Introduction

In many developing nations poverty and the degradation of the environmental resource base have been closely associated. This interrelationship is pervasive and causes major concern when such patterns are projected in the future. In many countries of Sub-Saharan Africa there has been a drop in per capita agricultural production, a stagnation and/or slow growth in cash crop agriculture, major pressure on rangelands and a continuous destruction of forests.

The economic crisis in Zambia has compelled the government to change its economic policy and restructure the economy away from over-dependency on the mining sector. Agriculture has now been given high priority as the sector of highest potential for replacing the mining sector as the most important part of the economy.

This chapter introduces the second of my sectoral case studies, which is agriculture. As many developing nations are still predominantly agrarian, the importance of this sector cannot be overemphasised. Since a large proportion of people are engaged in different kinds of agricultural activities, the significance of the cumulative impacts on the environment is one which needs urgent attention in many countries.

6.1.1 Agro-Ecological Zones

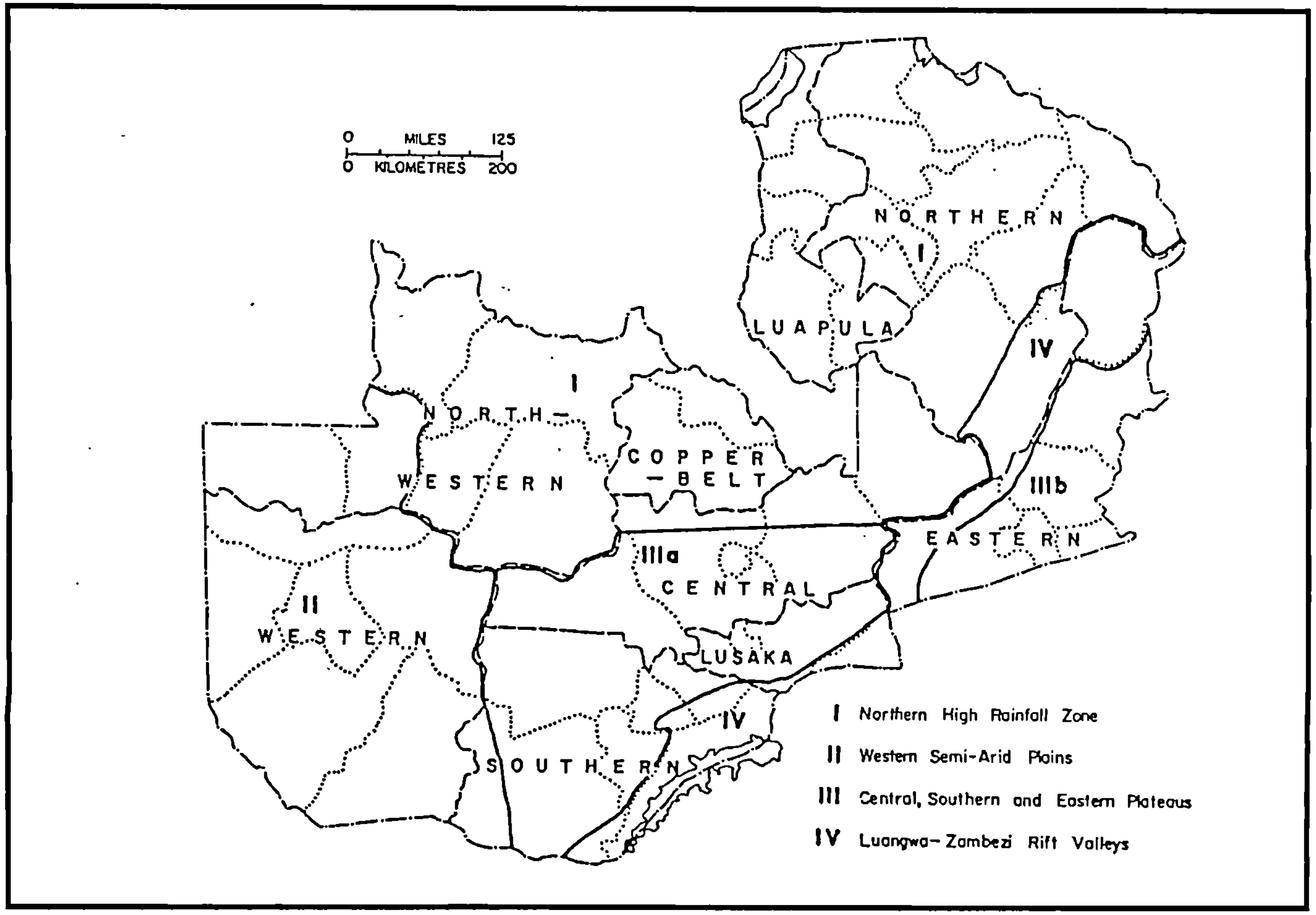
The agro-economic potential in Zambia is determined by a combination of factors. These include the relative abundance of cultivable land, the very low rural population densities and the high proportion of the population resident in urban areas.

There is a relatively low rural population density in Zambia, an average of 7 persons/km^2. Much of the country experiences a moist savanna climate. Resource management problems have arisen as farming systems have changed and as local areas of population pressure have developed. Problems include soil erosion and the decline in soil productivity, and damage to the soil structure. Other environmentally related problems reflect the agricultural development policy that encourages mono-culture of hybrid maize, neglecting environmental diversity and relying upon fertilizer inputs to overcome environmental variations and problems (Wood 1990). This technocratic approach to agricultural development and increased availability of chemical fertilizers has decreased environmental awareness in agricultural planning. The result has been the emphasis throughout the country that this is the acceptable route of progress from subsistence to semi-commercial production.

A wide range of environmental conditions exist in Zambia. Rainfall varies from place to place, from below 700mm in the Zambezi valley to over 1400mm in some parts of the north. The predominant natural vegetation across much of the country is *Miombo* Woodland. Grasslands cover extensive areas, swamps and other woodland types exist. This diversity is also reflected in the soils, from the Kalahari sands in the west and extensive areas of poor shallow lithosol, to small areas of fersiallitic clay loam such as upper valley soils around Mazabuka District (Veldkamp *et al.*, 1990).

In Zambia four general agro-ecological regions (Figure 6-1) can be identified based on average altitude, rainfall range, climate, soils and crop suitability (GRZ, 1983;1992b).

Figure 6-1: Zambia - Agro-Ecological Zones



Source: Republic of Zambia., (1983). Agricultural Baseline Data for Planning.

I- High Rainfall Region

This zone, found in areas of the Northern and parts of the Eastern Provinces, covers about 350,000km^2. The average altitude is 1,200 metres. It receives annual rainfall in excess of 1000mm. It is characterised by highly leached sand loam soils that have low base saturation, with a pH range of 4 to 5. These soils, which lack the major plant nutrients, require lime or fertiliser to enhance the agricultural capacity. These poor soils support the slash-and-burn *Chitemene* shifting cultivation in growing cassava, sorghum, millet and rice.

II- Western Semi-Arid Plains

This region covers the swamps and flood plains of Western province and parts of Southern and Central Provinces in a total area of 208,000km^2. The average altitude is 850m and rainfall ranges from 600 to 1000mm. The Kalahari sand soil is deep, loose and structureless in character. The main crops grown are cassava and millet with cattle rearing intensively practiced along the Zambezi flood plain.

III- Central, Southern and Eastern Plateaux

This region stretches from the Eastern province through Central province, covering 94,000km^2. The average altitude is 1,000 metres and receives rainfall ranging from 800mm to 1000mm. The sandvelt fersialitic soils are moderately leached. The clay to loam soils of this middle rainfall zone are the most fertile in Zambia, supporting semi-permanent small scale and permanent semi-commercial cultivation. The major crops are maize, groundnuts, tobacco, sunflower and cotton. Cattle rearing is central to the local economy.

IV- Luangwa-Zambezi Valleys

This zone occupies an area of 108,000km^2 and receives about 800mm of rainfall. The soils are shallow chestnut sand of marginal agricultural value. In this region the low rainfall regime has a major influence on land utilisation systems, especially the adoption of drought tolerant crops such as sorghum and millet.

6.1.2 Land Tenure and Land-Use Systems

Jansen (1988) estimates that of the country's 186 million acres, 174.3 million (93%) is held under traditional tenure. The remaining 12 million is state land. Almost half of the state land has been divided up by individuals for farming.

Nearly all the state land is situated along the line-of-rail, where there is a concentration of capital development. Small pockets of state land can also be found near Chipata, Mbala, Mwinilunga and Mumbwa. These areas are situated on some of Zambia's fertile soils, producing three-quarters of marketed produce. The land-use patterns on state land is based largely on mixed farming. Maize is grown on most farms, with commercial beef and dairy cattle raised on many. The great majority of farms range from 1,000 to 6,000 acres. The system prevailing for the vast majority of Zambian acreage is the traditional land tenure which varies widely with local custom. Possession of land depends on the ability of a farmer to demonstrate continuing use of land for cultivation or acceptable fallow. Estimates of land of arable potential are of the order of 9 million hectares, of which 1.4 million hectares is the national figure cropped annually. The utilisation of this land is constrained by sparseness of the rural population and the cost of access and development in many peripheral areas. Most of the agricultural holdings are under 4 hectares, with not more than 5% of the land in use of holdings over 20 hectares.

As pointed out earlier, the rainfall is important in identifying ecological regions. It also dictates the type of crops that can be grown in a particular area. Areas receiving over 1000mm of rainfall per year tend to have soils which are leached and ferrallitic. Natural vegetation grows well in these areas. Traditional farming systems tend to thrive in these areas. Those regions receiving less than 800mm per year will exhibit different types of farming systems.

Four broad land-use systems have been identified in Zambia, a land-use system being a combination of land resource utilizations and the arrangement of various components both in the spatial and temporal dimensions (GRZ, 1990). The following have been identified as depicting the existing systems of land-use:

Cropping/Forestry: In this system the main activities are directed at farming and exploiting forest products such as timber, poles, fibre and wildlife. This system is widely practiced in agro-ecological Region I.

Cropping/Livestock/Forestry: Animal husbandry is part of the system and is thus assigned particular time and space. The forests are used as rangelands. The Southern plateau, parts of western province and the areas in the north of the country practice these systems.

Fishing/Cropping/Forestry: Fishing is the most important activity associated with river valleys and lakes. The local population spends most of the time on activities related to fishing.

Fishing/Cropping/Livestock/Forestry: This land-use system includes a wide range of components and activities. Fishing is the main activity followed by livestock rearing, then farming and lastly forestry. These systems are found in the Gwembe valley and on the Kafue flats.

6.2 Zambian Agriculture

The Zambian economy has been dominated by the changing fortunes of the copper mining industry. The Government has changed the emphasis on development from the mining sector to agriculture and other natural resources. This shift was necessary because of the drop in Zambia's export earnings from mining. The resulting drop in revenue has had negative effects on expenditure on social services.

In its development planning, Zambia has had a series of five-year National Development Plans since 1970. In all of them highest priority has been given to rural development and the expansion of the production base of agriculture. This has been perceived as a means of reducing the disparities in the levels of income between rural and urban sectors.

6.2.1 Agriculture and the Economy in Zambia

Agriculture occupies a significant place in the economies of Southern Africa. Over half of the economically active population is estimated to be employed in this sector. This applies even in Zambia where the contribution of agriculture to the gross domestic product is below 20% (Low 1986).

In 1991 traditional farmers were estimated at 830,000 (about 70% to 80% of farm households). These cultivated an average of 2 hectares with family labour as the major input. Implements used are simple hand tools and they produce essentially for subsistence. Cultivated land in this category has been estimated to be 1.6 million hectares. A large proportion of traditional farmers grow crops and rear livestock at the same time. At the village level of technology these farmers are more at the mercy of the weather and other environmental factors than their commercial counterparts.

In 1991 there was an estimated 1,601 commercial farmers. These produced wholly for the market and account for 40% of the volume of maize, the main marketed crop and 55% of other crops. These are highly mechanized, cultivating up to 600 hectares and are favourably located with regard to infrastructural and marketing facilities.

6.2.2 Traditional Agricultural Systems

Several important systems of subsistence agriculture exist in various parts of the world. These systems are usually considered as `primitive' but are based on intrinsic ecological rationales and in some cases show high levels of productivity (Cox and Atkins 1979). It is therefore necessary to appreciate the rationale and the limitations of these systems in order to deal appropriately with problems of food production in many parts of the developing world. There are many forms of shifting agriculture differing in the aspects of land preparation, duration of tenure and fallow interval and other characteristics. These systems are being modified and displaced by pressures resulting from rapid population growth. The following farming systems are associated with traditional agriculture in Zambia. These broad farming systems are a result of a combination of various factors such as soil types and fertility, climatic conditions and traditional and cultural traits.

1 - Shifting Axe and Hoe Systems

This system found in the Northern, Central, Luapula, Copperbelt, North-Western and Western provinces is an extensive one covering 40% of the country and 20% of the total population in the country. It is found in areas with annual rainfall exceeding 1000mm with highly leached soils with inherent low fertility. In this system trees are either cut or lopped, heaped then burnt. Cultivation is restricted to the ash patches for reasons of fertility and weed control. This system falls within the cropping/forestry land-use system identified above. It is estimated that the ratio of the actual field to the cleared areas range between 5% to 20% and continuous cultivation ranges between 3 to 6 years as fallow depends on the fertility status and arboreal regrowth (GRZ, 1990). Therefore, this system tends to have a high land requirement as a result of the intensity of cultivation.

2 - Semi-Commercial Ox and Tractor Plough Systems

The plateaux soils supporting this system are generally more fertile. The system employs oxen and tractor implements since the fields of more than 5 hectares are comparatively bigger than in most systems. A marked specialisation and permanent cultivation is practised because of the use of fertilisers and cow manure. This renders high intensity of cropping with medium population density per cropland. The dominant crops are maize and groundnuts which are grown on a commercial level. Due to mixed farming the land requirements are high.

6.2.3 Modernized Systems

This type of farming system is commonly found in state land in Central, Copperbelt, Eastern and Southern provinces. A total of 301,400 hectares is under cultivation, with the cattle stocking rate of 20 ha/herd as is the case in the central plateau semi-commercial farming system. Table 6-1 gives the relationship between the land requirements of the various farming systems and the populations they support. Under the circumstances of increased population-land pressures Cox and Atkins (1979) identified four major possibilities:

Table 6-1: Population and Land-Use in Farming System in 1990

Farming System	Total (Area km^2)	Persons per/km^2	Average h/h size	Average farm (ha)	Cultivated land (ha)
Shifting Cultivation					
Large Circle	120856	4.2	5.0	1.8	182700
Small Circle	29252	2.7	5.7	1.9	26000
Block	140280	3.2	5.8	1.4	117400
Mwinilunga	27300	2.6	5.6	2.4	30400
Semi-permanent					
Valley Cultivation					
Luangwa	80096	2.0	5.6	1.2	39900
Gwembe	6706	7.1	6.3	1.9	14100
Zambezi	28710	5.0	6.3	1.8	40800
Semi-permanent					
Swamp/floodplain					
Northern	36377	7.0	5.4	1.4	71100
Lukanga	1554	1.1	6.1	1.4	400
Zambezi	13559	3.5	5.6	1.4	13800
Semi-permanent					
Plateau Cultivation					
Kalahari	159781	3.5	5.6	2.3	252900
Northeast	18285	6.4	5.0	1.4	32800
Semi-Commercial					
Plateau Cultivation					
Central	18301	10.8	6.1	2.6	84200
Eastern	20056	22.2	5.0	1.8	160300
Southern	19983	13.9	6.5	3.4	145300
Namwala	6039	4.2	6.5	2.5	9800

Source: Adapted from (GRZ, 1990)

1) productivity per unit area of agricultural land will be maintained by increasing human and animal labour to offset the increased nutrients taken from the land in the form of food and other types of deterioration caused more intensive use;

2) Productivity per unit area of cultivated land will be maintained by increasing the use of fertilisers, irrigation and other energy-intensive, high technology factors that compensate for the deterioration caused by more intensive utilisation;

3) Productivity per unit of agricultural land will be maintained by reorganizations in the structure and ecology of the agricultural system that will lessen deterioration, allow greater yields to be taken more often and involve little increase in labour or other inputs and;

4) productivity per unit area of agricultural land will decline.

However, any combination of these is possible. It seems that the intensification of food production in many areas can only occur if greater investments of energy, materials, and skills in the ecological design of agricultural systems are made.

6.3 Environmental Implications of Modernised Farming Systems

6.3.1 Modern Sector

Salination and waterlogging arise from bad irrigation practices. Improper fertilizer use results in pollution and eutrophication in the aquatic environments. Pesticide pollution is also common resulting in the contamination of food and water. In the parts of Zambia with tsetse infestations, the measures of control have been a source of pollution. This section will attempt to examine the characteristics of farming systems in Zambia and the practices involved. It will enable me to make an assessment of their environmental impacts, and will entail taking into consideration the magnitude and scale of cropping, the different phases of the production process and the impacts associated with such agriculture. Diverse systems have arisen based on the rotation of one or several years of cultivation, with a longer period of fallow, in which the natural vegetation is allowed to colonize the soil. The length of the fallow period varies according to the climate and fertility of the soil (FAO, 1986).

These systems have become known as bush fallowing or shifting cultivation and have assumed distinctive features and descriptions in different parts of the Continent (Cox and Atkins, 1979). Under the technically more advanced systems of cultivation, there are larger inputs of energy in terms of machinery, pesticides and artificial fertilizers.

In discussing the environmental impacts of agriculture as practised in Zambia, it will be helpful to consider three farming systems, namely; the shifting axe and hoe system, semi-commercial ox and tractor plough and the commercial farming systems. The first system is significant because it covers an extensive area and a large proportion of the population. Major agricultural development efforts have been directed at this system to boost production. The second system includes cultivation and the livestock sub-system, with its related grazing problems. The third system will highlight trends of environmental impacts associated with large scale commercial farming ventures.

