AGRO CLIMATIC AND AGRO ECOLOGICAL CHANGES AND ENVIRONMENT PROBLEMS

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There is significant concern about the impacts of climate change and its variability on agricultural production worldwide. First, issues of food security figure prominently in the list of human activities and ecosystem services under threat of dangerous anthropogenic interference on earth's climate (Watson et al 2000; IPCC 2001 a,b; Ecosystem millennium Assessment 2005). Second, each country is naturally concerned with potential damages and benefits that may arise over the coming decades from climate change impacts on its territory as well as globally, since these will affect domestic and international policies, trading patterns, resource use, regional planning and ultimately the welfare of its people

As of today, modern agriculture is one of the problems with high CO_2 emissions and in addition devastates crop and other bio diversity. In a comprehensive literature review of the options of lowering agricultural emissions at global and national levels (Wright 2000) of the overseas development institute concluded. "while humanity is confronted with the almost overwhelming challenge of climate change and finite resources, there is no evidence suggesting that it is impossible to find a way to move forward. To the contrary, the growing body of analytical work examining scenarios at the global and regional level suggests it is not only technically feasible but also economically affordable even profitable. The affordability of an ambitious response is even clearer when the costs of inaction are considered. These conclusions however, only apply assuming a global transformation towards sustainability begins in the very near future and accelerates quickly"

In agriculture, sustainability means a clear shift towards agro-ecological models of production that allows drastic reductions in the use of fossil fuel, present great

irrigation potential through soil and plant sequestration and have the flexibility and diversity required to allow adaptation to changing conditions

Current research confirms that while crops respond positively to elevated CO_2 in the absence of climate change, the associated impacts of high temperatures, altered patterns of precipitation and possibly increased frequency of extreme events such as drought and floods will probably combine to depress yields and increase production risks in many world regions widening the gap between rich and poor countries. A consensus emerged that developing countries are more vulnerable to climate change than developed countries because of the predominance of agriculture in their economies, the scarcity of capital for adaptation measures, their warmer baseline climates and their heightened exposure to extreme events (Parry et al 2001). Thus climate change may have particularly serious consequences in the developing world where some 800million people are under nourished.

Many interactive processes determine the dynamics of world food demand and supply. Agro climatic conditions, land resources and their management are clearly a key component, but they are critically affected by distinct socio-economic pressures, including current and projected trends in population growth, availability and access to technology and development. In the last three decades, for instance, average daily per capita intake has risen globally from 2400 to 2800 cal spurred by economic growth, improved production systems, international trade and globalization of food markets.

Given the virtual impossibility to test experimentally or to simply try to sum up in a linear fashion all relevant agro climatic and socio economic factors involved in determining long term future trends, it is no surprise that the scientific literature is replete with modeling studies attempting to assess at least some of the aspects likely to characterize the impacts of climate change in future agric production.

Global forces are challenging the ability of developing countries to feed themselves. A number of countries have organized their economies around a competitive export oriented agricultural sector, based mainly on monocultures. It may be argued that agricultural export of crops such as soy beans from Brazil make significant contributions to the national economies by bringing in hard currency that can be used to purchase other goods from abroad. However, this type of industrial agriculture also brings a variety of economic, environmental and social problems, including negative impacts on public health, ecosystem integrity, food quality and in many cases disruption of traditional rural livelihoods, while accelerating indebtedness among thousands of farmers.

The growing push towards industrial agriculture and globalization – with an emphasis on export crops, lately transgenic crops and with the rapid expansion of bio-fuel crops (sugar cane, maize soybean, oil palm etc) is increasingly reshaping the world's agriculture and food supply, with potentially severe economic, social and ecological impacts and risks. Such reshaping is occurring in the midst of a changing climate expected to have large and far reaching effects on crop productivity predominantly in tropical zones of the developing world. Hazards include increased flooding in low-lying areas, greater frequency and severity of droughts in semi-arid areas and excessive heat conditions, all of which can limit agricultural productivity.

Globally the Green Revolution, while enhancing crop production, proved to be unsustainable as it damaged the environment, caused dramatic loss of biodiversity and associated traditional knowledge, favoured wealthier farmers and left many poor farmers deeper in debt (Rosset P.M. 2006). The new Green Revolution proposed for Africa via the multi-institutional Alliance for a Green Revolution in Africa (AGRA) appears destined to repeat the tragic record left by the fertilizer dependent miracle seeds, in Latin America and Asia by increasing dependency on foreign inputs and patent – protected plant varieties which poor farmers cannot afford(Rosenzweig, C,

Hillel, D 2008). In the face of such global trends, the concepts of food sovereignty and ecologically based production systems have gained much attention in the last two decades. New approaches and technologies involving application of blended modern agro ecological science and indigenous knowledge systems spearheaded by thousands of farmers, NGO's and some government and academic institutions have been shown to enhance food security while conserving natural resources, biodiversity and soil and water throughout hundreds of rural communities in several regions.(Pretty, J et al 2003)

1.1 Agro ecological and Agro Climatic Change and Environment Problems Resulting from Human Activity

Large-scale climatic changes could be caused by alterations in the earth-atmosphere system through changes in: the atmospheric content of carbon dioxide; atmospheric turbidity (aerosol content); mean global cloudiness; the earth's surface; the composition of the stratosphere; and the amount of heat generated by man's activities.