For its size, Zambia has a relatively low rural population density, of 7 persons per km^2. However, as farming systems have changed local areas of population pressure have developed with resultant problems of soil erosion and decline in soil productivity and damage to the soil structure (Wood 1990). Other environmentally integrated problems involve the costs incurred in agricultural development policy emphasising maize monoculture, while neglecting environmental diversity. The result has been a technocratic approach to agricultural development relying upon inputs of fertilizers to overcome environmental variations and problems. This increased availability of chemical fertilizers as a more favourable route from subsistence to semi-commercial production has clouded environmental perception in agricultural planning.

6.3.2 Pesticides

Pesticides are chemicals used to control and eradicate disease vectors, which in turn improve agricultural production and protect stored agricultural products. The use of pesticides is increasing in Africa. There are a number of reasons for this increase in pesticide flow in Africa and the Third World in general. There is a growing tendency for chemicals which have been banned or restricted in developed countries to appear in large quantities in developing countries (Forget, 1991).

Table 6-2: FAO Preliminary Inventory of Obsolete Pesticide Stocks in Africa for Disposal

Country	Total (Tonnes)	Quantity (Tonnes) Of Known Pesticides	Pesticides	Status[1]
Algeria	> 937	900	HCH	PIC/DD
		37	Carbaryl	
Botswana	31	18	fenitrothion	
Burkina-Faso	93	40	TMTD+ heptachlor	PIC/DD
Cameroon	240	91	fenitrothion	
Cape Verde	21	15	trichlorfon	
Chad	101	55	lindane	DD
		39	HCH	PIC/DD
Ethiopia	295	147	unknown substance	
Gambia	10	5	unknown rat bait	
Ghana	36	5	parathion	PIC/DD
Guinea Bissau	33	10	fenitrothion	
Libya	>300	300	HCH	PIC/DD
Malawi	125	70	DT	PIC/DD
Mali	116	82	dieldrin (>20 years old)	PIC/DD
Mauritania	242	204	dieldrin (>30 years old)	PIC/DD
Morocco	>1862	1862	HCH (>30 years old)	PIC/DD
Senegal	155	55	HCH	PIC/DD
		46	dieldrin	PIC/DD
Sudan	980	not identified		
Tunisia	>500	500	HCH	PIC/DD
Uganda	?	51	dieldrin	PIC/DD
Zanzibar (Tanzania)	140	77	dieldrin	PIC/DD
Zambia	>85	10	DDT	PIC/DD

Source: *Pesticide News* Issue 14/December 1991, p.4.

Agrochemical imports have also been encouraged as a consequence of the increased numbers of agricultural

[1] Indicates whether pesticide is on Prior Informed Consent or Dirty Dozen list of pesticides. Dirty Dozen=pesticides targeted as causing severe health or environmental problems; PIC=pesticides for which 'Prior Informed Consent' is required under the FAO Code of Conduct on the Distribution and Use of Pesticides.

development programmes in these countries. The introduction of high yield varieties of grains (HYV's) requires massive agrochemical inputs for satisfactory growth. Obsolete pesticides in Africa are creating an ever-increasing environmental problem.

Obsolete pesticides have accumulated to alarming levels, stocks of over 6,500 tonnes of banned and out-of-date pesticides have been identified for about 20 African countries (see Table 6-2). Large quantities have built up through inappropriate and excessive pesticide donations, a policy of holding stocks in certain countries for locust control, poor assessment of needs and application capacity, poor storage facilities and inappropriate formulations or containers. No appropriate disposal facilities exist in Africa, yet these stocks pose immense health and environmental hazards, particularly to communities near dumping sites. Action must be taken quickly (*Pesticide News*, 1991).

In Zambia pesticides are freely available, the limiting factor being the amount of foreign currency involved in their importation. A study by Abrahamse and Brunt (1983), regarding pesticide use and distribution in Zambia revealed that imports of pesticides is controlled by three multi-national corporations, namely ICI, Shell and Wellcome. Other players include Hoechst and Ciba-Geigy. The study also established that it was difficult to ascertain the exact extent and nature of pesticide flow into Zambia. Most of the chemical companies regard this information as classified and perhaps understandably are reluctant to divulge it. Most of the pesticides are used in large-scale tsetse and malaria control schemes and for tick control at government controlled dips.

In 1991 the United Nations Environment Programme (UNEP) and the Food and Agricultural Organization (FAO) finalised a system of "Prior Informed Consent" (PIC). This system should provide governments with information regarding chemicals which have been banned or severely restricted in some countries for health or environmental reasons (*Pesticide News* 1991, 12:13).

The total quantity of pesticides used in Zambia in 1989 was estimated at 1700 metric tonnes, representing a retail value of US$16 million. Of this total 80% was used in agriculture.

The use in agriculture is confined to the main crops. A breakdown of pesticide use on agricultural crops in Zambia is shown in Table 6-3.

Table 6-3: Amount of Pesticides Use on Agricultural Crops

Crop Type	Amount of Pesticide Used
Cotton	30mt[2]
Maize	290mt
Coffee	150mt
Tobacco	115mt
Sugar cane	95mt

Table 6-4: Breakdown of Chemical groups

Estimated Division Per Group		Estimated Division Per Compound	
Insecticide	40%	Organochlorines	4%
Herbicides	30%	Organophosphates	20%
Fungicides	10%	Carbamates	8%
Rodenticides	1%	Synthetic pyrethroids	5%
Others	19%	Others	63%

Source: Tables 6-3 and 6-4 from Chalabesa and Kaposhi, (1991), p2.

Insecticides account for the largest chemical group used in Zambia, similarly organophosphates constitute the largest chemical compound used (Table 6-4). An estimated 60% of these pesticides are used in agriculture by large scale commercial farmers, 30% by small scale farmers and 10% by

[2] Metric tonne

specific projects. The livestock sector uses a lot of pesticides against ticks and tsetse fly control programmes. In 1987, for example, 160,000 litres of endosulphan were used in an EEC-funded tsetse eradication exercise. Up to 1990 there was no specific legislation to control the import, distribution and use of pesticide in Zambia, nor was there a requirement to register pesticides. In fact the registration of pesticides has just come into effect, since March of 1994. The Environmental Protection and Pollution Control Act provides for the establishment of a Pesticide and Toxic Substances Control Inspectorate, which will be responsible for the registration of pesticides. This Act, however, may not be sufficient substitute for a specific pesticide legislation. Abuses of pesticides in Zambia include inappropriate application of pesticides, use of persistent pesticides on vegetables, re-use of empty containers for other purposes, use of pesticides for fishing or preserving dried fish, suicide and homicide. Considerable data have now been amassed on the presence of organochloride pesticides and other metabolites in human milk both in the developing and industrialised countries. More importantly, the levels of persistent organohalogenated pesticides in human milk are highest in developing countries (Forget, 1991). This problem is compounded by popular practices in many developing countries. In Zambia, for instance, reports in the popular press indicate that DDT is commonly used to protect dried fish used for human consumption from pest attacks (Mwanza, 1987). A survey of dieldrin residues in dairy products in Zambia, revealed a high incidence of dieldrin levels exceeding limits allowed by the Ministry of Health. The source of dieldrin has not been established. It is suspected that this may be the result of heavy use in the past or contaminated fodder.

Another problem posed in developing countries by the importation and use of pesticides has to do with the storage of these chemicals. In general, warehousing and storage facilities are poor. Zambia has a problem with obsolete stocks. Most of the obsolete stock are dumped on the ground near warehouses, often in leaking drums. Undesirable occurrences such as pesticides stored near fertilizers, seeds, food or drink, lack of record keeping, absence of provision for spills, lack of labels, corroded, leaking containers and improper repackaging are commonplace (Forget, 1991). Use should be made of the FAO Guidelines for the legislation on the control of pesticides. Basic protective gear should be made available and affordable. Behaviour modification to prevent pesticide poisoning is possible at the grass-roots, community level through education and surveillance. Labels should be in conformity with the FAO Guidelines. (Chalabesa and Kaposhi 1991). Many labels have little or no information on safety aspects and almost all labels are only written in English. Sometimes labels are folded and placed inside plastic bags containing the chemical. To obtain and read these labels, the user invariably has to handle the chemical itself. Most labels do not give the exact chemical constituent, making medical treatment difficult if those chemicals are misused. Pesticide poisoning is not uncommon. There are an estimated 11 million cases of poisoning cases in Africa per year. Most poisonings are from organophosphates (*Pesticide News*, 1991). Organophosphate poisoning results in a higher mortality rate than other poisons. It is, however, very difficult for untrained persons to diagnose the symptoms of pesticide poisoning or to distinguish them from other forms of illnesses. Mild pesticide poisoning and malaria symptoms look alike (Muchena, 1991; Forget, 1991).

Clearly, there is need to reduce the effects of insecticides and pesticide poisoning of the environment in Africa. This can be achieved by developing new methods based on the principle of integrated pest control, which relies mainly on natural elements.

6.4 Environmental Impacts

Land degradation has emerged as the single most serious environmental problem in many developing countries. Deforestation associated with the expansion of the cultivable area is one of the main problems. The other problems relate to poor farming practices, usually on fragile areas thus leading to soil erosion and degradation. Soil erosion and infertility are concurrently degrading 30% of all rain-fed cropland in Central America, 17% in Africa 20% in Southwest Asia and 36% in Southeast Asia (FAO, 1987).

6.4.1 Environmental Impacts of Fertiliser Production

The sources of pollutants from a nitrogenous fertiliser plant include ammonia, oxides of nitrogen, fluoride, acid mist, sulphur dioxide and dust particles.

6.4.1.1 Water pollution

Almost all the components present in the waste waters of a fertiliser factory can affect, in one way or the other, the water body which receives them. Acids and alkalis not only destroy the normal aquatic organisms but are also lethal to fish. The alkaline nature of fertiliser waste is attributable to the presence of ammonia, urea and other alkalis, such as caustic soda and potassium carbonate. Ammonia in very small concentrations is toxic to fish and has been reported to harm fish at 1.2 to 3 mg/l (UN/ESCAP 1982). The toxicity of ammonia and ammonium salts can be extremely high even at pH values below 9, being dependent largely upon the concentration of undissociated base. Urea when disassociated into free ammonia and carbon dioxide can be toxic in clean oxygen-rich river water, where it is transformed into nitrates. This poses a potential health hazard when the river is a source of drinking water supply. Nitrate present in drinking water above 50 mg/l may cause a condition in infants called methaemoglobinaemia or blood cyanosis. Other toxins include arsenic, hydrogen sulphide, cyanides and fluorides which are all injurious to human and aquatic life. Table 6-5 volume of effluents from a nitrogenous fertilizer plant.

Table 6-5: Volume of Flow of Effluents and Losses of Waste Constituents in a Nitrogenous Fertiliser Plant

Types of Wastes	**Loss in kg/ton NH_3/day**	**Effluents gpd/ton NH_3/day**
Carbon slurry		
Total Carbon	1.45 - 1.47	430 - 500
Scrubber Wastes		
K_2CO_3	0.065 - 0.074	5 - 20
NaOH	0.02 - 0.03	10 - 30
AS_2O_3	0.052 - 0.055	0 - 160
Monoethanolamine	0.038 - 0.23	10 - 160
Process wastes in ammonia and ammonium salts plants		
Ammonia as NH_3	4.65 - 10.0	456 - 600
Process wastes in urea plant		
Urea	15.0 - 17.5	1100 - 1500

Source: United Nations/ESCAP (1982)

6.4.1.2 Air pollution

Emission of particulates, sulphur dioxide, oxides of nitrogen and compounds of fluorine from fertiliser works are a source of air pollution and can have harmful effects on human health and plant life. Sulphur dioxide can cause widespread injury to man and vegetation. When chemically converted in the atmosphere into sulphuric acid it return to earth through precipitation. The effects of acid rain can lead to reduction of forest productivity and damage to agricultural crops.

6.4.2 Impact Abatement

Good housekeeping and operating maintenance practices should be given priority and must precede any attempt to provide external pollution control facilities. This can be achieved by preventing the loss of valuable processing chemicals, intermediates and final products through effluents and at the same time reducing their load on the water treatment plants. Leakages, spill-overs and indiscriminate handling of materials can substantially add to the concentration of various substances in floor-washing and general factory drainage. The production technologies which generate little or no waste discharge should be explored for adoption, regardless of the likely higher costs for such technology, since in the long run it could prove more economical. Treatment of waste water for disposal to rivers is essential. Certain wastes such as phosphate and fluoride bearing wastes, oily wastes, carbon slurry and concentrated arsenic and other toxic wastes need to be segregated and subjected to physical and/or chemical treatment, to reduce their load and adverse effects on the final treatment of the total waste. It would be desirable to set up a monitoring programme in every fertilizer plant to keep watch on the performance of pollution-control facilities. It is also desirable to analyze and monitor the level of nitrate in the ground water table in suspected areas, where it is the principal source of drinking water supply to the public, and control use of nitrogenous fertilisers in agricultural lands accordingly.

6.5 Agricultural Practices and Environmental Management

Some of the major problems in agriculture include the following:

1. Agro-chemical runoff contaminating water and ground water
2. Pesticide concerns
3. Effluent disposal from crop processing

There are crop-specific impacts: for example, cotton requires more pesticides than most other crops. Crops like coffee, cotton, cocoa, sugar and tea have major impacts accruing from processing, mainly the disposal of highly polluting washing water.

6.5.1 Agro-Industries

Agro-industry involves a diverse range of industries which process raw agricultural products and some generate a lot of pollution. Among them are tanneries, slaughter houses and canneries. The main agro-industry subsectors include agriculture, forestry and fisheries. Discharges of effluents from these can be a source of serious pollution for soil, air and water. It can also be a source of food contamination as well as a vector for disease among humans and animals (Alheritiere, 1982). Wastewater streams vary with the type and size of the agro-industrial operation. Effluents typically have high biochemical oxygen demand (BOD), chemical oxygen demand (COD), and suspended and dissolved solids. Other contaminants such as pesticide residues, complex oils, alkaline or acidic compounds, and other organic constituents may also be present in wastewater. Discharges from tanneries and slaughter houses can be potential sources of disease among humans and animals. Air emissions from agro-industries commonly include particulate matter, sulphur dioxide, nitrous oxide, hydrocarbons and other organic compounds.

6.5.1.1 Tanneries

Tanning is the process of converting animal hides into leather. The hides are dehaired, tanned by reacting with tanning agents, dyed and finished to produce finished leather. The four processes involved in tanning hides are: beamhouse, tanhouse, retanning and finishing.

In the beamhouse hides are processed by degreasing, fleshing and dehairing in order to prepare them for the tanning operation. Waste waters contains dirt, salt, blood, manure, oil and grease, flesh, hair etc. The waste is characterised by high alkalinity, sulphide, nitrogen, BOD, COD, dissolved and suspended solids and oil and grease.

Tanning is accomplished by bleaching the hides with chrome, vegetable tannin, alum, metal salts or formaldehyde. Waste water from the operation is substantial. The spent chromium tanning solution is relatively low in BOD, COD and total suspended solids (TSS), but can contain significant concentration of chromium, a toxic chemical. Vegetable tanning solution is high in both BOD and colour.

Retan, colour and fat liquor operations constitute the third major step in the tanning operation. The three operations involve addition of tanning solution (retan), dyes, and oils to replace natural oils of the hides (fat liquor). The process generates high-strength, low-volume discharges containing oil and colour.

Finishing operations include drying, coating, staking, seeding, pasting and washing. The last two operations generate high-strength low-volume wastewater.

The tanning process generates significant airborne particulate matter and hydrogen sulphide discharges. Other gaseous emissions occur from ammonia stripping and utility boilers. The process also generates solid wastes in the form of fleshing, sanding dust, hide trimmings, sludge, greases etc., which are normally recovered and sold to rendering plants. The main health hazard is dermatitis from contact with chemicals and hides. Other health risks result from exposure to excessive dusts, toxic chemical, noise and anthrax.

6.5.1.2 Monitoring

An important factor in the abatement of pollution in agro-industrial development projects is the simultaneous strengthening of both in-plant and government monitoring capabilities. Effective government surveillance and legal and regulatory enforcement are required. Technical capability to comply with the effluent standards should be improved.

6.6 Integrated Pest Management

Crop protection is an integral part of agricultural development. The term 'Pests' refers to all animals, plants and micro-organisms which have a negative impact on agricultural production. The use of chemical pesticides have helped raise crop productivity. However, where pesticides are used indiscriminately, pest species have become resistant and difficult or impossible to control. In some cases, resistance in important disease vectors for example, malarial mosquitoes, has resulted. With the problems of pesticide use becoming more prevalent, crop protection specialists have devised a more diversified and sustainable approach, IPM. This is based on three fundamental principles:

a) reliance is placed on using non-chemical measures to keep pest populations low. Breeding and cultural practices are used to make the environment less hospitable to pests and to keep the crop healthy and resistant or tolerant to attack. This may include the introduction of non-indigenous pathogens or natural enemies.

b) The goal is to manage pests, not to eradicate them. Populations of important species are monitored and control interventions are made only as necessary.

c) When pesticides have to be used, they are selected and applied in such a way as to minimise adverse effects on beneficial organisms, humans and the environment.

With these basic principles, approaches may vary depending on the crops or pests involved. The levels of control necessary may also vary considerably, particularly for fruit and vegetable crops where cosmetic damage may significantly decrease market value. The common statistical models used are the economic threshold level (ETL) and the action threshold level (ATL). The ETL is established through crop loss assessment of the value of the crop, the amount of damage it can tolerate at each growth stage without significant effect on yield and market value, and the cost of crop protection measures. The ATL is the pest population at which control action should be taken to prevent its reaching the ETL. Use of appropriate ATLs minimises the frequency of pesticide application.

IPM can be introduced at any level of agricultural development, through variation in such basic crop management practices as planting times, crop spacing and residual disposal. Specialised information or management requirements is the beginning. IPM will be strengthened by the following:

a) An understanding of the interactions between the elements of the local agro-ecosystem (e.g., crops, pests, beneficial organisms, the abiotic environment, etc.) and of any disruptions that may arise from the overuse or misuse of pesticides.

b) The development, with farmer involvement of a pest management plan using practical methods to reduce pest levels (including methods related to the total crop production system as well as those targeted specifically for pest control).

c) The establishment of realistic economic and action threshold levels for key pests.

d) The development of practical systems for monitoring pest populations or infestation levels and whatever support structures are necessary to sustain them.

e) The existence of farmer education concerning the principles and practices of IPM.

f) The availability of appropriate materials and equipment, including establishment of insectaries to facilitate biological pest control where appropriate.

g) Social and/or economic policy support that gives the farmer both incentive and opportunity to minimise pest management costs and increase productivity on a sustainable basis.

6.7 Impact Mitigation

A review of all the major ecological problems arising out of agricultural development in Zambia is needed. The focus of EIA on fertilizer and pesticides should be on the physical, chemical and bacteriological parameters of water bodies within the project sites. Historical trends in water and air quality, current or previous pollution problems, the ambient quality standards and effluent standards; physical and chemical effects, ecological effects on terrestrial and aquatic species and habitat have to be spelt out. The following measures can be adopted to address the situation:

- Encourage research to develop best management practices tailored to local farming conditions.

- Optimise the use of fertilizers and crop protection chemicals
- Control the improper use of chemicals and end subsidies that lead to the over-use of chemicals
- Restrict farming of fragile soils and forests
- Develop more research and new technologies, plants and inputs best suited to fragile soils, and management practices tailored to poor farms.

Research on crop protection/pest management should be comprehensive. In addition to testing the efficacy of pesticides, a complete research plan should include:

a) Basic studies of the agro-ecosystem, including biology and life cycles of crops, pests and beneficial organisms and interactions among them (e.g., identification and classification of pests and natural enemies and evaluation of the impact of indigenous natural enemies on pest populations).

b) Development and improvement of pest-resistant crop varieties.

c) Examination of cultural practices for reducing pest populations (e.g., crop rotations, intercropping, timing of planting and irrigation, crop hygiene, land preparation, plant spacing etc.).

d) Investigation of biological control methods, such as a release of indigenous or introduced natural enemies, microbial pesticides, pheromones, repellents, etc.

e) Identification of pesticides and techniques of pesticide use with minimal impact on beneficial organisms, humans and the environment.

f) Determination of the actual impacts of different pests and population levels on crop yield and quality.

g) Review of traditional pest management practices of local farmers, as these often have a sound biological basis.

The discussion in this chapter has highlighted the importance of agriculture in the Zambian economy. However, sustainable development of the agricultural sector has to address the significance of its cumulative impacts on the environment. This is necessary for maintaining the long term quality of the resource base.

CHAPTER SEVEN

SECTORAL CASE STUDY III - TOURISM DEVELOPMENT

7.1 Introduction

In an effort to diversify her economy in response to the fluctuating fortune of the established mining sector, Zambia is making great strides towards encouraging non-consumptive tourist utilisation. Tourism development is, therefore, emerging as one of the most important sectors of the economy. There is an intrinsic interrelationship between tourism and the environment. An unspoilt natural environment is an essential condition for the development of tourism. Accordingly, the positive and negative effects of tourism on the environment will affect prospects for tourism development. In this chapter the role of tourism development in Africa is examined with particular reference to Zambia; the conflicts between development and conservation; the economic and environmental impacts of tourism development; and the question of sustainable tourism development.

7.2 Theoretical Perspectives

This section discusses ideas that form the basis for the theoretical issues which are fundamental to understanding the many variants inherent in the study of tourism.

7.2.1 Tourism and the Environment

Tourism can certainly contribute to environmental degradation and be self-destructive. It also has the potential to bring about significant enhancement of the environment. With tourism-induced change an important issue is that of irreversibility. This is a function of the characteristics of tourism, the resilience of the resource base and the spatial and temporal pattern of impacts.

7.2.2 Alternative Tourism

Alternative tourism has emerged as one of the most widely used phrases. Alternative tourism is not alternative to all other forms of tourism, but rather to the least desirable type of mass tourism (Pigram, 1991; Butler, 1992). It denotes options or strategies considered preferable to mass tourism. Tourism is an industry, but also a form and agent of development and change. Controlled and managed properly, it can be a non- or low-consumptive utilizer of resources and can operate on a sustainable basis. However if developed beyond the capacity of the environment, the resource base, and the local population to sustain it, it becomes a "boom and-bust enterprise". The implications of alternative tourism include the reduction in numbers of tourists, the change in the type of the tourist, the education of all parties involved and the impact resulting from a new set of activities. Such scaling down involves encouraging smaller enterprises at the local level as well as promoting devolution of power from central political systems to local, self-reliant communities. Various other descriptions alluding to environmentally compatible tourism include "green tourism" (Jones, 1987), "nature oriented-tourism" (Durst and Ingram, 1988), "soft tourism" (Mader, 1988), and "defensive tourism" (Krippendorf, 1982;1987).

7.2.3 Public Participation

An impressive body of literature on public participation in decision making exists (Romsan, 1990; McMillan, 1994; Boulle, 1987). Given the scale or resource management decisions in tourism development, it makes good sense to consult local communities. Community involvement is not merely good public relations, it can also play a role in facilitating the policy implementation process. Without sustained pressure from the grass roots, more environmentally compatible development run the risk of not being considered seriously as alternatives to mass tourism.

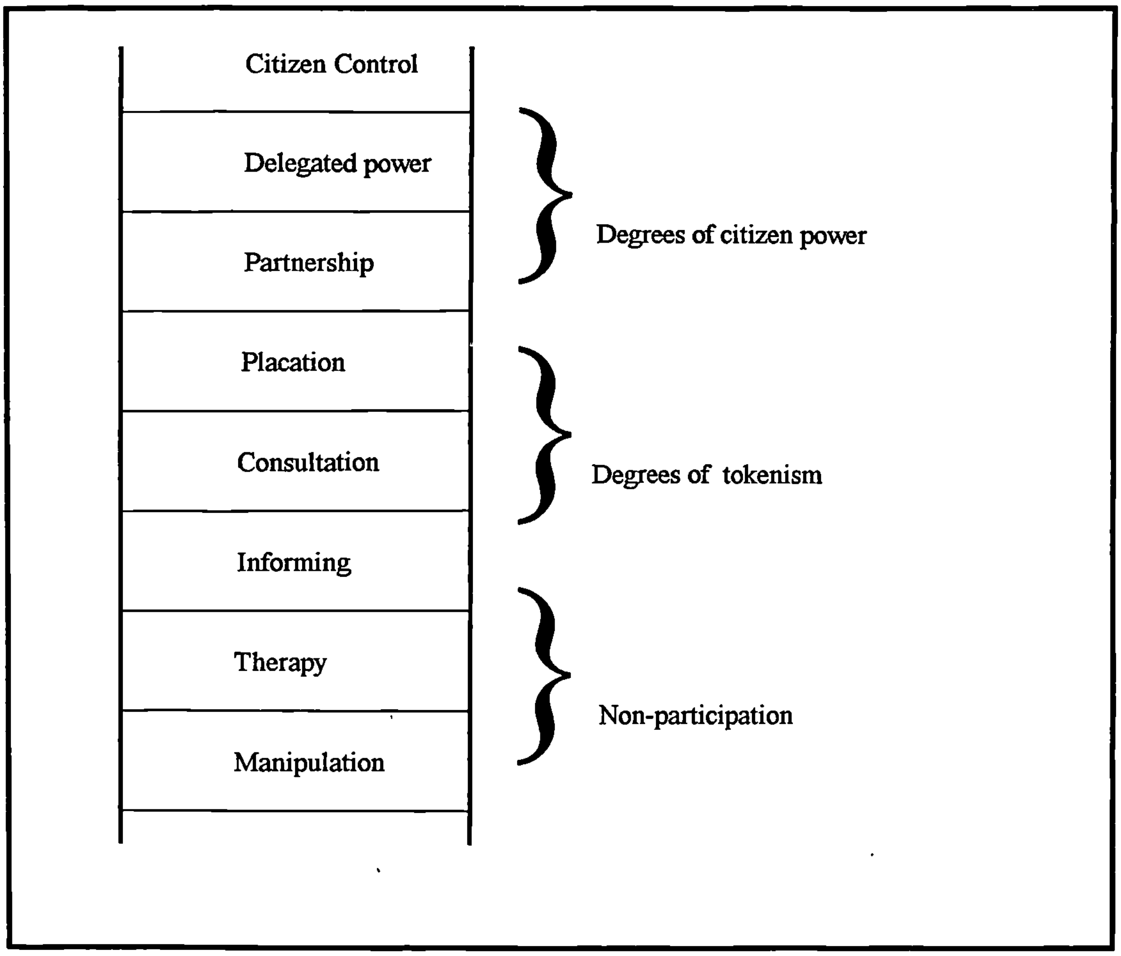
There is a critical difference between going through the empty ritual of participation and having the real power needed to affect the outcome of the process. This was brilliantly capsulized in a poster by French students. The poster highlights the fundamental point that participation without redistribution of power is an empty and frustrating process for the powerless.

Source: Arnstein, (1969)

Figure 7-1: French Student Poster. In English, I participate; you participate; he participates; we participate; you participate. . . They profit.

Arnstein, (1969), provides a typology of eight levels of participation. The eight types are arranged in a ladder pattern with each rung corresponding to the extent of citizens' power in determining the end product.

Figure 7-2: Eight Rungs on a Ladder of Citizen Participation



Source: Arnstein, (1969)

The bottom rungs of the ladder are *Manipulation* and *Therapy*. These describe levels of non-participation whose objective is to enable powerholders to 'educate' or 'cure' participants. The *Informing* and *Consultation* levels of 'tokenism' allow the have-nots to hear and have a voice. Citizens may indeed hear and be heard, but they lack the power to ensure that their views will be heeded. In *Placation* which is a higher level of tokenism, groundrules allow have-nots to advise, but retain for the powerholders the right to decide. Further up the ladder are levels of citizen power with increasing degrees of decision-making clout. *Partnership* allows them to negotiate and engage in trade-offs with traditional powerholders. At the topmost rungs, *Delegated Power* and *Citizen Control,* citizens obtain the majority of decision-making seats or full managerial power.

7.3 Tourism And Development

Many developing countries have a strong historical function of exporting primary commodities. This has usually been inadequate to meet the financial requirements of economic development. This has encouraged governments in developing countries to turn to tourism as means of raising the financial resources needed for development.

Tourism may be defined as the phenomena originating from journeys and the temporary stay of people travelling essentially for leisure or recreational purposes (Pearce, 1987). The 'travel and stay' attributes are characterised by the demand for provision of a wide range of goods and services (Pearce, 1989). At destination these include attractions, transport, accommodation, supporting facilities and infrastructure. In a review of the sociology of tourism, Cohen (1984), identifies eight sociological perspectives on tourism: tourism as commercialised hospitality, as democratised travel, as a modern leisure activity, as a modern variety of traditional pilgrimage, as an expression of basic cultural themes, as an acculturative process, as a type of ethinic relations and as a form of neo-colonialism. Direct links between tourism and theories of economic development have been made. Tourism has been seen to have a special function in developing countries. It is the sector's perceived ability to generate capital which may be transferred to other sectors of the economy. This theory also underlines the multiplier impact of tourism, the creation of employment, public revenue and foreign exchange earnings. A multiplier estimates the ratio between the ultimate effect of tourist activity in an economy and the immediate expenditure made by tourists themselves, and can be used to indicate the extent to which an economy is directly and indirectly dependent on the tourism sector (Curry, 1992: 194). Others, however, like Kassé (1973) raise two crucial questions: What are the real costs of developing tourism? What are the direct and indirect effects which tourism has on the rest of the economy? Drawing on the African experience, he suggests that the costs of tourism may be greater and the benefits smaller than popularly supposed.

7.4 International Tourism

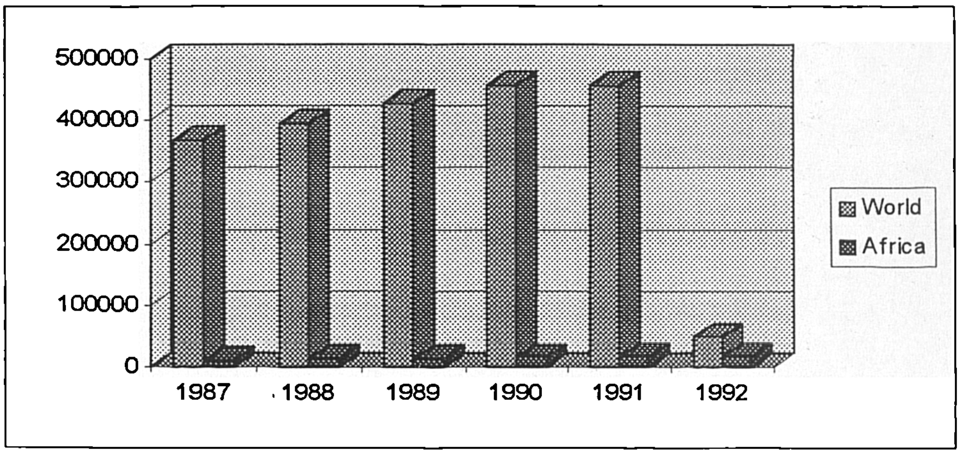
Tourism has emerged as a major industry in the past few decades rivalling manufacturing industries and other services in terms of sales, employment and foreign exchange earnings (Sinclair and Stabler 1991). It is a sizeable and complex service industry controlled by the laws of supply and demand. In most areas it shows a strong seasonality of demand and can be affected by the relatively undependable changes in consumer preferences. In addition it is an industry strongly influenced by political events in the host country. The improved facilities for travel and the tendency to spend leisure time away from bustling urban centres has meant more and more people are drawn to the wild. The growth in real income per capita and an increase in leisure time, especially in developed countries, accounts for recent trends in international tourism.

The form and level of tourism development in a Third World country is partly dependent on the level of incorporation in the world economy. Bull (1991), defines incorporation in terms of market articulation, the impact of the core on the periphery, and the impact of the periphery on the core. The continuum of incorporation can range from none, to weak, moderate and strong. The greater the incorporation, then the greater is the market articulation, and the greater the impact of the core on the periphery. There is no other international trading activity which involves such critical interplay among economic, political, environmental and social elements as tourism. International tourism is characterised by asymmetrical power relationships. This is illustrated by the nature of the exchange which takes place. Tourists from developed countries demand high levels of luxury at prices below those for which they are willing to pay in their home countries. Furthermore, relationship between Third World countries and the tourist markets in the developed world are mediated by travel agencies, tourism companies and airlines. The result is not only structural dependence but also a high level of income leakage. Attention has been paid to the role played by transnational corporations. In Kenya, for example, foreign equity participation accounts for almost 60% of hotel beds, with large transnational hotel groups such as Inter-Continental and Hilton International having major developments (Rosemary, 1987). The implication for developing countries are considerable: a loss of control by the host country over its national tourist industry; leakage of earnings and the development of isolated tourist enclaves separated from the host population (Lea, 1988).

In Africa international tourist arrivals rose by 5.5% from 14,973 million in 1990 to 15,842 million in 1991. Receipts decreased from US$5,075 million in 1990 to US$4,830 million in 1991. The economic recession in the

United States of America and Europe and the strong performance of intra-regional flows accounted for this decrease. Arrivals from within Africa are of lower per capita expenditure. Africa's share in both world tourist arrivals and receipts is negligible. The figures demonstrate that despite the increase in both tourist arrivals and receipts world-wide, Africa has earned very little from this large and booming trade.

Figure 7-3: International Tourist Arrivals ('000)

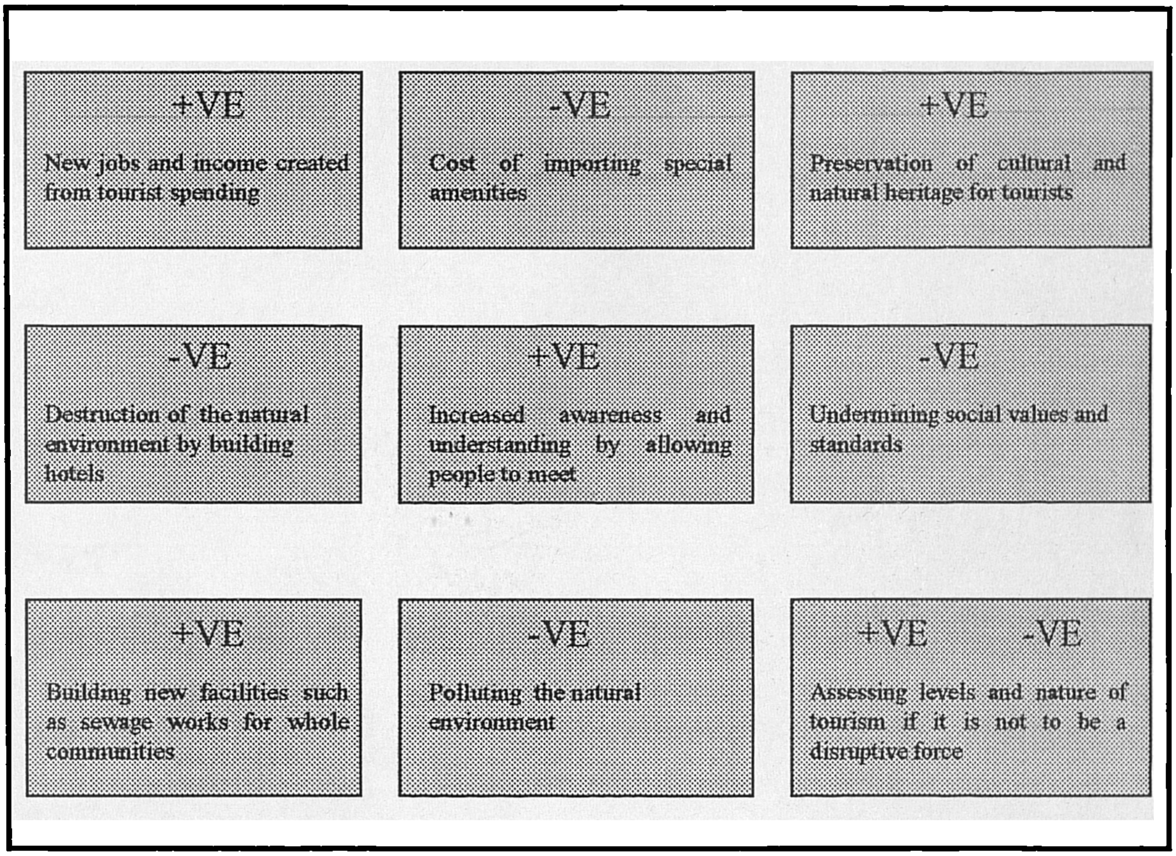


Source: WTO (1990)

7.5 *Environmental and Socio-economic Impacts of Tourism*

The socio-economic and environmental impacts of tourism will depend on how the developments and activities are managed. El-Hinnawi and Hashmi (1982) identify the costs and benefits of tourism, which must be taken into account.