The concentration of atmospheric carbon dioxide is increasing at an average annual rate of nearly 0.3 percent. This increase, which is due to the burning of fossil fuels, is expected to accelerate in the future accompanying global economic development. Atmospheric carbon dioxide can influence climate through the "green-house effect", i.e. it is transparent to incoming solar radiation but partially absorbs the outgoing longer wavelength energy emitted by the earth. The best current estimates suggest that by 2020 A.D. the effect of increased CO_2 alone will be an average warming of the global surface temperature by roughly 2°C.

Atmospheric aerosols attenuate solar radiation by absorbing and scattering (re-directing) it and are thereby potentially capable of affecting local and global climate. The nature of the climate change (warming or cooling) depends on the relative

importance of these two radioactive processes as well as the character of the earth's surface. In addition, atmospheric particles can
affect the physical processes of precipitation and cloud formation through their role as condensation nuclei. Recent estimates have indicated that on a global basis, man's production of atmospheric particles is now roughly 10 to 50 percent of the natural rate. Locally, of course, the man-made contribution may far exceed that occurring naturally.

Changes in the earth’s reflectivity (albedo) are dominated by variations in cloudiness. Thus, any activity of man that affects large-scale cloudiness is likely to have an impact on climate. Potential examples of such activity include subsonic and supersonic aircraft flights that add moisture to the atmosphere at high altitude, atmospheric particles that serve as condensation nuclei, and attempts at weather modification. Man-made changes in the earth's surface can affect the albedo and the availability of solar energy. Examples of such changes include deforestation, erosion, extension of arid or desert land, irrigation, urbanization, and the creation of artificial lakes.
The combustion of fuels and the use of energy result in the liberation of heat. In large, temperate-latitude cities during winter this man-made-energy can often equal or exceed that naturally available from solar radiation. Man-made energy is, however, not yet significant on a global scale but within 30 to 40 years it will equal several percent of the available solar energy over large, highly industrialized regions. The specific regional climatic consequences are unknown but are likely to be significant.
Plans to build commercial fleets of supersonic aircraft that cruise in the lower stratosphere have caused some scientists, but certainly not all, to become concerned about possible stratospheric contamination. The exhaust products from these aircraft-soot particles, water vapour, nitric oxide, etc. could attenuate solar radiation, increase cloudiness or decrease ozone
concentrations. Since these substances would have a much longer average lifetime than those emitted near the earth's surface, a relatively small stratospheric emission

rate could lead to significant ambient concentrations. Thus an early programme is needed to obtain baseline measurements of substances in the stratosphere and to determine whether they have a natural or man-made origin.

1.2 Agro ecological and Agro Climatic Change and Environment Problems Resulting from Changes on Biota and Man from Contamination by Toxic Substances

This is one of the most complex and widespread of the environmental problems because many potential contaminants are involved, with the list growing each year, and immense number of species that could be affected. Many cases of local catastrophes or widespread poisoning in man and wildlife have already occurred.

The more hazardous toxic substances include heavy metals (lead, mercury and cadmium), organic chlorine compounds (DDT, its degradation products and metabolites, polychlorinated biphenyls) and possibly petroleum products. Contamination occurs in all media: air, land, water and biota. Of particular importance, however, are those parts of the biosphere where the substances show long residence times, namely in soils and sea water. The sea is the ultimate repository of almost every kind of pollutant material created by man. Industrial effluents and biocides are discharged directly into coastal waters or carried to the sea by rivers. Toxic materials are often dumped in quantity on the seabed or into the open waters of the oceans. Hazardous cargoes, transported by ships as freight or fuel, are released either by accident or design into the sea. Pollutants transported by the atmosphere are continuously transferred by precipitation or direct diffusion onto the surface waters.

The use of the biosphere as a recipient for toxic and other waste products will inevitably affect animal and plant species, their growth and reproduction. Every kind of pollutant in some measure affects the character of an ecosystem structure by decreasing the species diversity. Toxic substances may endanger man's health directly or by passage and accumulation through food chains.

The effects of contaminants on biota can be studied by considering various biological effects, such as changes in the numbers and distribution ranges of organisms, changes in the structure of plant and animal communities, replacements of whole ecosystems and changes in productivity. Thus, by assessing selected parameters which describe changes in single species or biological systems of higher order, both specific and general effects on biota can be determined. Important changes in many species populations, including extinctions, are well known. Inadvertent or deliberate simplifications of ecosystems with a resulting decrease in stability and tolerance of environmental stress have occurred many times. The transfer of natural ecosystems to mono-cultural agricultural systems constitutes the best examples of ecosystem simplification which now need continuous management to preserve the desired state. In some cases whole ecosystems have been completely replaced by new ones because of intensive pollution or grazing by domestic animals. Possible adverse effects on agricultural productivity are of special concern because any factor that tends to decrease the production of food and fibre must receive a high priority in the monitoring system. To arrive at the optimal combination of exploitation and management of natural resources, programmes must be developed that provide continuous information on the use of these resources and permit evaluation of the consequences of predicted future developments.