Figure 7-4: The Costs and Benefits of Tourism[1]



Source: After El-Hinnawi and Hashmi (1982).

7.5.1 Economic Impact of Tourism Development

The development of tourism is a means for increasing foreign exchange earnings and represents a diversification of the economy. As a service industry, the labour-intensive nature of tourism is one of the

[1] -VE Negative Impacts/Costs of Tourism
+VE Positive Impacts/Benefits of Tourism

major impacts of tourism development. Tourism is significant in stimulating infrastructural investments and in creating external economies. It also fosters inter-sectoral linkages and the resulting multiplier effects of tourist expenditures (Bull, 1991). The economic impacts of tourism have been well documented. Little, however, is known about the associated costs. The emphasis on the positive economic impacts of tourism has contributed to the widespread optimism in developing countries concerning the potential of tourism in stimulating economic development. The economic benefits have been accompanied by a variety of costs. The economic costs of tourism include the hidden indirect costs, such as importation of goods for tourists, high inflation, high leakages from the economies of developing countries, overdependence and opportunity costs (Mathieson and Wall, 1982).

Many governments in developing countries encourage tourism as a development strategy because of the expected economic benefits it brings in its wake. There is a multiplier effect as jobs are generated not only in facilities directly serving tourists, but also in industries and commercial enterprises benefiting from increased local spending power. In Third World countries, tourism is seen as a way of generating reserves of foreign exchange, but economic autonomy can be lost in the process, and the employment opportunities envisaged may be fewer and costlier. Poor countries may find that much of the tourist revenue generated remains with the multinational consortia, hotels and agencies who control the mass holiday market. Often, too, the wealth created by tourism benefits only a small area of a country and a local elite. In their exposé of the structure of international tourism, Sinclair *et al.*, (1992), observe that past literature on tourism and developing countries has discussed tourism's contribution to income, employment and foreign exchange earnings. Little attention, they surmise, has been paid to the way in which such effects are influenced by the interrelationships between tourism enterprises in developing countries and other major intermediaries in the tourism industry, for example, foreign airlines, tour operators and travels agents. Tourism takes place in an international context dominated by the actions of large foreign firms.

The benefits and costs associated with tourism development are, therefore, greatly influenced by the nature of the international foreign operators and those based in the host countries. Developing countries as a whole are a net importer of services but a net recipient of foreign exchange from travel, which constitutes the generally accepted proxy for tourism earnings.

Many developing countries have a comparative advantage in tourism due to their attractive climatic, cultural and scenic resources. However, destination areas only supply part of the tourism product, notably accommodation, infrastructure and other destination-specific characteristics. Foreign ownership or control of such assets, as well as airlines used to transport tourists, can be considerable. Moreover, payments for holiday expenditure are often made to travel agents and tourism operators in tourist origin countries so that only a percentage reaches the destination. Further reductions in the potential revenue of the destination occur in the form of payments for imports consumed by tourists in the destination area and remittances of profits, interest and dividends to foreign owners of tourism businesses. A major issue related to tourism in developing countries is, therefore, the distribution of the revenue obtained from tourism between firms and individuals in destination and origin countries. Air transport plays a great role in the distribution of earnings from tourism. In her study Sinclair (1991) estimates that for every £1,000 spent on a 14-night safari and beach holiday, Kenya receives between £500 and £660 if the tourist travels to and from Kenya with an overseas carrier. The leakage percentages for Kenya are considerably lower if Kenya Airways provides the international air transport. In other items the import content estimates for Kenya are favourable in comparison to those for various other developing country tourist destinations. Kenya benefits from the fact that agricultural and manufacturing sectors of the economy can provide many of the inputs required by its tourism industry.

Many developing countries are faced with the problem of whether to continue to use their scarce national resources to subsidise a loss making national carrier.

Lending institutions like the IMF and World Bank have argued for privatisation and foreign participation. Developing countries are reluctant to see majority ownership of their 'flagship' airline pass into foreign hands. In the case of Zambia, the reality has been brought to bear with the liquidation of the national carrier, Zambia Airways. This has profound economic implications in terms of leakages and loss of earnings from tourism that a national carrier can provide. The returns from tourism development are therefore likely to vary from country to country. There is need to take into account different forms of foreign intervention by foreign participants, during the process of policy formulation. There is need to assess the opportunity costs of tourism, both in the sense of the diversion of resources from other sectors, and in the sense of evaluating what other economic strategies are open to a particular country.

7.5.1.1 Cultural Impact

The tourist industry can help a country rediscover its national identity. Customs may be revived and monuments restored. New markets are created for indigenous arts and crafts and presentations for song and dance, which can give a community new pride in its culture, but conversely local people can be exploited in order to provide tourists with packaged amusement. `Culture' can become divorced from everyday life and devalued as a result. Much visited communities may see their traditions and life-styles fossilised or adapted to suit their visitors rather than their needs (Lea, 1988).

7.5.1.2 Social Impact

There is often improvement in the educational and agricultural infrastructure of the community. Small and middle level industries increase to meet fresh food needs. At tourist resorts, improved facilities for recreation, leisure and eating may be available to the whole community, but social imbalance, racial and communal tensions can all emerge from the uprooting of villages, the influx of new residents and the new forms of employment which may accompany tourism development. However, for local people tourism also means disturbance to ways of life and social structure, and increased costs to build and maintain facilities, such as sewage treatment plants or roads, to cater for numbers of tourists. Governments may benefit from an improved balance of payments position in the host country but countries can use tourism's demand for stability as an excuse to stifle opposition. The aura of glamour and prosperity surrounding tourist venues can be used to convey a false image of a country's social and economic realities (Lea, 1988).

7.5.2 Environmental Impacts of Tourist Development

In assessing the environmental impact of tourism, consideration must be taken of the composite nature of tourism. Tourism-generated stressor activities and the associated stresses have been suggested as a basis for a framework for the study of impacts of tourism on the environment (OECD, 1981). Stress comes in the form of restructuring of local environments, expansion of built environments and land taken out of primary production. The generation of waste is another source of stress, through pollution loadings, emissions, effluent discharges, solid waste disposal and noise. Certain tourist activities generate stress through the trampling of vegetation and soils and destruction of species. Finally, stress comes in the form of congestion and increased demand for facilities due to the seasonal increase in population in tourist areas.

Figure 7-5: Potential Impacts Of Tourism On The Natural Environment

A. Changes in floral and faunal species composition
1. Disruption of breeding habits
2. Killing of animals through Hunting
3. Killing of animals in order to supply goods for souvenirs trade
4. Inward or outward migration of animals
5. Destruction of vegetation through the gathering of wood or plants
6. Change in extent and/or nature of vegetation cover through clearance or planting to accommodate tourist facilities
7. Creation of a wildlife reserve/sanctuary

B. Pollution
1. Water pollution through discharges of sewage, spillages of oil/petrol
2. Air pollution from vehicle emissions
3. Noise pollution from tourist transportation and activities

C. Erosion
1. Compaction of soils causing increased surface run-off and erosion
2. Change in risk of occurrence of land slips/slides
3. Change in risk of avalanche occurrence
4. Damage to geological features
5. Damage to river banks

D. Natural resources
1. Depletion of ground and surface water supplies
2. Depletion of fossil fuels to generate energy for tourist activity
3. Change in the risk of fire occurrence

E. Visual impact
1. Facilities (e.g. buildings)
2. Litter

Source: Green and Hunter (1992)

The pollution of land, sea or air can be seen to some degree in almost every tourist resort. Tourism's relationship with the environment is complex. It involves many activities that can have adverse environmental effects. These range from air pollution by planes and buses, water contamination by sewage, tourists' solid waste generation, and ecological damage caused by trampling and road construction. All these impacts add up, and there are many examples of severe local environmental impacts, for example coral reefs have been damaged in Kenya, Tanzania, Madagascar, Mauritius, and the Seychelles (UNEP, 1992). Figure 7-5 outlines some potential impacts of tourism on the natural environment.

7.5.3 Wildlife Tourism

In the past two decades there has been an increase in the patronage of African national parks. Viewing and experiencing the splendour of African wildlife in a natural setting exceeds the artificial spectacle experienced in city zoos. This desire to see wildlife in as natural a setting as possible concentrates large numbers of tourists into a limited number of areas endowed with rich wildlife habitats. It is also under such conditions that the most significant environmental impacts occur. One significant impact on wildlife is the disruption of feeding and breeding. Shadowing of large predators like lions and cheetahs undermines the privacy of the animals and leads to many missed kills.

7.5.4 Wildlife and Habitat Loss

A survey of conditions and trends of wildlife and habitat, in most regions of the world indicate a decline, as the land has been settled and developed (IIED/WRI, 1987). Areas designated as wildlife parks have been encroached upon by humans seeking land for grazing and invaded by poachers. A report by the FAO (1986) notes that wildlife is under pressure in all of Africa. The most serious, it states, is the modification, degradation and destruction of habitats. Various development projects are undertaken without the evaluation of their effects on the wildlife resource. In most pastoral areas, overstocking with domestic animals depletes grazing resources to the detriment of both livestock and wildlife. Another areas of conflict is that of disease relationships. Diseases in domestic animals can infect wildlife with disastrous consequences. An example is cited of the Serengeti where the elimination of rinderpest from cattle has stopped the annual die-off of wildebeest calves, resulting in the build up of the population from 100,000 in the 1960s to 1 million in the mid-1980s (FAO, 1986). Conversely, over-exploitation of wildlife resources is a consequence of the commercialisation of their products and from illegal hunting for personal benefit. Illegal trade in wildlife and its products continues to be a major threat to many species.

Most wildlife legislation in Africa was designed primarily to regulate sport hunting rather than to manage wildlife (FAO, 1986). A more positive approach would be to strengthen wildlife management services. Species conservation is usually so dependent on habitat conservation that it is difficult to separate them. National land-use programmes must, therefore, include the conservation of representative biotypes. Concern for wildlife habitat loss has increased as a result of the rates of deforestation and clearance of natural forests. Deforestation, especially in the tropics, is considered the worst threat to the world's wildlife. The results of the IUCN-UNEP study reveals that 65% of the original wildlife habitat in tropical Africa has been lost. In this region only Zambia has lost less than 30% of its original habitat. However, species loss through poaching is seen as the biggest problem, robbing the nation of income through wildlife-based tourism and legal hunting.

This is perhaps symptomatic of a failure to distribute the benefits of wildlife conservation to local people.

Figure 7-6: 1994 IUCN Red List of Threatened Animals in Zambia

Class	Order	Family		
Mammalia	Artiodactyla	Bovidae	Lechwe	*Kobus leche*
	Carnivora	Canidae	Wild Dog	*Lycaon pictus*
	Carnivora	Felidae	Cheetah	*Acinonyx jubatus*
	Proboscidea	Elephantidae	African Elephant	*Loxodonta africana*
	Perissodactyla	Rhinocerotidae	Black Rhinoceros	*Diceros bicornis*
Reptillia	Crocodylia	Crocodylidae	African Slender-snouted crocodile	*Crocodylus cataphractus*

Source: World Conservation Monitoring Centre, 1994.

Figure 7-6 lists some of the threatened animal species in Zambia. To prevent the wholesale loss of species, global conventions have been adopted such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Parties to CITES pledge to abide by certain regulations and to report trade in designated animals and animal products to its secretariat. CITES members agree to prohibit commercial international trade in endangered species and to monitor trade in species that may become depleted by trade. Species are classified in two categories, Appendix I and Appendix II. Appendix I is a list of species threatened with extinction and

Appendix II a list of species not yet threatened but which could be if trade is not controlled. An example of such agreements is the elephant ivory trade ban of 1989. All countries party to the agreement have officially stopped exporting ivory, including the southern African countries that were opposed to the ban.

7.5.5 Ecological impacts

Generally the vegetation of all game reserves in Africa is semi-arid or arid savannah. These ecosystems are notably fragile, easily becoming vulnerable to uncontrolled vehicular traffic. Tourist off-road driving is common in all the main reserves on the continent and is indicative of tourist recreation pressure on the reserves. Many areas of the reserves could only be reached by unimproved tracks. Tourists' game viewing in the dry season regularly go off the existing roads. One of the main reasons for regular off-road traffic is to get a closer view of the large carnivores whose population levels are comparatively low, particularly Lion (*Panthera leo*), Leopard (*Panthera pardus*), and Cheetah (*Acinonyx jubatus*). Thus, tourist vehicles very often go off the management roads for considerable distances in search of them.

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Onyeanusi (1986) has studied the impact of tourist off-road driving on grasslands in the Masai Mara National Reserve in Kenya. Off-road driving simulation experiments were conducted with a Land Rover. The vehicle's speed (20 kph) and weight (1,600 kg) were held constant while the number of runs was varied among the plots. In plot 1 of the grassland strip 10 runs were made, and in plots 2, 3 and 4, there were 20, 50 and 100 runs respectively. The impact of vehicle tyres on grassland standing crop was assessed to measure the damage to the vegetation cover. From data obtained from tourist game drives, a Land Rover vehicle travelled a total of 189.17 km on secondary tracks during 5 game drives. The speed averaged 37.83 kph for each game viewing drive. The total time taken for the 5 drives was 6.90 hours, giving an average of 52 km per drive travelled off the main roads by the tourists. The width of the tyre of the experimental Land Rover was 17cm. During the first quarter of 1982, 2,963 motor vehicles, made up of Land Rovers, Land Cruisers, Suzukis, and Minibuses, entered the Mara Reserve through the Olemelepo gate. Using the impact of a single motor vehicle passage deduced from the loss to standing crop in plot 1 of the simulation experiments, the loss of standing crop over the Mara was estimated by extrapolation.

The following formula was used to estimate total damage arising from off-road driving:

$$\mathbf{d} = \frac{\mathbf{V(r.2t)\ L}}{\mathbf{P}}$$

where

d = Percentage loss in vegetation mass
V = Number of annual vehicle entries
r = Average distance driven off-road (in km)
t = Tyre width (cm)
P = Area of park (km^2)
L = percentage loss of standing crop per vehicle passage

For the whole Masai Mara, he calculated 0.00038% of standing-crop loss due to a single motor vehicle passage by each of the 2,963 motor vehicles noted as entering through the Olemelepo gate. Similarly, the loss of standing crop in the most heavily used part of the reserve was calculated. This area extended from the Mara River in the west to Olemelepo gate in the east, and from the Tarek River in the north to Sand River in the south. There was an estimated 0.00055% loss of standing crop for each vehicle passage within the same quarter of 1982. In discussing the impact of off-road driving on grassland in the Mara Reserve, Onyeanusi (1986), observes that the findings seemed to contradict the impression of the extent of ecological damage which any ecologist or range manager, visiting the reserve, could have had from noting the extensive areas that showed conspicuous secondary tracks. Moreover through regular use, some of those secondary tracks were gradually being converted into permanent tracks. Crushing and tearing of the standing crop by vehicle tyres, as well as dislodging of the underground plant parts, were apparent from the simulation experimental plots. In the reserve the ecological impact on the grasslands was generally negligible. The simulation experiments further demonstrated that the turning of tourist vehicles had more destructive effects on the grasslands than when the same vehicles were driven on a straight course. The increasing populations of migratory wild herbivores like Zebra (*Equus burchelli*), Wildebeest (*Connochaetes taurinus*), and Thomson's Gazelle (*Gazella thomsoni*) in the Mara-Serengeti system, triggers off an increase in the volume of tourism in the area. The ecological impact of off-road driving is much smaller in the Mara. However, the negative aesthetic effects of numerous secondary tracks, (which are visible all over the reserve) on the quality of game viewing constitutes a management problem.

For Third World countries tourism is billed as an essential factor in diversifying sources of foreign exchange opportunities. In fact, the economic benefits of tourism have been substantially overestimated. Numerous studies have pointed out the high "foreign exchange leakage" of tourism-generated income; as much as two-thirds of the money tourists spend goes to foreign-owned tour operators, airline, hotels and pays for imported food and drink. Little money goes to local people who tend to be employed in the lower paid and menial tourist jobs and bear the brunt of the adverse impacts, including erosion of cultural values and an extensive environmental degradation.

Many tourism companies in the North and South are now promoting what is called "Eco-tourism". In many countries "Eco-tourism" replicates the characteristic problems of conventional mass tourism. "Eco-tourism" is being promoted in the name of "sustainable development" and "bio-diversity protection". Projects seeking to preserve bio-diversity rely on "ring-fencing" particular areas. Too often this is being done at the expense of the local people who rely on the area for their livelihood. This clash of conservation-versus-people has become particularly common in Africa, where conservation concepts are imposed through USA-style national parks. Such projects often regard local people as ignorant of and responsible for the destruction of the environment.