In the future, however, the predicted growth of nuclear-powered electrical generating plants will necessitate greater awareness of the potential hazards from storage of radioactive wastes.

1.3 Improper Land-use As an Agroecological Factor and Environmental Problem

The land surface in extensive parts of the world is changing because of the intense agricultural methods necessary to provide for a growing population with an increasing per capita consumption. In many parts of the world, improper land use has resulted in irreversible degradation of soils and vegetation. Soil erosion by wind and water,

leaching of nutrients, salinization and extension of arid zones have been caused by such improper land-uses as overgrazing in arid zones, deforestation in areas with unstable soils and over-use of both surface and ground-water resources.

Usually, these problems are local or regional in nature and are the responsibility of individual governments. However, because similar changes in soil fertility have occurred throughout the world in many nations, a global, multi-governmental approach to the problem is appropriate. Moreover, because the local effects of decreased soil fertility may be very significant, the economy of adjacent regions may also be affected. Extension of arid zones can also induce large-scale climatic changes by allowing considerable amounts of windblown dust to become airborne.

1.4 Eutrophication of Waters As A Factor of Agroecological and Environment Problem

Both natural and man-made lakes have suffered from eutrophication and its secondary effects. In lakes receiving nitrogen and phosphorus compounds and other agricultural fertilizers, unprecedented blooms of algae have occurred. The algae themselves can spoil water quality and recreational conditions. When they die and decay, the oxygen demand may exceed the supply with resultant fish kills. The average oxygen content of some fresh water bodies has decreased very markedly in historic times. The effects of added nutrients on marine life are not well known but there may be particularly important synergistic effects, for example, if the oxidation of oil in the sea is biologically controlled. Fertilization of the seas may enhance the production of directly economically valuable species. Because eutrophication is primarily a local problem, it has not been included in the global environmental monitoring system.

1.5 Decreasing Freshwater Resources: An Agroecological Change and Environmental Problem

The availability to man of freshwater of high quality is becoming an acute problem in many countries. Water requirements continue to increase with the growth of

populations and living standards and the expansion of agriculture and industry. Water is needed for power generation irrigation, navigation and community water supply. Often it is drawn from international rivers or lakes and in many instances international co-operation is needed in the allocation of water and the financing and technical aspects of water resource development projects. The availability of ground water is most often a local problem but it has international implications in relation to the general effects which a depletion of ground water may have within a larger region.

1.6 Natural Disasters As an Agroecological and Agroclimatic Changes and Environmental Problem

Although natural disasters constitute a very important environmental problem, it is not pertinent to include a programme directly related to natural disaster monitoring or warning within the global environmental monitoring system. It is appropriate, however, that the system should provide assistance in reporting phenomena that relate to natural disasters.

CHAPTER TWO

2.O SOCIO ECONOMIC ISSUES AFFECTING ENVIRONMENTAL DEGRADATION

Environmental degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wild life. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable. (Johnson, D.L et al, 1997)

Environmental degradation is caused by the combination of an already very large and increasing human population continually increasing economic growth or per capita affluence and the application of resource depleting and polluting technology.(Chetow, M.R, 2001,Hussemann, M.H, Joyce, A.H 2011)

The United Nations International strategy for disaster reduction defines environmental degradation as the reduction of the capacity of the environment to meet social and ecological objectives and needs

Environmental degradation can occur naturally, or through human processes. The largest areas of concern at present are the loss of rain forest, air pollution and smog,

ozone depletion, and the destruction of the marine environment. Environmental degradation is an important issue globally and locally. In many developing countries, high population growth is a great problem to environment and development. Many studies claim that population growth is a significant cause of environmental degradation. But people's perception to environmental degradation and choice of family size is simultaneously important to analyze in considering the concepts as interrelated since people perception to environmental degradation may influence to use contraception and family size.

In economic theory, land clearance or land reclamation involves a market failure. The market does not value naturally occurring resources in the production process. Nature's capital is not assigned a value by the market. The externalities that lead to private individuals cutting trees and the real economic costs and benefits to the nation of doing so arise because some of the biosphere's products, especially environmental protection functions are neither produced goods nor do they have clearly defined ownership. As a consequence, they are regarded as free goods.

Destruction of forested areas, wetlands, grasslands and bodies of water arises because of the difference between the discount rate of the individual and the society as a whole. Poor people, who are responsible for a significant share of the losses because of their pressing current need for fuel, fodder, water and land for cultivation assign a higher discount rate to these resources than does society as a whole.

The private interest of poor people and the social interests of the broader society diverge. The interest of poor, local people in using these lands and water resources is intense, immediate and focused – food, fuel, fodder, crop land and irrigation water. They will (often unknowingly) incur almost any social cost to permit the immediate exploitation of these environmental resources to sustain their livelihood. The interests of loggers, commercial farmers, builders and others who exploit the forests, range and

grasslands and water resources are equally intense, but driven more by immediate profit considerations, not by the need to survive.

Society as a whole, traditionally, has not placed a monetary value on the benefits derived from these resources, as such benefits are not marketable. When society has recognized these resources as having value, it has assigned a diffused, non-specific value to them and has not translated that assigned value into market signals i.e. financial incentives for preservation or disincentives for destruction of these land and water resources embodied in the nation's legal and administrative system. Thus, the intense, focused private interests are permitted to discount the value of environmental resources to the detriment of the longer term benefits to society of investment in these areas because these resources have neither been given market values nor a legal, enforceable means of translating value into market signals. The costs of land clearance arising from the exploitation of natural resources for financial gain highlight the problems involved all too clearly, since these resources provide a myriad of functional processes which go beyond the clearly tangible areas of providing food and products for commerce. These functional processes are not merely essential to a sound ecological balance and therefore ideologies advocated and imposed on society by conservationists; they are naturally occurring systems on which the economic wellbeing of societies at local, national and international level depend.

The Socio – Economic Issues Include

2.1 LAND DEGRADATION

Forested areas are especially sensitive to population pressure and commercial exploitation. At a local level, once the trees are felled, the highly productive potential of that region is immediately threatened, since the quality of the soils is generally poor. It is in the mass of vegetation that the nutrients essential to fast growth are stored so that, if the vegetation cover is removed, organic breakdown is almost immediate and nutrients are quickly washed away. When large gaps in the forest canopy occur, the

micro climate of the area is also likely to be changed and the forest floor becomes exposed to direct sunlight. Consequently, both air and soil become dry, to the direct detriment of the land's productivity. Because of these factors, not only has the forest's capacity to provide fuel and shelter been removed, but so has the land's capacity to regenerate them. Degradation is further increased through soil erosion

2.2 EROSION

Around a quarter of a million tons of topsoil are washed from the deforested mountain slopes of Nepal alone each year. On a global scale about eleven million hectares of arable lands are annually lost through erosion, desertification and toxification processes which are greatly encouraged by poor resource management. (N.Meyers 1985) It is human activity that causes natural erosion rates to increase many times over. Steep slopes are cultivated without terracing, irrigation projects are poorly developed and livestock overgraze grassland. Soil erosion is one of the major types of land degradation that poses biggest threat to sustainable agricultural production and also leads to contamination of water resources

2.3 FLOODING

The socio economic impact resulting from a decline in productive capacity due to ecological interactions does not remain localized, especially when forest cover is lost in a watershed. The soil's water retention capacity is lost and the release of rainfall becomes erratic; periods of floods followed by droughts become the norm. deforestation has caused so much injury to the effective functioning of water sheds that domestic water supplies are being threatened, bringing risk of contamination and pandemics. Once the forests have been clear felled, the reduction or elimination of resultant flooding may require very heavy investment in compensatory measures such as channeling, damming and diking. These measures to reduce the natural patterns of flooding have the potential to damage replenishment of alluvial soils and recharges of soil moisture. They may also damage the vegetation and wildlife on the flood plain as well as riverine fisheries.

2.4 INTENSIFICATION OF FARMING PROCESS

Intensification of agriculture takes two forms. Clearly, the most destructive is putting former grass and marsh lands to the plow. These activities have dramatic and far reaching effects both on biodiversity and on human communities. Animal and plant species may become extinct if deprived of the environment in which they survive. Human communities are affected by a removal of flood control areas and the land itself is subject to erosion and soil depletion if not carefully managed.

Intensification on existing agricultural lands can and often produce significant environmental degradation. For example, the conversion of grazing land into crop production often results in the expulsion of the grazers and their livestock into environmentally sensitive areas, in habitat reduction for wildlife species that co exist with grazing stock, in the felling of the remaining trees and the clearing of land for processing facilities. The introduction of machinery often produces a compaction of the soil, reducing its capacity to absorb rain water, thus speeding up runoff. Unless, newly cultivated lands are carefully managed, erosion accelerates and the runoffs of agricultural chemicals contaminate waters. Frequently when grazing lands are denuded of grasses, wind erosion begins. Soil salinization may result from inadequate irrigation practices. The destruction of adjoining areas is necessary to create the required infrastructure to support intensive agriculture (dams, roads and plants for processing the product).

Large scale production and processing of many tropical crops has an impact on the environment with the release of untreated toxic wastes. Tea, sugar, cocoa, coffee, rubber, oil palm and fibers such as cotton, require specialized processing facilities which produce effluent that, if not processes and recycled, pollutes the land and

streams adjacent to the processing facilities. Crops that require washing, such as coffee produce highly toxic wash waters that must be processed before being released.