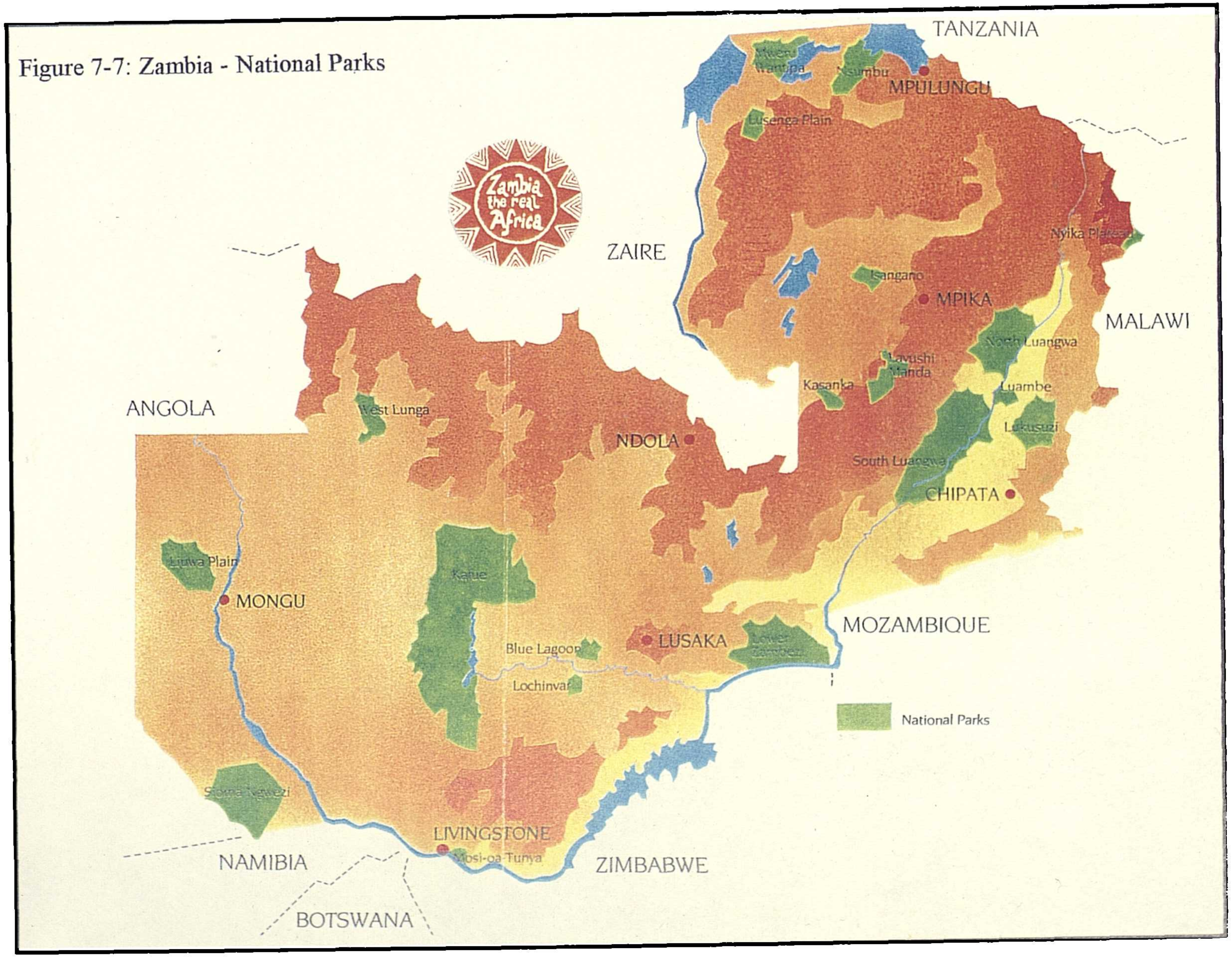
With tourism increasingly becoming internationalised more political will and better planning and management are required to avoid problems and past mistakes. What is required is to take into account the political and economic structures of tourism and the realities of corporate interests.

Over the past century, governments have pursued policies which alienate the wildlife from the people and frequently turn it from a valuable commodity into a threat and a nuisance. The establishment of parks and reserves, which may attract tourists and foreign exchange for the government, exclude and have often directly displaced rural communities from land they have traditionally considered to be their own. Anti-poaching laws turn centuries' old practice of subsistence into a crime, and people are often prevented from eliminating "problem" animals to protect crops, their livestock and themselves. Rural people bear the costs of living with wildlife but have been progressively excluded from obtaining any benefit from them. The concept of wildlife management as a viable alternative or complementary land-use in marginal areas has only recently begun to enter mainstream economic development planning (Kiss, 1990).

7.6 Tourism in Zambia

Wildlife is the main attraction of the tourist industry in many regions where spectacular numbers or unique species occur. Nowhere is this wildlife-based tourism accomplished on such a large scale as in Africa. Some nations, where tourism is well developed receive a large part of their foreign exchange from wildlife-associated tourism. For example, countries like Kenya, are chief beneficiaries netting as much as US$300 million in 1985. This surpassed that country's usual chief export earners of coffee and tea (IIED/WRI, 1987).

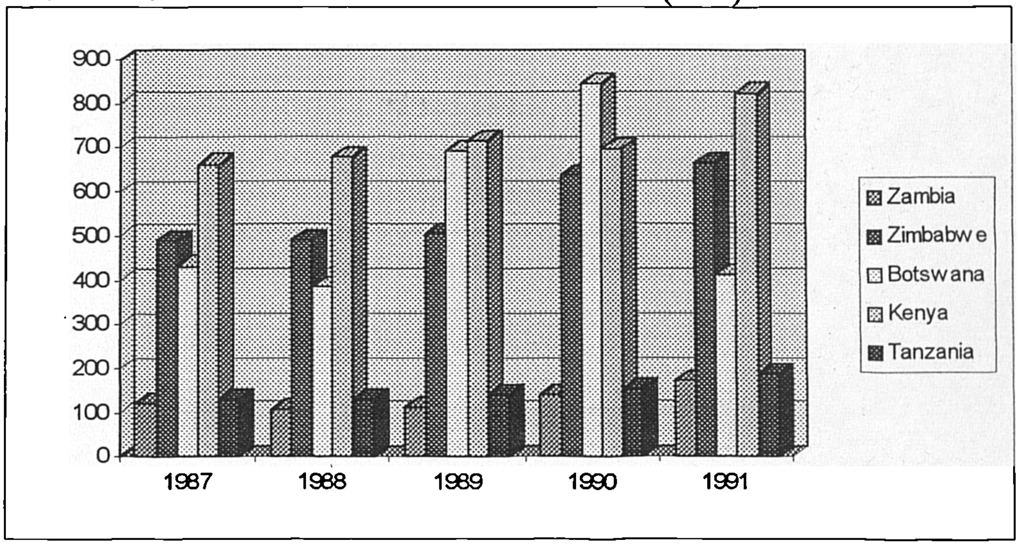
Figure 7-7: Zambia - National Parks



Source: Zambia National Tourist Board

Zambia is a big country which is rich in scenery and wildlife. It has 19 National Parks, providing some of the largest remaining wildlife sanctuaries of big game animals in the world. These are popular tourist spots for game viewing by vehicles and walking safaris. These National Parks have lodges and camps, some open between June and November and others remain open all year round.

Figure 7-8: Tourist Arrivals in Selected African Countries ('000)



Source: Zambia National Tourist Board, 1993

The trend of tourist arrivals in Zambia since 1987 has been on the increase. However, compared with neighbouring countries, its performance in this sector is lagging behind. This means that its share of earning from tourism is negligible. This is reflected in Figure 7-8. Compared to Botswana and Kenya, tourism development in Zambia is still in its infancy. Perhaps there is a positive aspect to this scenario: the country is in a position to learn from the negative impacts that tourism engenders, especially on the environment.

The level of tourist facilities provision is an important aspect of the tourist industry. Table 7-1 shows that for the period 1987-1992, the average occupancy rates in tourist lodges and camps in Zambia of rooms and bed space were below 50% occupancy.

Table 7-1: Zambian Tourist Lodges and Camps Average Occupancy Rates[2] (%)

Year	Beds	Rooms
1987	33.0	37.4
1988	41.0	47.7
1989	35.0	42.3
1990	34.4	45.2
1991	47.0	45.0
1992	41.0	46.0

Source: Zambia National Tourist Board, 1993

7.7 Development or Conservation?: Resolving the Conflict

The traditional conservation model adopted by many developing countries stresses custodial management

[2] Occupancy rate (%) is the number of occupied room/bed nights divided by the yearly available number of room/bed nights.

techniques, such as the designation parks and reserves that prohibit most human activities within their confines. Protected areas are typically there to preserve such species as elephants, tigers or bears. Efforts to conserve wildlife and habitats have been to address the threats to those species. In most cases conservation efforts have been largely influenced by organisations or agencies outside these nations. The protected areas are sometimes too small to provide for their inhabitants, as many animals must range outside boundaries during certain seasons to find enough food to survive. Where protected areas are imposed on local communities with no input from or regard for the local people, a conflict is created. Conflict also arises when benefits are perceived, by local people, to go to society at large while they bear the costs. Other problems facing protected areas include ineffective management and insufficient funding. Responsible agencies are usually grossly underfunded and understaffed.

Tourism which is integrated into a national and local strategic planning framework and which undertakes environmental impact assessments increases the long-term viability of tourism. The aim of economic development should take environmental costs into account and integrate the tourism sector within a diverse economic base. This will ensure that the resources in this sector are well managed for the industry's stability.

7.7.1 Wildlife Management Projects

Wildlife offers a variety of consumptive and non-consumptive uses. There are high-use values of wildlife, i.e., tourism and safari hunting, which do not depend directly on total animal biomass. Consequently, profits can be increased without increasing pressure on the environment and can help to strengthen Zambia's economy.

7.7.2 Local Participation In Wildlife Management

National Parks in Zambia amount to 8% of the country's land area and Game Management Areas (GMAs) make up another 22%. Created in 1970 from controlled hunting areas, GMAs provide a framework within which wildlife management can be integrated into the rural economy. The Administrative Design for Game Management Areas (ADMADE) programme is run by the Department of National Parks and Wildlife Service. The programme focuses on the distribution and use of wildlife revenues. Local Wildlife Management Authorities are established to participate in making decisions particularly those regarding the allocation of the communities share of the proceeds.

7.7.3 Zambia Wetlands Project

About 6% of Zambia is classified as wetlands, covering the Upper Zambezi floodplains of the Western Province, the Bangweulu Swamps, the Kafue Flats, the Busanga Plains and the Lukanga Swamps. In these areas wildlife is a significant resource.

The Kafue Flats and Bangweulu Swamps are important refuges for wildlife, including the Black and Kafue Lechwe (*Kobus leche and Kobus leche kafuensis*), Sitatunga (*Tragelaphus spekei*), Tsessebe (*Damaliscus lunatus*), Zebra (*Equus burchelli)*, Wattled Cranes (*Grus carunculatus*) and Shoebills (*Balaeniceps rex*). The first five are officially protected species in Zambia. These wetlands also support fisheries, irrigation, hydro-electric power production, water supply, agriculture, communal grazing, tourism and hunting activities.

The WWF-Zambia Wetlands Project was developed in 1986 with technical and financial assistance coming from IUCN and WWF-International. Its objective was to establish a natural resource management regime with the participation of local communities. Management includes anti-poaching, control of hunting and infrastructure development. Training in skills related to utilisation of wetland resources and management is undertaken. Aspects of community development include provision and maintenance of social services.

7.7.4 Debt-for-Nature Swaps

Debt-for-Nature Swaps involve the purchase of developing country debt at a discounted value and the subsequent exchange of the foreign debt in return for a newly created obligation on the part of the debtor nation. The payments on the new obligation are made in domestic currency to fund agreed upon conservation programmes. WWF in 1989 purchased a Face Value of Debt $2.270 million at the cost of $454,000. The conservation funds generated ($2.270m) were earmarked for conservation and management of the Kafue Flats and Bangweulu Basin wetlands; supporting conservation education activities; alleviation of soil erosion and habitat degradation; protection of Black Rhinoceros (*Deciros bicornis*) and African Elephant (*Loxodonta africana*) populations and the strengthening of local conservation institutions (World Resources Institute, 1992).

7.7.5 Impact Mitigation

It is inevitable that the development of tourism will produce some impacts. The very nature of tourism means that it is likely to bring about land-use conflicts. Some of these impacts cannot be avoided completely. Planning for tourist development is a complex process involving consideration of diverse economic, environmental and social structures. Planning measures should be directed at restraining and directing growth rather than encouraging it. The development and marketing of tourism have been oriented primarily towards the needs of tourists. Planning for impacts of tourism should be undertaken. This can be addressed in two ways. Firstly, measures should be devised to mitigate the existing impacts of tourism. Where tourism planning has been undertaken it has often been remedial. Some of the more common methods include the closure of vulnerable sites and attractions, the establishment of barriers and paved walkways in areas which are ecologically sensitive. Secondly, planning measures may manipulate the tourists by encouraging them to make travel decisions in certain directions. This can help relieve pressures in much more popular spots. This is likely to be easy since many tourists are now environmentally conscious.

The negative impacts of tourism, in conjunction with the emergence of environmental problems has stimulated demand for:

1. the emergence of public participation programmes;
2. requirements that environmental impact assessments be conducted.

In theory, public participation is a positive contribution towards more effective decision making. From a practical perspective it may be difficult to arrive at decisions which are socially and environmental acceptable and, at the same time, economically feasible. Furthermore, satisfactory procedures have yet to be developed for integrating social and environmental impacts into an economic framework. Impact research is an indispensable input to the planning of tourist destinations and can help to ensure that these goals are met. In the next section, the application of environmental impact assessment to the tourism sector is discussed.

7.8 Environmental Impact Assessment In The Tourism Sector

Tourism has emerged as a forceful agent of change and creates impacts which are the product of tourist development. In the developed world environmental issues are being promoted in tourism, inspired by the 'green movement'. This represents one of the major forms of change in societal attitudes towards tourism, although this is set within the wider context of ecological values associated with the green consumer. Environmental impact assessments have become necessary in some countries, where tourism development projects have to fulfil the requirements of legislation.

More recently the importance of the environment as a tourism resource and the need to consider the sustainability of that resource has been given attention. It has been recognised that it is imperative to reconcile the need for an enduring and sustainable environmental tourism resource with a continuing pursuit of social and economic goals. In sustaining tourism activity it is appropriate to consider 'thresholds' of tourism activity. A given environmental impact can be tolerated up to a point beyond which the environmental resource ceases to be a positive attraction and the tourism activity that relies on it has to substitute other resources or decline.

Figure 7-9: World Bank Sample Terms of Reference (TOR)

An Environmental Assessment of Tourism Development

Task 1. Description of the Proposed Project. Provide a full description of the project and its existing setting, using maps at appropriate scales.

The proposed project should include: general layout (size, capacity etc.); pre-construction and construction activities; operations and maintenance; life span; plans for providing utility, waste disposal, and other necessary services; physical setting, ecological setting, demographic setting, sociocultural setting and institutional setting.

Task 2. Description of Environment: If the tourism development is associated with an existing or planned park or reserve, include copies of park/reserve management plans, appropriate maps, and special studies characterising the resources at issue.

Task 3. Legislative and Regulatory Considerations. Describe the pertinent regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, rights of indigenous peoples, etc.' At international, national, regional and local levels.

Task 4. Determination of the Potential Impacts of the Proposed Project. Special studies may include the following:

Environmental carrying capacity of sensitive ecological sites or cultured properties.

Social carrying capacity, including attitudes of the local people to the proposed influx of foreigners and potential sources of conflict

Physical carrying capacity of local infrastructure and public services (if not adequately addressed in feasibility studies).

Task 5. Assist in Inter-Agency Co-ordination and Public/NGO Participation. In tourism projects, it is critical to involve all potentially involved government agencies, especially at local level. It is also important to provide complete information to the affected community, so that community members can form their opinions about the project.

Consulting Team. A typical EA team may have any or all of the following disciplines: environmental impact specialist, team leader; civil engineer: wastewater, roads, ports and harbours, water supply; ecologist; cultural specialist such as park and recreational planner; urban sociologist or anthropologist; specialist in tourism.

Source: World Bank., (1991). Environmental Assessment Sourcebook Volume II Sectoral Guidelines.

The increased attention paid to environmental issues by lending institutions like the World Bank , has given rise to the evolution of methodology providing a good framework for investigating the impact of tourist development.

In the discussion of the tourism sector above, an attempt has been made to demonstrate its potential as a source of government revenue. However, the benefits from the sector are not without environmental or social costs. Environmental assessments need to be integrated in any future plans for expanding this sector. The nature of such environmental assessments may take the form illustrated in Figure 7-9. This can be used for both future projects and those which have already taken place. Although expertise and infrastructure are rudimentary, such assessments should form an important part of strategic sectoral policy appraisal. While wildlife conservation enjoys international good-will in many developing countries such as Zambia, local capacity building is essential for accomplishing this, and will require a more concerted effort from the government.

CHAPTER EIGHT

A FRAMEWORK FOR ENVIRONMENTAL PROTECTION IN ZAMBIA: A CONCLUSION

8.1 Introduction

This chapter is a synthesis of the findings of the study and proposes the necessary steps required to address the problems concerning development and environmental protection. It is divided into the sections reviewing some of the major findings of the study, the proposed framework for environmental protection, and conclusions and recommendations.

8.2 Major Findings

This section highlights some of the major findings in my examination of environmental protection and management in Zambia. These include:

1. Lack of Data and Information

Generally there are no baseline data available for use in various aspects of the environment monitoring. Therefore it makes it difficult to possess quantitative data on the quantity of industrial effluents available, even where the nature of pollutant is known. Very often, where the data exists there are gaps in data collection. This problem is compounded by a lack of interagency coordination of those holding information and those who can benefit from its use.

2. Lack of Institutional Capacity

The second notable problem is lack of institutional capacity and tools for implementation. The financial resources that any government has at its disposal for environmental improvements are severely limited. These constraints have led to substantial shortfalls in both essential technical knowledge and equipment relating to the enforcement of regulations. Compounding the absence of sufficient enforcement clauses is the unavailability of tools and technology that must precede enforcement. Monitoring technology is essential for the proper enforcement of regulations. Such technology is often lacking and inadequate to effectively monitor environmental abuse. In some cases industries monitoring aspects of the environment are expected to report faithfully to the regulating bodies. Such faith may be misplaced if the industry concerned is flouting regulations.