Agro-industries including horticultural, forestry and fishery industries, produce significant volumes of toxic wastes. In many cases, these pollutants are simply dumped into nearby streams or landfills without concern for the environmental consequences. Some industries require large quantities of poles (for stakes in horticulture for example) or fuel wood. These needs are frequently met by stripping the poles and fuel wood from nearby forests.

The intensified use of agrochemicals presents an especially challenging problem of environmental degradation. High yield tropical monocultures, without the benefit of rotations and fallows require heavy doses of pesticides to control pest population build ups. Many of these pesticides are currently used as a preventive measure before an unacceptable level of pest populations has developed. The spraying often has wide reaching effects on beneficial insect populations, as well as affecting the human inhabitants in the spray zones, unless the spray programs are very carefully managed as to the dose applied and the method and timing of application. As pest populations become resistant to the current pesticides, higher doses of more potent chemicals are required. Cotton is a good example of a crop that requires massive doses of pesticides to obtain profitable production levels and to meet acceptable quality norms.

Animal based industries also generate massive quantities of toxic organic effluent. Discharges from poultry, swine and cattle production and processing facilities often pose serious dangers to human health; the organic discharges are a source of disease if dumped untreated into the environment.

2.5 WATER RESOURCE DEGRADATION AND DEPLETION

Water resource degradation reduces both the quantity and quality of water supply.

2.5.1 Sedimentation (siltation)

The rapid population growth in the country has exerted great pressure on the land resource, promoting soil erosion and deforestation. Silt loads surface water run off lead to significant problems in downstream water quality such as increased suspended solids and turbidity, water treatment costs and water flow problems. During the rainy season, virtually all rivers carry heavy loads of sediments. The turbid water is not good for human consumption. The majority of people in rural communities depend on untreated river water supply and chances of drinking unclean water are therefore very high.

Case studies show that catchment areas with high deforestation rates have higher rates of discharge which in turn leads to increased levels of turbidity and suspended solids. High sediment loads in the rivers bring about siltation of rivers and water reservoirs. The silted river course and water reservoirs tend to have reduced capacities so that when it rains the banks may overflow, causing flooding at times; or the water erodes the banks in order to accommodate the increased volume of run off.

2.6 THREAT TO BIODIVERSITY

Nigeria is rich in biodiversity. The rich genetic pool is vital for scientific research, agricultural and medicinal values and for socio economic development of the country. Biodiversity can be looked at in terms of wild and domesticated fauna and flora

2.6.1 FLORA AND FAUNA

So far about 4000 fauna, 5300 species of indigenous plants and 1000 microbiota have been described. Of the fauna, nearly 1,500 are vertebrates such as mammals, 163; amphibians, 54; reptiles, 92; fish, 548 and birds 620 species (sweeny 1970, konning 1990, Ansell 1985 and Dowsett 1988, Newman et al 1992). Due to high increase in

human population and the need for land for agricultural purposes, most of the terrestrial faunas are found in national parks, game and forest reserve. Over the years, these areas have been encroached and government has given in by changing some of the boundaries, thereby reducing the sizes of the protected areas.

In addition to plants and animals, there are micro organisms, a heterogenous group of taxonomically unrelated organisms. Some microbes are more closely related to the animals (protozoa), others to the plants (green algae) while yet others are related to neither group (viruses, bacteria and fungi). The micro – organisms are important in improving soil fertility because some bacteria and fungi help in the decomposition of organic matter while others fix nitrogen into the soil. They are also important for pharmaceutical purposes and in industries.

2.7 AIR POLLUTION

Although this is not yet a big environmental problem, generally in major urban areas gaseous emissions from industries, car exhaust fumes as well as burning of old tyres pollute the air. In the rural areas, uncontrolled bush fires also pollute the air apart from destroying vegetative cover. Air pollution also arises from quarrying and coal mining activities. With the increased scope of these activities, air pollution could be a serious problem especially in nearby areas

2.8 CLIMATE CHANGE

Climate change and climate variation have impacts on the environment and society in the following manner

a. Environment

i. Hydrological systems through change in precipitation and soil moisture

ii. ecosystems and vegetation changes vegetation zones and species mix thereby reduce biological diversity

b. Society

i. Water resources increased floods and droughts

ii. food and agriculture changes to growing seasons, yields, pest distribution and cultivated land, forestry and fisheries

c. Economic Activity

Change in energy requirements, effects on transport and industry

d. Human Settlement: Changes in diseases patterns can have effects on infrastructure etc.

Although climate change and climate variations have not yet been assessed with absolute certainty and throughout the world in general, recent climate abnormalities such as droughts, floods bear witness to climate change.

CHAPTER THREE

3.0 EVALUATION OF ENVIRONMENTAL PROJECTS

A development project involves several steps. The systematic approach used in a typical project cycle includes identification, preparation, appraisal, negotiation and financing, implementation, supervision and post project audit (World Bank, 2006)

Identification: This involves the preliminary selection of potential projects that appear to be viable in financial, economic, social and environmental terms and conform to national and sectorial development goals

Preparation: This lasts up to several years and includes systematic study of economic, financial, environmental, engineering – technical and institutional aspects of the project (including alternative methods of achieving the same objectives)

Appraisal: This consists of a detailed review that comprehensively evaluates the project in the context of financial, social and environmental issues. Environmental and social assessments are also key elements which may affect the project design and alter the investment decision. The economic evaluation itself involves several well defined stages, including the demand forecast, least cost alternative, benefit measurement and cost benefit analysis

Financing: If outside financial assistance is involved, the country and financier negotiate measures required to ensure the success of the project and the conditions for funding (usually included in loan agreements)

Implementation and Supervision: Implementation involves putting into effect in the field all finalized project plans. Supervision of the implementation process is carried out through periodic inspections and project reports. Ongoing reviews help to update and improve implementation procedures.

Evaluation: This is the final stage, involving an independent project performance audit to measure the project outcome as against the original objectives. This analysis can yield valuable information to improve processing of future projects.

CHAPTER FOUR

4.0 RESOURCE CONSERVATION

Resource conservation is the protection, preservation, restoration and rational use of all resources in the total environment.

Conserving earth's biological diversity and safeguarding the benefits or "ecosystem services" that functioning ecosystems provide to humans are two major objectives of natural resource conservation

Our society depends on the maintenance and protection of ecosystems. Yet resources in many ecosystems are often over exploited or managed in non-sustainable ways. Urban development, agricultural, mineral/oil extraction, fisheries and forestry practices can threaten the very existence of some ecosystems and alter or eliminate important habitats, biodiversity and people's way of life. Global climate change presents the largest uncertainty and threat to the sustainability of our present natural resources and ecosystems. To maintain healthy ecosystems, we have to strive to achieve a balance between society's ever increasing need for goods and services and protection of natural environments and do so in era of changing climate.

Nigeria is blessed with rich and unique array of ecosystems and a great variation in natural resources. These have evolved a diversity of fauna and flora supporting more than 1,340 species of animals, among which are 274 mammals, 860 birds and about 4,600 species of plant (FORMECU, 1996). This ranks Nigeria as one of the richest countries of Africa in terms of biodiversity (FMoE, 2001). However, wildlife conservation and management have been facing many social and ecological problems in Nigeria. Several authors have identified some of the factors affecting biodiversity conservation in Nigeria, including land clearing for agriculture and uncontrolled logging, gathering of firewood (Asibey and Child, 1990); overgrazing and deforestation; indiscriminate or ill-planned bush burning; high population rate and illegal hunting for bush meat (Agbelusi, 1994) and shape of the landscape, drainage, vegetation and soil types (Ayodele and Lameed, 1999).

There are a number of available resource conserving agricultural technologies that reduce soil erosion and improve resource conservation. They can be defined as a rationale use of land resources , application of erosion control measures, and water conservation technologies, and adoption of appropriate cropping patterns to improve soil productivity and to prevent land degradation and thereby enhance livelihoods of local communities.

Management of the human use of natural resources to provide the maximum benefit to current generations while maintaining capacity to meet the needs of future generations. Conservation includes both the protection and rational use of natural resources. Earth's natural resources are either non-renewable such as minerals, oil, gas and coal or renewable such as water, timber, fisheries and agricultural crops. The growing combination of growing population and increasing levels of resource consumption is degrading and depleting the natural resource base. The world's population stood at 850million at the onset of the industrial age. The global population has grown to nearly seven times as large (6 billion) and the level of consumption of resources is far greater. This human pressure now exceeds the carrying capacity of many natural resources

Non renewable resources such as fossil fuels are replaced over geologic time scales of tens of millions of years. Human societies will eventually use up all of the economically available stock of many non-renewable resources such as oil. Conservation entails actions to use these resources most efficiently and thereby extend their life as long as possible.

It may be expected that the biggest challenge of resource conservation would involve non – renewable resources since renewable resources can replenish themselves after harvesting. Infact the opposite is the case. Historically, when non-renewable resources have been depleted, new technologies have often reduced pressure on these resources even before they are fully depleted. Renewable resources in contrast can be seriously depleted if they are subjected to excessive harvest or otherwise degraded and no substitutes are available for, say, clean water or food products such as fish or agricultural crops. Moreover, when the misuse of biological resources causes the complete extinction of a species or the loss of a particular habitat, there can be no substitute for that diversity of life. Conservation is sometimes used synonymously with

"protection". More appropriately however, it refers to the protection and sustainable use of resources. Critical elements of the effective conservation of natural resources include sustainable resource management, establishment of protected areas and ex-situ (off site) conservation

4.1 RESOURCE MANAGEMENT

Some of the most pressing resource conservation problems stem directly from the mismanagement of important biological resources. Many marine fisheries are being depleted for example because of significant over capacity of fishing vessels and a failure of resource managers to closely regulate the harvest. In theory, a renewable resource stock could be harvested at its maximum sustainable yield and maintain constant average annual productivity in perpetuity. In practice however, fishery harvest levels are often set too high and in many regions, enforcement is weak with the result that fish stocks are driven to low levels. A similar problem occurs in relation to the management of timber resources. Short term economic incentives encourage cutting as many trees as quickly as possible.