3. Lack of Standards

Standards to serve as guidelines for industries and monitoring agencies are generally lacking. Environmental legislation suffers from a lack of quantified limits and standards, which makes these laws ineffective and difficult to enforce. By not specifying any standards, the rule leaves enforcement to the whims of the enforcing authority. This lack of standards can act as an impediment to both regular enforcement and voluntary public compliance.

4. Deficiencies of Law

In many developing countries fines which are meant to act as a disincentive to offenders tend to be derisory. Fines imposed are normally not commensurate with the misdemeanor. Since they are not revised regularly, many become negligible owing to inflation. Poverty is widespread in many developing nations and inevitably elevates the importance attached to subsistence. This, in turn, tends to breed disregard for legislation aimed at resource conservation unless such conservation is seen to produce immediate tangible gain.

5. Lack of Awareness.

The pace at which progress in environmental awareness can be achieved in many developing countries depends on the levels of literacy. Low levels of literacy relate to lack of environmental awareness and has delayed the evolution of environmental pressure groups, which have provided an impetus for better legislation and enforcement in developed countries. This lack of awareness also precludes effective public participation in environmental issues.

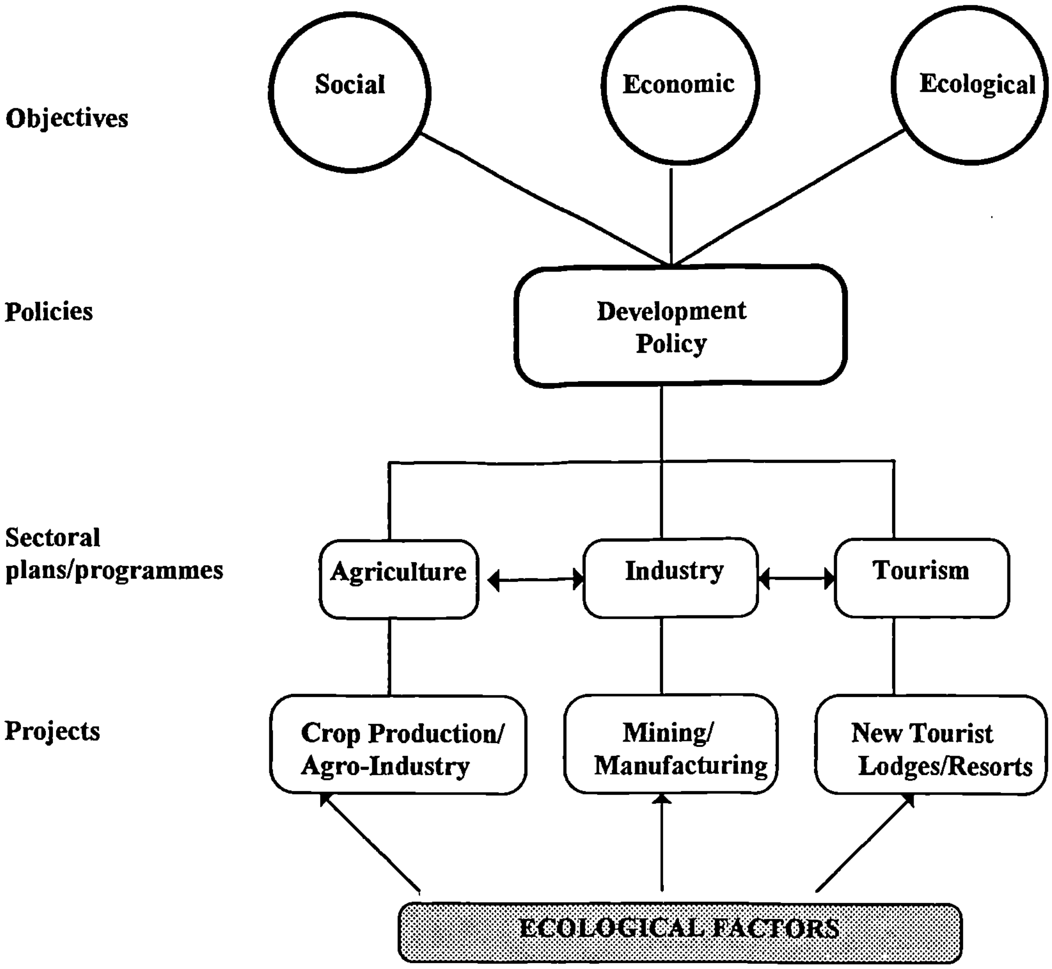
6. Lack of Political Commitment.

As with many aspects of social policy, political commitment to the environment tends to be rhetorical. It is, therefore, not surprising that the required high-level political commitment is not usually evident when dealing with environmental issues. This lack of commitment can in part be explained by the lack of awareness, if not appreciation of the interaction between the environment and economics, on the part of politicians.

8.3 Framework and Guidelines for Implementation

The importance of ecological factors in the development process calls for the integration of developmental activities and the environment. To achieve this a review of development objectives in relation to conservation/ecological objectives has to be made. Development policy should, therefore, reflect a balanced consideration of socioeconomic and ecological objectives.

Figure 8-1: Integrating Development And Environment



This review will help to identify the main obstacles to achieving the objectives and to removing them or reducing threats. Such a review would also help to identify measures required to achieve the objectives and to remove or reduce the threats to the resources involved. Taking my three case studies as an example, the framework for such integration is represented in Figure 8-1. The pre-occupation with socio-economic objectives is replaced by the inclusion of ecological considerations.Environmental planning and allocation of uses are essential for optimal use of resources. One way of achieving this allocation is through ecosystem evaluation which assesses the characteristics of ecosystems and matches them to the most appropriate uses. This process is sometimes referred to as land evaluation, or land capability assessment, land suitability assessment and is an integrated method of evaluating land and water resources. Supplemented by environmental assessments, it can improve environmental planning.

Environmental policy mainly deals with the fight against pollution and nuisances and can be divided into the following areas:

1. water
2. air
3. flora and fauna

4. waste

5. chemicals

The constituent elements for environmental policy are the political framework, legal, legislative and regulatory action and information. Political authority should pay attention to the environmental situation. Environmental protection should become a fundamental part of economic, industrial, agricultural and social policies of the country. The legal framework should provide a link between environmental and economic policies. Legislative measures, either regulatory or administrative, should be concerned with fighting pollution and the curative aspects involved. Other measures should deal with the improvement and protection of natural resources. Measures should be adopted aimed at a more preventive approach to environmental policy. Another important area of policy concerns information and awareness raising of environmental issues amongst the population.

8.3.1 National Environmental Policy

A clearly defined environmental policy is required to provide the broad framework for environmental protection. Environmental protection , being interventions necessary to maintain a high level of environmental quality, are needed to enhance sustainable socio-economic development.

Objectives

The broader objectives of environmental policy should be to:

- ensure sound management of natural resources and the environment
- integrate environmental considerations in sectoral, structural and socio-economic plans at all levels

The environmental policy should be based on the following general principles:

1. The best environmental policy consists in preventing the generation of pollution at source.
2. Impacts on the environment should be taken into account at the earliest stage of planning and decision making.
3. Any exploitation of natural resources which may cause damage to the ecological balance should, if possible, be avoided.
4. The cost of preventing and eliminating pollution should be borne by the polluter.

The protection of the environment should be a matter for everyone, therefore the public should be made aware of its importance.

8.3.2 Environmental Action Programmes

Zambia should consider adopting environmental action programmes. Such steps have been taken in other African countries like Ghana, where such programmes have proved useful as a starting point for implementing environmental policy. Programmes need not be too ambitious and must be achievable. Programmes of action with timetables should be established as a basis for implementing the objectives of the national environmental policy. The objectives of this policy should:

- prevent, abate and, as far as possible, eliminate pollution
- ensure sound management of natural resources
- ensure that more attention is paid to environmental aspects of land use
- seek collective solutions to environment problems with the outside world, in particular international organizations

Environmental protection must address pertinent policy issues in land management, forestry and wildlife, water management and industrial pollution.

Policy action is needed in management of land resources, forestry and wildlife, water and human settlements. Instruments of such action include the improvement in the scientific base of environmental policy. Integration of environmental dimensions in national economic policies and the establishment and implementation of appropriate standards and guidelines for environmental protection are essential. Appropriate legal instruments should be adopted and enforced. Collection and access to information on the environment must be improved.

Projects under the action programme should include the wide use of environmental impact assessment. Monitoring systems in air quality, industrial chemical control should be put into place. Environmental awareness programmes should be used to inform and educate the general population about the importance of the environment in their lives. Water resources management requires a stringent water quality monitoring system of environmental impacts of water based activities. River basin or catchment water plans would help in achieving this objective.

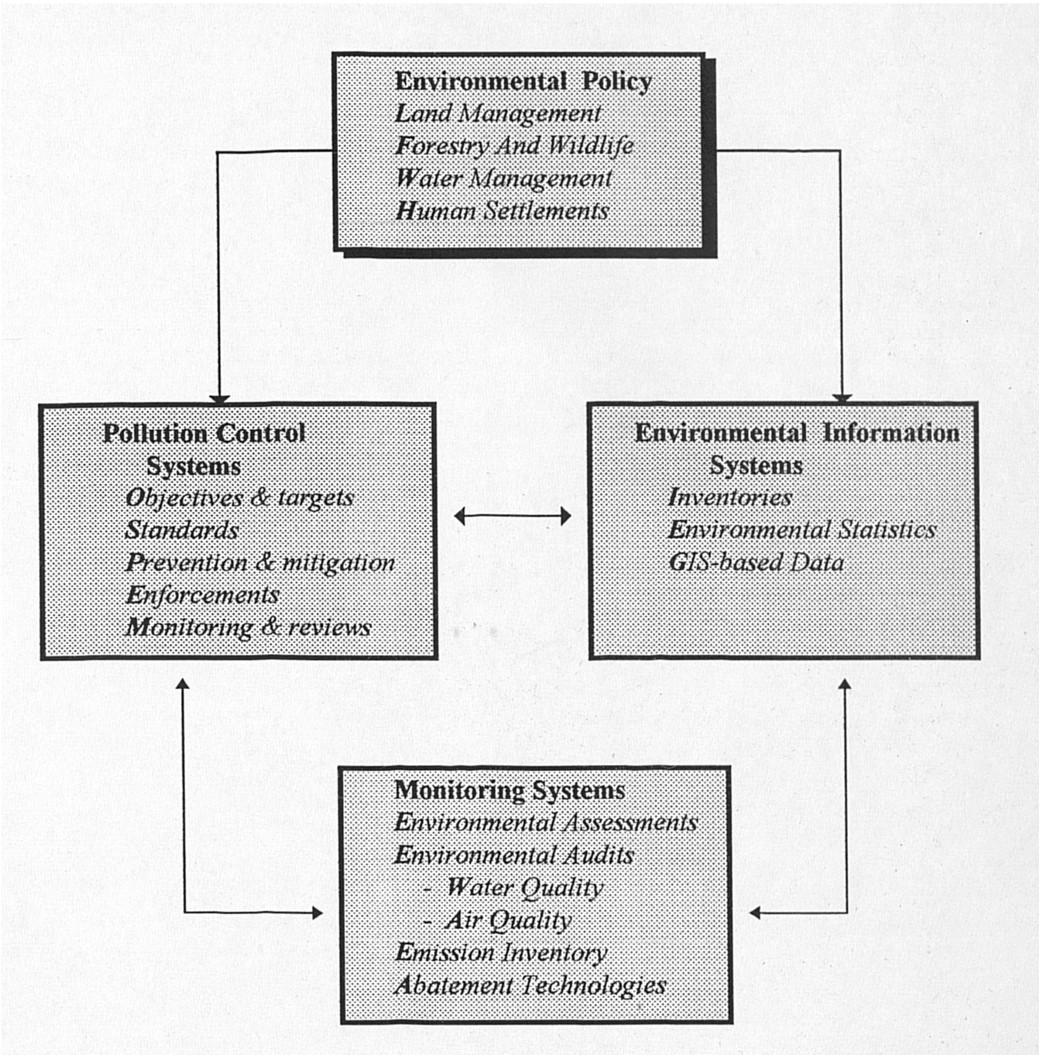
8.3.3 Environmental Protection Systems

Standards and regulations regarding air and water quality should be strictly enforced. Most importantly, regulations for discharge of pollutants into water bodies should be carefully monitored according to established environmental regulations for industry.

Above all institutional support is vital. This requires the strengthening of the Environmental Council in terms of its institutional structure. It calls for the establishment of regional offices with necessary staffing and logistics.

Figure 8-2 outlines the requisite components of environmental protection systems. Environmental policy sets out policy action in the management of resources. This is has three integral systems: Pollution Control Systems, Environmental Information Systems and Monitoring Systems. Pollution Control Systems set the objectives, targets and standards of pollution control. It also identifies prevention and mitigation and enforcement measures.

Figure 8-2: Environmental Protection Systems



Environmental Information Systems include natural resources inventories and environmental statistics. This data may be held in easily accessible GIS format. Monitoring Systems monitor the performance of environmental policy through use of such tools as Environmental Assessments and Environmental Audits.

Figure 8-3: An Integrated Framework for Environmental Management

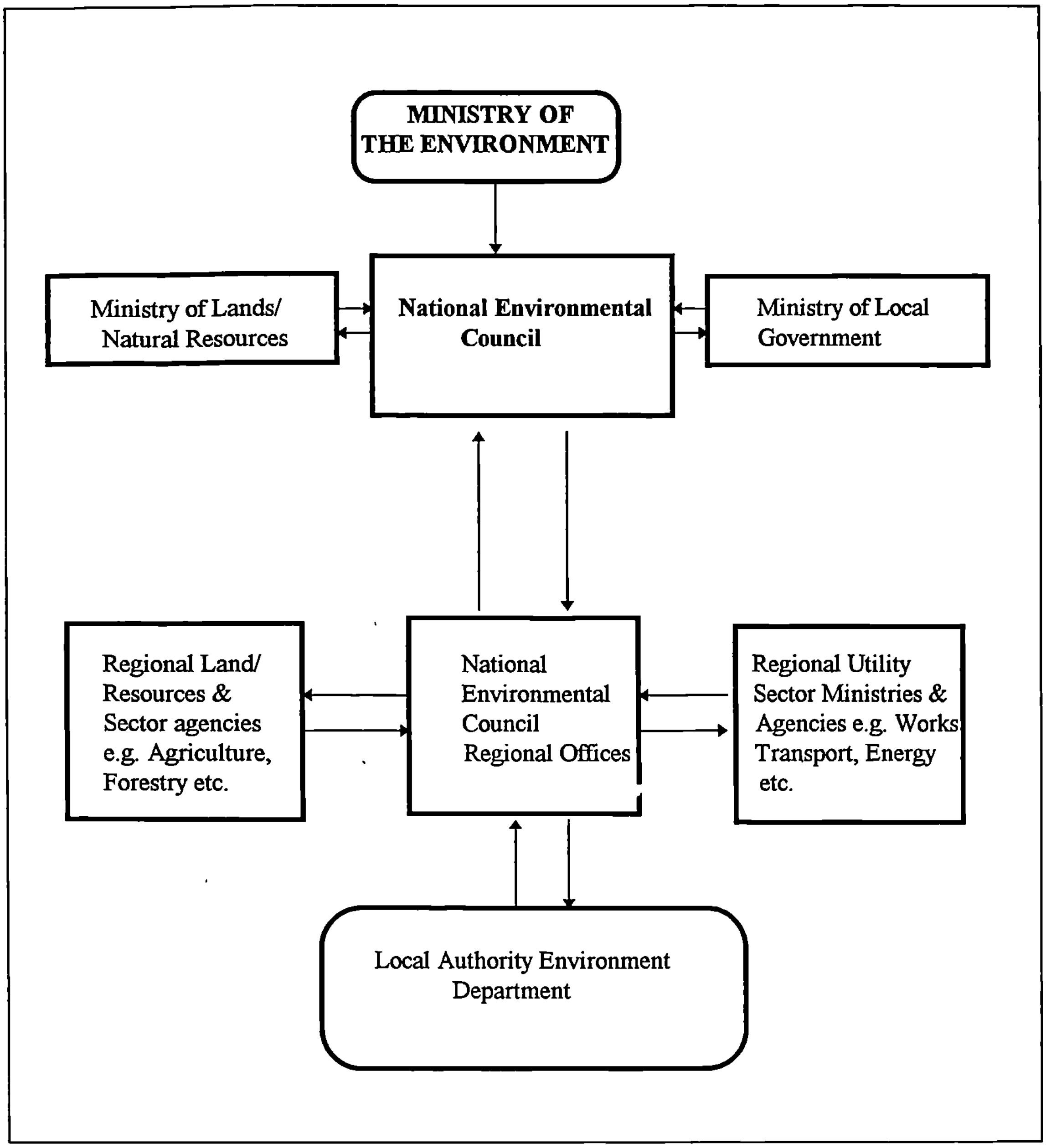


Figure 8-3 proposes an integrated framework for environmental management. In this model the Central Government sets out environmental policy through the Ministry of the Environment. The Environmental Council implements the established policy and coordinates all activities relating to the environment involving other Government Ministries. Local environmental issues are addressed through a network of Environmental Council Regional Offices working with Local Authorities.

8.4 Recommendations

This section sets out general sectoral recommendations which may be adopted to address some of the environmental problems identified in this study. Further, recommendations are made with regard to the management of information in the environmental sector.

8.4.1 Agricultural Sector Policies And Measures

Sustainable agriculture should be sought in three ways:

1. Improving the quality and availability of resources
2. Increases in resource use efficiency
3. Better management and the application of modern technology need to be harnessed to improve both resource use efficiency and output levels.

8.4.1.1 Agricultural Measures

- manage water runoff to prevent soil erosion.
- optimise land use to avoid poor utilisation of land leading to soil and land degradation.
- restore and improve structure and fertility of degraded soils.
- encourage recycling of organic matter.
- minimise use of synthetic fertilizers.