A number of steps are being taken to improve resource conservation in managed ecosystems

1. Considerable scientific research has been undertaken to better understand the natural variability and productivity of economically important resources.
2. Many national and local governments have been enacted regulations for resource management practices on public and private lands.
3. in some regions, programs recently have been established either to involve local communities who have a greater incentive to manage for long term production more directly in resource management decisions or to return to them resource ownership rights
4. Efforts are underway to manage resources on a region or ecosystem scale using methods that have come to be known as ecosystem management or bio-

regional management. Since the actions taken in one location often influence species and processes in other locations, traditional resource conservation strategies were often focused too narrowly to succeed.

4.2 PROTECTED AREAS

One of the most effective strategies to protect species from extinction is the establishment of protected areas designed to maintain population of a significant fraction of the native species in a region. Worldwide, 9832 protected areas, totaling more than 9.25million square kilometers (24 million square miles) cover about 8% of landon earth. Although these sites are not all managed exclusively for the conservation of species, they play an essential role in protecting species from extinction.

Many problems remain however in ensuring effective protected area conservation networks. For example, several regions with important biodiversity still lack effective protected areas. In addition, where protected areas have been designated, human and financial resources are not always available to effectively manage the areas. Particularly in developing countries, the establishment of protected areas has resulted in conflicts with local communities that has been dependent upon the areas for their livelihood. These challenges are now being addressed through international efforts such as the international convention on biological diversity which aims to increase the financing available for protected areas and to integrate conservation and development needs

4.3 EX – SITU CONSERVATION

The most effective and efficient means for conserving biological resources is to prevent the loss of important habitats and to manage resources for their long term productivity of goods and services. In many cases, effective conservation in the field is no longer possible. For example, some species have been so depleted that only a few individuals remain in their natural habitat. In these cases, there is no alternative to the

ex – situ conservation of species and genetic resources in zoos, botanical gardens and seed banks. Ex situ collections play important conservation roles as well as serving in public education and research. Worldwide, zoos contain more than 3000 species of birds, 1000 species of mammals and 1200 species of reptiles and botanic gardens are believed to hold nearly 80,000 species of plants. These collections hold many endangered species some of which have breeding populations and thus could potentially be returned to the wild. Gene banks hold an important collection of the genetic diversity of crops and live stock

4.4 CONSERVATION AGRICULTURE AS A FORM OF RESOURCE CONSERVATION

4.4.1 DEFINING CONSERVATION AGRICULTURE (CA)

Conservation Agriculture has emerged as an alternative to conventional agriculture as a result of losses in soil productivity due to soil degradation (e.g. erosion and compaction). CA aims to reduce soil degradation through several practices that minimize the alteration of soil composition and structure and any effects upon natural biodiversity. In general, CA includes any practice that reduces, changes or eliminates soil tillage and avoids the burning of residue in order to maintain adequate surface cover throughout the year (ECAF, 2001). In contrast, conventional forms of agriculture regularly use ploughs to enable a deep tilling of the soil (FAO, 2001). The line between conventional and CA often blurs as conventional agriculture utilizes many practices typical of CA, such as minimum or no-tillage. Hence, the differentiating feature of CA and conventional agriculture is the mind-set of the farmer. The conventional farmer believes that tilling the soil will provide benefits to the farm and would increase tillage if economically possible. On the other hand, the conservation farmer questions the necessity of tillage in the first place and feels uncomfortable when tillage occurs.

CA maintains a permanent or semi-permanent organic soil cover consisting of a growing crop or dead mulch. The function of the organic cover is to physically protect the soil from sun, rain and wind and to feed soil biota. Eventually, the soil micro-organisms and soil fauna will take over the tillage function and soil nutrient balancing, thereby maintaining the soil's capacity for self-recuperation.

Residue-based zero tillage with direct seeding is perhaps the best example of CA, since it avoids the disturbance caused by mechanical tillage. A varied crop rotation is also important to avoid disease and pest problems. The last two decades have seen the perfecting of the technologies associated with minimum or no-tillage agriculture and their adaptation for nearly all farm sizes, soil and crop types and climate zones. Some examples of CA techniques include:

- **Direct sowing/direct drilling/no-tillage:** The soil remains undisturbed from harvest to planting except for nutrient injection. Planting or drilling takes place in a narrow seedbed or slot created by coulters, row cleaners, disk openers, in-row chisels or row-tillers. Weed control is primarily by herbicides with little environmental impact. Cultivation is a possibility for emergency weed control. This strategy is the best option for annual crops.
- **Ridge-till:** The soil remains undisturbed from harvest to planting except for nutrient injection. Planting takes place in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is by herbicides and/or cultivation. Ridges are rebuilt during cultivation.
- **Mulch till/reduced tillage/minimum tillage:** The soil is disturbed prior to planting. Tillage tools such as chisels, field cultivators, disks, sweeps or blades are used. Weed control is by herbicides and/or cultivation. In non inversion tillage, soil is disturbed (but not inverted) immediately after harvest to partially incorporate crop residues and promote weed seed germination to provide soil cover during the intercrop period. These weeds are later chemically destroyed (using herbicides) and incorporated at sowing, in one pass, with non-inversion drills.