8.4.2 Wildlife Policies And Measures

- Draw up and implement a national wildlife conservation policy compatible with resource use policies
- Control the harvesting and cropping of wildlife resources in order to ensure sustainability

8.4.2.1 Measures

- Provide incentives to encourage higher productivity of food and other goods in areas immediately outside existing national parks.
- Promote community-based management systems for local people to participate in protection and conservation of habitats and related wildlife species.

- Enforce existing legislation strictly by supporting it with appropriate higher penalties.
- Ensure that CITES is implemented.
- Prepare management plans and conservation reviews.

8.4.3 Industrial Policies And Measures

8.4.3.1 Policy

- Develop and enforce effective pollution controls.

8.4.3.2 Measures

- Set in place an industry-wide system for collection of national and regional statistics on location, type and amount of effluents and hazardous wastes, including a survey of waste treatment equipment and degree of use.
- Establish government regulations and standards in consultation with industry.
- Implement a phased programme of pollution controls by NEC Inspectorates
- Implement in-plant and end-of-pipe environmental safeguards within industry, along with waste management plans for the reduction, collection, reuse, or treatment and disposal of industrial wastes.
- Encourage modernisation of industry that reduces pollution.

8.4.3.3 Policy

- Promote clean industrial processes

8.4.3.4 Measures

- Encourage recovery of material in industrial processes
- Develop institutions for acquisition and transfer of environmentally benign technologies.
- Insist that branches of transnational corporations meet or do better than the environmental standards in their home countries.

8.4.4 Pollution Control Policies And Measures

8.4.4.1 Effluent Control Policies

- Focus regulatory approach on discharges, as these contain toxic effluents
- Support the recovery and use of heavy metals from industrial effluents
- Adopt domestic waste water treatment technologies that provide for recovery and reuse of water, nutrients, and organic matter
- Give priority to areas where there is risk of ground water contamination

8.4.4.2 Measures

- Develop systems for safe sewage irrigation.
- Use sludge as fertilizer and soil amendment.

- Encourage source reduction, through recovery by industrial units of heavy metals before discharge.
- Provide alternative disposal methods, backed by regulations preventing the discharge of industrial effluents into municipal sewers.
- Establish legal, institutional and pricing systems to support these measures.

8.4.4.5 Emissions Control Policies

- Promote good maintenance of motor vehicles and of industrial boilers and furnaces.
- Encourage higher fuel efficiency in motor vehicles.
- Consider terrain and wind characteristics when siting factories.

8.4.4.6 Measures

- Defer the requirement to install catalytic converters in cars, as they require unleaded fuel, are expensive and reduce fuel use efficiency.
- Require all new cars to meet the most stringent standards for emission that can be achieved without catalytic converters.
- Change import duties to favour fuel-efficient engines.

- Adjust taxes on fuels to make unleaded petrol perhaps 5% cheaper, even though it is more expensive to make.
- Keep prices of fuel (except diesel) relatively high.

8.4.4.7 Solid wastes Policies

- Promote reuse and recycling by privatisation of collection.
- Encourage marketing assistance for effective use of scavenging systems.

8.4.4.8 Measures

- Develop effective municipal garbage purchase mechanisms.
- Promote energy from waste and composting plants by private sector.
- Ensure proper sanitary landfill practices.
- Establish incentive and control systems for these measures.

8.4.5 Environmental Information Systems Policies And Measures

Information on the environment is required to avoid pitfalls of pollution, resource depletion and unsustainability.

8.4.5.1 Policies

- Develop a range of environmental information systems to increase efficiencies of natural resource use and avoid pitfalls of pollution, resource depletion and unsustainability.
- Develop institutional arrangements that support the use of these systems at all levels and their application in different types of measures.

8.4.5.2 Measures

- Improve collection, storage and retrieval of existing natural resource inventories. Information gaps result from inadequate data collection design, poor and uneven reporting by unmotivated staff and slow processing.

Inventories of a soil survey provide an example of the potential of, and constraints on, the nation's data base. The rate of soil degradation, the pace of water and wind erosion and the extent and seriousness of waterlogging need to be continuously updated.

- Set up systems for the widespread dissemination of information to all natural resource users, while removing outmoded protocols limiting such access.

- Use inventories and satellite imagery for resource and environmental monitoring feedback, valuation and control.
- Encourage NGOs to develop a well-rounded capability to do national State of the Environment analysis in sectoral departments.
- Move incrementally towards incorporating valuations of natural resources and the environment into national income accounts.

8.5 Conclusions

In many developing countries the framework for environmental planning is not well defined. *Ad hoc* measures are usually adopted to preserve the environment. In some others, however, a more established pattern is emerging.

It is becoming apparent that in the quest for development, Zambia is a potential victim of environmental hazards and ecological degradation. Degradation will eventually feedback in the form of diminishing food supplies in the face of rapidly expanding population, in squalor, poverty, disease and various forms of problems associated with inadequate care and management of the environment. The adoption of a National Conservation Strategy in 1985 by the Government was a step in the right direction. The scope of the strategy deals with natural resource implications of all major sectors of the economy. The recognition that the environmental problems and opportunities associated with mining, energy development and human settlements needed to be tackled, as well as those that follow from agricultural and forestry and wildlife management, has not been matched by a coherent framework for environmental protection. This situation arises from various constraints, the main one being the absence of definite cross-sectoral guidelines for land and other natural resources allocation and preservation according to productive capacities. There is also inadequate co-ordination between present conservation and development efforts. The other constraints are in the areas of finance, legislation and lack of an information inventory. There is a general paucity of information on the effects of industrial activities and the use of hazardous chemicals on the environment due to insufficient institutional support for sustained research and monitoring of the environment. This has meant that baseline data for virtually all the monitoring indicators are non-existent in this country. There are no baseline data for all the monitoring indicators for air, water, soil, vegetation etc. This means that the effective monitoring of changes in air quality, water quality, soil vegetation, wildlife and public health due to industrial activities and hazardous chemicals is not possible since the requisite background data are lacking. The lack of data may conceal significant public health and environmental problems arising from developmental activities. In the absence of adequate data it is difficult to establish ambient air quality standards and water quality standards which are designed to protect human health and welfare and the environment.

Good policies are meaningless without adequate and efficient machinery for the execution of such policies. In this regard considerable effort and resources should be devoted to monitoring and enforcement operations. However, developing an efficient administration is not enough. Environmental considerations must be integrated in the overall economic policy. A fundamental prerequisite for success in the effort of environmental protection is well-informed opinion. Politicians and policy-makers must know what is required to protect the environment. Only with such awareness of the importance of the environment and the determination to ensure its protection and conservation can tangible results be accomplished.

REFERENCES

Abrahamse, T. and Brunt, M. A., (1984). "An Investigation into Pesticide Imports, Distribution and Use in Zambia with Special Emphasis on the Role of Multinational Companies". ***Insect Sci. Applic.*** Vol. 5, No. 3, pp. 157-173.

Adams, W. M., (1990). Green Development. Environment and Sustainability in the Third World. Routledge, London.

Ahmad, Y. J. and Sammy, G. K., (1984). Guidelines to Environmental Impact Assessments in Developing Countries. Hodder and Stoughton, London

Allan, T., (1986). "Remote Sensing For Renewable Natural Resource Appraisal" in Millington, A. C *et al.* (Eds.). ***African Resources*** 1(96): *Appraisal and Monitoring.* Geographical Papers, Department Of Geography University of Reading.

Archer, R. D., (1971). "Relief" in Davies, H. D. (Ed.). Zambia in Maps. University of London Press, London.

Arnstein, S. R., (1969). "A Ladder of Citizen Participation". ***Journal of the American Institute of Planners*** July 1969, pp. 216-224.

Aronoff, S., (1989). Geographic Information Systems: A Management Perspective. WDL Publications, Ottawa.

Ball, S and Bell, S., (1991). Environmental Law: The Law and Policy Relating to the Protection of the Environment. Blackstone Press, London.

Barbier, E. B., (1988). New Approaches In Environmental and Resource Economics: Towards an Economics of

Sustainable Development. IIED/The New Economics Foundation, London.

Barde, J and Pearce, D., (Eds.). (1991). Valuing the Environment: Six Case Studies. IIED, London.

Bari, M., (1992). "Environmental Impacts of Mining Activities." Paper read at Sub-Regional Workshop on Environmental Impact Assessment in Central Africa, Malawi, 1992.

Barrow, C. J., (1994). Land Degradation. Development and Breakdown of Terrestrial Environments. Cambridge University Press, Cambridge.

Bartone, C. *et al.*, (1994). Toward Environmental Strategies for Cities. Policy considerations for Urban Environmental Management in Developing Countries. Urban Management Programme, The World Bank, Washington, D.C.

Bird, P. M. and Rapport, D. J., (1986). State of the Environment Report for Canada. Canadian Government Publishing Centre, Ottawa, Ontario.

Biswas, K. A and Geping, Q., (Eds.). (1987). Environmental Impact Assessment for Developing Countries. United Nations University. Tycooly Publishing, London.

Boulle, L. T., (1987). Limiting State power: Opportunities for greater public participation in policy decisions. Institute for the Study of Public Policy, Rodenbosch.

British Standards Institution., (1992). British Standard BS 7750: Environmental Management System.

Brown, L. R *et al.*, (1986). State Of The World 1986. A Worldwatch Institute Report On the Progress Toward a Sustainable Society. W. W. Norton & Company, New York.

Brown, L., Flavin, C. and Postel, S., (1992). Saving the Planet. How to shape an Environmentally Sustainable Global Economy. Earthscan Publications Ltd, London.

Bryden, J. W., (1971). "Misuse of Insecticides in Zambia", :19-22 in Proceedings and Report of Seminar on Pollution and Environment in Zambia. University of Zambia, Lusaka.

Buffin, D. and Dudley, N., (1992). "1962-1992 Silent Spring: Record of Achievement". ***Pesticide News*** September 1992 17:3-6.

Bull, A., (1991). The Economics of Travel and Tourism. Pitman Publishing, London.

Butler, R., (1992). "Alternative Tourism: The thin edge of the wedge" pp. 31-46 in Smith L. V. and Eadington, W. R. (Eds.) Tourism Alternatives: Potentials and Problems in the Development of Tourism. John Wiley & Sons, Chichester.

Carriere, J., (1991). "The Crisis in Costa Rica: An Ecological Perspective": 184-204 in Goodman, D and Redclift, M (Eds.). Environment and Development in Latin America: The Politics of Sustainability. Manchester University Press, Manchester.

Chalabesa, A. and Kaposhi, C. M., (1991). "Zambia Country Report on Pesticide Management." Paper presented at FAO/SADCC Subregional Workshop on Pesticide Management for SADCC Member States, Harare, Zimbabwe, 20-27 May 1991.

Chen, L. C., Fitzgerald, W. M and Bates, L., (1994). "Women, Politics, and Global Management" ***Environment*** January/February 1995 Volume 37 Number 1 p. 4-9, 31-33.

Cohen, E., (1984). The Sociology of Tourism: approaches, issues and findings, ***Annual Review of Sociology,*** **10**, 373-92.

Commission of the European Community., (1992). ***The Courier*** "Environment and Development", ACP European Community. May/June (133):1-104.

Commonwealth Secretariat., (1988). Conservation for Sustainable Development. A Study on the Scope for Commonwealth Action on Soil Erosion, Desertification and Related Drought Problems in Commonwealth Africa. Commonwealth Secretariat, London.

Corral, T., (1994). "Overview - Empowering Women. The Cairo Conference" ***Environment*** January/February 1995 Volume 37 Number 1, p. 3,45.

Cox, G. W and Atkins, M. D., (1979). Agricultural Ecology: An Analysis of World Food Production Systems. W. H. Freeman and Company, San Francisco.

Curry, S., (1992). " Economic Adjustment Policies and the Hotel Sector in Jamaica", pp. 193-213 in Johnson, P. and Thomas B. (Eds.). Perspectives on Tourism Policy. Mansell Publishing Limited, London.

Dankelman, I and Davidson, J., (1988). Women and the Environment in the Third World: Alliance for the future. Earthscan/IUCN, London.

Davidson, D. A., (1992). "GIS and Environmental Management", ***European Environment***, 2(3), pp. 13-17.

Durst, P. and Ingram, C. (1988). Nature-oriented tourism promotion by developing countries. ***Tourism Management*** 26:39-46.

El-Hinnawi, E. and Hashmi, M. H., (1982) (Eds.). Global Environmental Issues. Tycooly International, Dublin.

Engel, J. R and Engel, J. B, (1990). (Eds.). Ethics of Environment and Development: Global Challenge, International Response. Belhaven Press, London.

Engel, J. R., (1990). "Introduction: The Ethics of Sustainable Development" pp. 1-23 in Engel, J. R and Engel, J. B. (Eds.). *ibid.*

Falloux, F., (1989). Land Information and Remote Sensing For Renewable Resources Management In Sub-Saharan Africa. A Demand-Driven Approach. World Bank Technical Paper Number 108. The World Bank, Washington, D.C.

Faruqee, R and Gulhati, R., (1983). Rapid Population Growth in Sub-Saharan Africa: Issues and Policies. World Bank Staff Working Papers Number 559. The World Bank, Washington, D.C.

Forget, G., 1991. "Pesticides and the Third World". ***Journal of Toxicology and Environmental Health*** 32:11-31.

Friend, A. M and Rapport, D. J., (1991). "Evolution of Macro-information Systems for Sustainable Development". ***Ecological Economics*** 3:59-76.

Garbutt, J., (1992). Environmental Law: A Practical Handbook. Chancery Law Publishing, London.

Goode, P. M and Johnstone, A. I., (1988). "EIA - Its Potential Applications to Appropriate Technology in Developing Countries". ***The Environmentalist*** 8(1):57-65.

Goodman, D and Redclift, M., (Eds.). (1991). Environment and Development in Latin America: The Politics of Sustainability. Manchester University Press, Manchester.

Goudie, A., (1986). The Human Impact on the Natural Environment. Basil Blackwell, Oxford.

Green, H. and Hunter, C., (1992). "The Environmental Impact Assessment Of Tourism Development" pp. 29-47 in Johnson, P. and Thomas B. (Eds.). Perspectives on Tourism Policy. Mansell Publishing Limited, London.

Haigh, N. and Baldock, D., (1989). Environmental Policy and 1992. British Department of the Environment, London.

Haigh, N., (1987). EEC Environmental Policy and Britain. Longmans, London.

Heap, D., (1987). An Outline of Planning Law. (Ninth Edition). Sweet and Maxwell, London.

Henning, D. H. and Magnum, W. R., (Eds.) (1989). Managing the Environmental Crisis. Incorporating Competing Values in Natural Resource Administration. Duke University Press, London.

Her Majesty's Government., (1990). Environmental Protection Act, Chapter 43. HMSO, London.

Her Majesty's Government., (1994). Sustainable Development. The UK Strategy. Cm 2426. HMSO, London.

Hester , R. E. and Harrison, R. M., (Eds.). (1994). "Mining and its Environmental Impacts". ***Issues in Environmental Science and Technology.***

Hildebrand, P. M., (1993). "The European Community's Environmental Policy, 1957 to '1992': From Incidental Measures to an International Regime", pp. 13-44, in David Judge (Ed.), A Green Dimension for the European Community: Political Issues and Processes. Frank Cass and Co. Ltd, London.

Hombergh, van den, H., (1993). Gender, Environment and Development. A Guide to Literature. International Books, Utrecht.

Hyman, L. E. and Stiffel, B., (1988). Combining Facts and Values in Environmental Impact Assessment: Theories and Techniques. Westview Press, London.

Institution of Chemical Engineers (UK)., (1993a). Environmental Auditing. Safety Health and Environment Department, Rugby.

Institution of Chemical Engineers (UK)., (1993b). Air Emission Vol. 1. Safety Health and Environment Department, Rugby.

IIED/World Resources Institute., (1987). World Resources 1987. Basic Books Inc., New York.

IUCN, (1984). Towards Sustainable Development, A National Strategy for Zambia. First Report Prepared for The Government of Zambia. The Conservation for Development Centre/ International Union For Conservation Of Nature and Natural Resources, Gland.

IUCN/UNEP/WWF., (1980). World Conservation Strategy: Living Resource Conservation for Sustainable Development. International Union For Conservation Of Nature and Natural Resources, Gland.

Jansen, D., (1988). Trade, Exchange Rate and Agricultural Pricing Policies in Zambia. World Bank Comparative Studies. World Bank, Washington D.C.

Johnson, P. S. and Corcelle, G., (1989). The Environmental Policy of the European Communities. Graham and Trotman, London.

Jones, A., (1987). Green Tourism. ***Tourism Management*** 26:354-56.

Kasonde, J. M. (1991). "Aspects of Environmental Pollution in the Kafue River" in Proceedings of the Eleventh Eastern and Southern Africa Environmental Workshop, Dar es Salaam, Tanzania, February 10-17.

Judge, D., (1993). 'Editorial'. A Green Dimension for the European Community: Political Issues and Processes. Frank Cass and Co. Ltd, London.

Kassé, M., (1973). La théorie du développement de l'industrie, touristique dans les pays sous-développés, ***Annales Africaines***, 1971-1972, 53-72.

Kiss, A., (Ed.) (1990). Living with Wildlife: Wildlife Resource Management with Local Participation in Africa. World Bank Technical Paper Number 130, Africa Technical Department Series. The World Bank, Washington, D.C.

Klaassen, G. A. J and Opschoor, J. B., (1991). "Economics of Sustainability or the Sustainability of Economics: Different Paradigms. ***Ecological Economics*** 4:93-115.

Klatte, E., (1991). "Environmental and Economic Integration in the EC" pp. 37-67 in Lomas, O. (Ed.). Frontiers of Environmental Law. Chancery Law Publishing, London.

Krämer, L., (1990). EEC and Environmental Protection. Sweet and Maxwell, London.

Krippendorf, J., (1982). Towards new tourism policies. ***Tourism Management*** 3:135-73.

Krippendorf, J., (1987). The holiday makers. Heinemann, London.

Krutilla, J. V and Fisher A. C., (1975). The Economics of Natural Environments: Studies in Valuation of Commodity and Amenity Resources. John Hopkins University Press, Baltimore.

Krutilla, J. V., (Ed.). (1973). Natural Environments: Theoretical and Applied Analyses. John Hopkins University Press, Baltimore.

Lea, J., (1988). Tourism and Development in the Third World. Routledge, London.

Lewis, L. A and Berry, L., (1988). African Environments and Resources. Unwin Hyman, Boston.

Loevinsohn, M .E., (1991). "Improving Pesticide Regulation in the Third World: The Role of An Independent Hazard Auditor". ***Pesticide News*** March 1991 11:3-7.

Lomas, O., (Ed.). (1991). Frontiers of Environmental Law. Chancery Law Publishing, London.

Low, A., (1986). Agricultural Development in Southern Africa: Farm Household Economics and the Food Crisis. James Curry Limited, London.

Mader, V., (1988). Tourism and environment. ***Annals of Tourism Research*** 15(2):274-76.

MAFF (1992). Code of Good Agricultural Practice for the Protection of Air. MAFF Publications, London.

Markandya, A and Perrings, C., (1991). Resource Accounting for Sustainable Development: A Review of Basic Concepts, Recent Debate and Future Needs. IIED, London.

Markandya, A and Richardson, J., (1992). The Earthscan Reader in Environmental Economics. Earthscan Publication Limited, London.

Mathieson, A. and Wall, G., (1982). Tourism: Economic, Physical and Social Impacts. Longman Scientific & Technical, Essex.

McCormick, J., (1991). British Politics and the Environment. Earthscan, London.

McDonnell, L. J and Warhurst, A., (1992). "Environmental Regulations" pp. 9-24, in United Nations/DTCD and DSE.

Mining and the Environment. The Berlin Guidelines. UN/Department of Technical Co-operation for Development/DSE. Mining Journal Books, London.

McMillan, W. J., (1994). Open the door: Improving decisions through public consultation. Dark Horse Books, Edmonton.

McLoughlin, J. and Bellinger, E.G., (1993). Environmental Pollution Control: An Introduction to Principles and Practice of Administration. Graham and Trotman, London.

Meadows, D. H. *et al.*, (1972). The Limits To Growth. A Report for The Club of Rome's Project On The Predicament Of Mankind. Earth Island Limited, London.

Meadows, D. H, Meadows, D. L and Randers, J., (1992). Beyond The Limits. Global Collapse Or A Sustainable Future. Earthscan Publications, London.

Merchant, C., (1989). The Death of Nature: Women, Ecology and the Scientific Revolution. Harper Collins Publishers, New York.

Merchant, C., (1992). Radical Ecology: The Search for a livable World. Routledge, London.

Mhlanga, A. T and Madziva, T. J., (1990). "Pesticide Residues in Lake Mcllwaine, Zimbabwe". ***Ambio*** 19(8):368-372.

Middleton, N., O'Keefe, P. and Moyo, S., (1993). Tears of the Crocodile: From Rio to Reality in the Developing World. Pluto Press, London.

Millington, A. C *et al.*, (1986). (Eds.) African Resources Vol. 1: Appraisal and Monitoring. Geographical Papers, Department Of Geography University of Reading.

Millington, A. C *et al.*, (1986). (Eds.) African Resources Vol. 2: Management. Geographical Papers, Department Of Geography University of Reading.

Moyo, S. , O'Keefe, P. and Sill, M,. (1993). The Southern African Environment: Profiles of the SADC Countries. Earthscan Publications Limited, London.

Muchena, P., (1991). "Zimbabwe Country Report on Pesticide Management." Paper presented at FAO/SADCC Subregional Workshop on Pesticide Management for SADCC Member States, Harare, Zimbabwe, 20-27 May 1991.

Murley, L., (Ed.). (1994). NSCA Pollution Handbook 1994 National Society For Clean Air and Environmental Protection, Brighton.

Mwanza, F. (1987). "Zambia moves to block use of DDT." ***Gemini News***. May 1987.

Myers, N., (1993). "The Question of Linkages in Environment and Development". ***Bioscience*** 43(5):302-310.

Naess, A., (1990). "Sustainable Development and Deep Ecology" pp. 85-96 in Engel, J. R and Engel, J. B. (Eds.). *op cit.*

National Academy of Sciences. (1977). Resource Sensing from Space: Prospects for Developing Countries. Washington, D.C.

O`Riordan, T., (1981). Environmentalism. Pion Limited, London.

Omara-Ojungu, P. H., (1992). Resource Management in Developing Countries. Longman Scientific and Technical, London.

Onyeanusi, A. E., (1986). "Measurements of Impacts of Tourist Off-road Driving on Grasslands in Masai Mara National Reserve, Kenya: A Simulation Approach". ***Environmental Conservation,*** Vol. 13, No. 4 pp. 325-329.

OECD.(1981). The Impact of Tourism on the Environment. OECD, Paris.

OECD.(1986). Environmental Assessment and Developing Assistance. OECD Environmental Monograph (4), Paris.

OECD. (1989). "The Application of Economic Instrument for Environmental Protection (Summary and Conclusion)." Environment Monograph No. 18., Paris.

OECD. (1990). Environmental Policies for Cities in the 1990s. OECD, Paris.

Pearce, D., (1987). Tourism Today: A geographical Analysis. Longman Scientific & Technical, Essex.

Pearce, D., (1989). Tourist Development (2nd Edition). Longman Scientific & Technical, Essex.

Pearce, D., Markandya, A. and Barbier, E. B., (1989). Blueprint for a Green Economy. Earthscan Publication Limited, London.

Pearce, W. D and Turner, K. R., (1990). Economics of Natural Resources and the Environment. Harvester Wheatsheaf, London.

Peñon de Cotter, M. E., (1994). "Overview - Empowering Women. The Cairo Conference" ***Environment*** January/February 1995 Volume 37 Number 1, p. 45.

Pepper, D., (1986). The Roots of Modern Environmentalism. Routledge ,London.

Pesticide News March 1991 11:11 "Third World Pesticides Poison Victims Estimated at 25 Million".

Pesticide News December 1991 14:3-6 "Hazardous Pesticide Dumps in Africa".

Pesticide News June 1992 16:12-15 "Pesticides, Europe and the Environment: a Review".

Pietilä, H., (1990). "The Daughters of the Earth: Women's Culture as a basis for sustainable development." pp. 235-244. in Engel, J. R and Engel, J. B. (Eds.).op cit.

Pigram, J. J., (1992). "Alternative Tourism: tourism and Sustainable Resources Management" pp. 76- 87 in Smith L. V. and Eadington, W. R. (Eds.) Tourism Alternatives: Potentials and Problems in the Development of Tourism. John Wiley & Sons, Chichester.

Pimentel, D and Edwards, C. A., (1982). "Pesticides and Ecosystems". ***Bioscience*** 32(7):595-600.

Pimentel, D *et al.*, (1991). "Environmental and Economic Effects of Reducing Pesticide Use" ***Bioscience*** Vol. 41 No. 6 June pp. 402-409.

Portney, P. R., (1990). "Air Pollution Policy." in Paul R. Portney (Ed.). Public Policies for Environmental Protection. Resources for the Future, Washington, D.C.

Ramakrishna, K., (1985). "The Emergence of Environmental Law in Developing Countries. A Case Study of India". ***Ecology Law Quarterly*** 12(4):907-935.

Redclift, M., (1984). Development and the Environmental Crisis: Red or Green Alternatives? Methuen, London.

Redclift, M., (1987). Sustainable Development: Exploring the Contradictions. Methuen, London.

Reed, D., (Ed.). (1992). Structural Adjustment and the Environment. Earthscan Publications Limited, London.

Repetto, R. *et al.*, (1991). Accounts Overdue: Natural Resource Depreciation in Costa Rica. World Resources Institute, Washington, D.C.

Repetto, R., (1992). "Earth Balance Sheet: Incorporating National Resources in National Income Accounts". ***Environment*** September 34(7):12-20,43-45.

Republic of Zambia., (1983). Agricultural Baseline Data for Planning. National Commission for Development Planning/University of Zambia, Lusaka.

Republic of Zambia., (1990). National Soil Conservation and Agro-Forestry Needs Assessment. Department of Agriculture, Lusaka.

Republic Of Zambia., (1992a). Selected Socio-Economic Indicators 1992. Central Statistical Office, Lusaka.

Republic of Zambia., (1992b). Zambia's National Report to United Nations Conference on Environment and Development 1992. Ministry of Environment and Natural Resources, Lusaka.

Republic of Zambia., (1993). Investment Guidelines. Ministry of Commerce, Trade and Industry/The Investment Centre. Government Printers, Lusaka.

Republic of Zambia., (1994a). Social Sector Rehabilitation and Development Programme 1993-1996. Office of the President, National Commission for Development Planning. Government Printers, Lusaka.

Republic of Zambia., (1994b). Zambia - Stabilisation, Growth and Development: Efforts and Policies of the government of Zambia. Report presented to the Consultative Group for Zambia 22-23 March 1994. government Printers, Lusaka.

Ricks, G. and Moynan, P., (1992). "Environmental studies programme at Connish gold prospect for Fynegold Exploration Ltd" pp. 254-257 in Institution of Mining and Metallurgy. Minerals, Metals and the Environment. Elsevier Applied Science, London.

Romsan, A., (1990). The future role of public participation in environmental management and decision-making processes: A case study of Indonesian transmigration sites in the province of South Sumatra. National Library Canada, Ottawa.

Rosemary, J., (1987). Indigenous Enterprises in Kenya's Tourism Industry. UNESCO, Geneva.

Santos, P. J., (1992). The Utilization of EIA Techniques in Food and Cash Crop Systems of Brazil. Unpublished Ph.D. Thesis, University of Salford.

Sayer, J. A., Harcourt, C. S., and Collins, N. M., (Eds.) (1992). The Conservation Atlas Of Tropical Forests: Africa. IUCN, Gland.

Schmidheiny, S., (1992). Changing Course: A Global Business Perspective on Development and the Environment. Massachusetts Institute of Technology, Cambridge.

Schrijvers, J., (1993). The Violence of "Development": A Choice For Intellectuals. (Inaugural speech 15 May 1992). International Books, Utrecht.

Sen, G., (1994). "The World Programme of Action (WPOA): A New Paradigm for Population Policy" ***Environment*** January/February 1995 Vol. 37 Number 1, pp. 10-15, 34-37.

Shiva, V., (1989). Staying Alive: Women, Ecology and Development. Zed Books, London.

Siebert, H. and Antal, B. A., (1979). The Political Economy of Environmental Protection. JAI Press, Connecticut.

Sinclair Thea, M., (1991). "The Tourism Industry and Foreign Exchange Leakages in a Developing Country: The Distribution of Earnings from Safari and Beach Tourism in Kenya" pp. 185-204, in Sinclair Thea, M. and Stabler, M. J. (1991) (Eds.). The Tourism Industry: An International Analysis. C.A.B Publishers, Wallingford.

Sinclair Thea, M. and Stabler, M. J., (1991) (Eds.). The Tourism Industry: An International Analysis. C.A.B Publishers, Wallingford.

Sinclair Thea, M., Alizadeh, P. and Onunga Adero, E. A. (1992). "The Structure Of International Tourism and Tourism Development in Kenya" pp. 47-63 in Harrison, D. (Ed.) Tourism and the Less Developed Countries.

Speth, J. G., (1990). "Can the World Be Saved?" pp. 64-81, in Wolbarst, A. B. (Ed.). Environment in Peril. Smithsonian Institution Press, Washington.

Spivak, G. C., (1994). "Overview - Empowering Women. The Cairo Conference" ***Environment*** January/February 1995 Volume 37 Number 1, p. 2-3.

Stirling, A., (1993). "Environmental Valuation: How Much is the Emperor Wearing?" ***The Ecologist*** May/June 23(3):97-103.

Stone, P., (1973). Did We Save the Earth at Stockholm? Earth Island, London.

Sudbury, M. P., (1992). "Unfinished Environmental Developments In Milling, Concentrating, Smelting and Refining Of Sulphide Ore", pp. 292-310, in Institution of Mining and Metallurgy, *op cit*.

Telling, A. E., (1990). Planning Law and Procedure (Eighth Edition). Butterworths, London.

Therivel, R. et al., (1992). Strategic Environmental Assessment. Earthscan Publications Ltd, London.

Timberlake, L., (1988). Africa In Crisis. The Causes, The Cures Of Environmental Bankruptcy. (Second Edition). Earthscan Publications, London.

Tromans, S., (Ed.) (1987). Best Practicable Environmental Option -A New Jerusalem? A Report by a Working Group of the United Kingdom Environmental Law Association.

Tromans, S., (1991). The Environmental Protection Act 1990. Text and Commentary. Sweet and Maxwell, London.

UNEP. (1989). United Nations Environmental Programme Environmental Data Report. Basil Blackwell, Oxford.

UNEP. (1991a). United Nations Environmental Programme Environmental Data Report. Basil Blackwell, Oxford.

UNEP. (1991b). Environmental Aspects of Selected Non-ferrous Metals (Cu, Ni, Pb, Zn, Au) Ore Mining: A Technical Guide. Technical Report Series No. 5. UNEP/IEPAC, Paris.

UNEP. (1992). ***Industry and Environment*** Vol. 15 No. 3-4 July-December 1992, pp. 3-5. UNEP/IEPAC, Paris.

United Nations Conference on Environment and Development. (1992). Earth Summit '92. Rio de Janeiro 1992. Regency Press, London.

United Nations Development Programme., (1992). Human Development Report 1992. Oxford University Press, Oxford.

United Nations Development Programme., (1993). Human Development Report 1993. Oxford University Press, Oxford.

United Nations Economic Commission For Africa (ECA)., (1989). "African Alternative Framework to Structural Adjustment Programmes for Socio-economic Recovery and Transformation". ECA, Addis Ababa.

United Nations Food and Agriculture Organization (FAO)., (1986). Natural Resources and Human Environment for Food and Agriculture in Africa. FAO, Rome.

United Nations Food and Agriculture Organization (FAO)., (1987). Agriculture Towards 2000. FAO, Rome.

United Nations Food and Agriculture Organization (FAO)., (1990a). Sustainable Development and Natural Resource Management. FAO, Rome.

United Nations Food and Agriculture Organization (FAO)., (1990b). International Code of Conduct on the Distribution and Use of Pesticides (Amended Version includes Prior Informed Consent in Article 9 as adopted by the 25th Session of FAO Conference November 1989). FAO, Rome.

United Nations Food and Agriculture Organization., (1992). Sustainable Development and The Environment: FAO Policies and Actions Stockholm 1972-Rio 1992. FAO, Rome.

United Nations. (1972). Report of the United Nations Conference on the Human Environment. Document A/Conf. 48/14/Rev1. The United Nations, New York.

United Nations/ ESCAP (1982). Industrial Pollution Control Guidelines *I. Fertilizer Industry*. United Nations/ESCAP, Bangkok.

United Nations/DTCD and DSE. (1992) Mining and the Environment. The Berlin Guidelines. UN/Department of Technical Co-operation for Development/DSE. Mining Journal Books, London.

Veldkamp, W. J. *et al.*, (1990). "*Agro-Ecological Perspectives in Planning*" in Adrian .P. Wood, *et al.* (Eds.) The Dynamics of Agricultural Policy and Reform in Zambia. Iowa University Press, Ames.

Walsh, F., Lee, N. and Wood, C. (1991). The Environmental Assessment of Opencast Coal Mines. Occasional Paper 28. Department of Planning and Landscape, University of Manchester.

Wangari, M., (1988). The Green Belt Movement. Sharing the Approach and the Experience. Environment Liaison Centre (International), Nairobi.

Warhurst, A., (1992). "Environmental Management", pp. 98-105 in United Nations/DTCD and DSE. Mining and the Environment. The Berlin Guidelines. UN/Department of Technical Co-operation for Development/DSE. Mining Journal Books, London.

Wolbarst, A. B., (Ed.). (1991). Environment in Peril. Smithsonian Institution Press, Washington.

Wood, A. P. *et. al.*, (Eds.). (1990). The Dynamics of Agricultural Policy and Reform in Zambia. Iowa University Press. Ames.

Woodgate, G., (1991). "Agro-Ecological Possibilities and Organisational Limits: Some Critical Impressions From A Mexican Case Study" pp. 155-183 in Goodman, D and M. Redclift *op cit*.

World Bank., (1986). Population Growth and Policies in Sub-Saharan Africa. A World Bank Policy Study. The World Bank, Washington, D.C.

World Bank., (1989). From Crisis to Sustainable Growth: A Long-Term Perspective Study. The World Bank, Washington, D.C.

World Bank., (1991). Environmental Assessment Sourcebook Volume II Sectoral Guidelines. World Bank Technical Paper No. 140, Environment Department. The World Bank, Washington, D.C.

World Bank., (1992a). Social Indicators of Development, 1991-92. The World Bank, Washington D.C.

World Bank., (1992b). World Development Report 1992: Development and The Environment. Oxford University Press, Oxford.

World Bank., (1993a). Environmental Assessment Sourcebook Update. Geographic Information Systems for Environmental Assessment and Review. April 1993, No. 3. Environment Department. The World Bank, Washington D.C.

World Bank., (1993b). Environmental Assessment Sourcebook Update. Sectoral Environmental Assessment. October 1993, No. 4. Environment Department. The World Bank, Washington D.C.

World Bank., (1994). Making Development Sustainable. The World Bank Group and the Environment Fiscal 1994. The World Bank, Washington D.C.

World Bank/UNDP., (1989). Sub-Saharan Africa's Adjustment and Growth in the 1980s. The World Bank, Washington, D.C.

World Commission on Environment and Development (WCED)., (1987). Our Common Future. Oxford University Press, Oxford.

World Resources Institute., (1992). World Resources 1992-93. Oxford University Press, Oxford.

World Resources Institute/IIED/UNEP., (1988). World Resources 1988-89 : An Assessment of the Resource Base that supports the Global Economy. Basic Books Inc., New York.

World Tourism Organisation (1990). Economic Review of World Tourism. World Tourism Organisation, Madrid.

Zambia National Tourist Board (1993). Annual Report 1991-1992. Zambia National Tourist Board, Lusaka.