• **Cover crops:** Sowing of appropriate species, or growing spontaneous vegetation, in between rows of trees, or in the period of time in between successive annual crops, as a measure to prevent soil erosion and to control weeds. Cover-crop management generally utilizes herbicides with a minimum environmental impact.

4.5 FACTORS AFFECTING THE ADOPTION OF THE PRACTICE OF CONSERVATION AGRICULTURE

4.5.1 Farmer characteristics

Since Ryan and Gross (1943) first showed that the adoption of agricultural innovations is typically uneven from farmer to farmer, researchers have directed attention to certain characteristics and attributes of farmers in an effort to explain this unevenness. In the case of soil conservation technology adoption, Gould *et al*. (1989) emphasize awareness on the part of farm operators to soil erosion or other soil problems as an obvious prerequisite to adoption. Indeed, farmer awareness or perception of soil problems is frequently found to positively correlate with CA adoption (Stonehouse, 1991). Similarly, the central place of information and knowledge in CA adoption, in terms of being aware of soil problems and potential solutions, should lead the level of education of a farm operator to correlate positively with adoption. Education, be it specific or general, generally correlates positively with the adoption of CA practices, notwithstanding some findings of insignificance or even negative correlation (Warriner and Moul, 1992).

Age and/or experience are difficult factors to link to CA adoption, given that studies have shown both a positive and negative correlation. Based on a study of conservation tillage adoption in Wisconsin, Gould *et al*. (1989) showed that older and more experienced farmers were more likely than their younger colleagues to recognize soil problems. However, they were less likely than their younger colleagues to address the

problems once recognized. In contrast, several studies have found that income correlates positively with the adoption of soil-erosion control practices (Wandel and Smithers, 2000).

4.5.2 Farm characteristics

Studies of the adoption of conservation tillage and other CA-type practices have often given significant attention to farm size (or sometimes planted area). Many studies have found that farm size correlates positively with adoption (Westra and Olson, 1997). However, other studies have shown no significant relationship (Uri, 1999b), or even a negative correlation (Shortle and Miranowski, 1986). Hence, the overall impact of farm size on adoption is inconclusive.

Some studies have found that the presence of soil erosion and other soil problems on the farm correlates positively with conservation tillage adoption (Stonehouse, 1991). However, farmer awareness of and concern for soil problems is probably the more critical factor affecting adoption. Another important farm characteristic is underlying land productivity. In the case of no-till and mulch tillage, Uri (1999) shows that in the United States adoption is more likely on farms with low rather than high levels of soil productivity. In addition, a good fit between CA and the farm's production goals encourages adoption. A more complex factor liable to affect adoption is land tenure. In simple terms, privatizing land should lead to better incentives for the adoption of conservation technologies. However, studies of the privatization of land or titling have not shown that this is necessary to motivate sustainable practices and, in some instances, it has had the opposite effect. As a result, it appears that producers may accept titling because it guarantees land rights, but this does not necessarily bring about changes in their land management. In contrast, there are numerous studies indicating that traditional institutions governing access to land resources in developing

regions are flexible in responding to internal and external pressures. Thus, general claims that titling will lead to increased investment in land improvements should be viewed with caution.

4.5.3 Information

Without knowledge of the practices associated with CA via some information or communication channel, adoption is improbable. Indeed, studies of innovation adoption and diffusion have long recognized information as a key variable, and its availability is typically found to correlate with adoption (Harrera and Sain, 1999). Information becomes especially important as the degree of complexity of the conservation technology increases.

Information sources that positively influence the adoption of CA-type practices can include: other farmers; media; meetings; and extension officers. However, with respect to this latter source, Agbamu (1995) shows that contact alone will not promote adoption if information dissemination is ineffective, inaccurate or inappropriate. Studies have not always shown that the ease of obtaining information correlates with adoption.

4.5.4 Biophysical and technical factors

In technical terms, the characteristics and availability of CA technologies are crucial factors in adoption. However, Harrera and Sain (1999) note that availability does not imply individual ownership of the necessary machinery as lease/hire arrangements proliferate. Furthermore, potential adopters must believe that the technology will work. Technical factors interact with biophysical factors, e.g. soil type, rainfall or topography can encourage/facilitate or discourage/ limit CA adoption. While some studies have shown that farm operations located within regions of steep slopes and

erodible soils have a greater tendency to use CA practices, other studies have found these variables to be insignificant.

4.5.5 Social factors

CA adoption is seldom strictly a function of individual profit maximization alone, but also can reflect non-individual or societal interests. More specifically, Lynne (1995) argues that farmer decision making usually reflects a compromise between private economic utility and collective utility. Producers often identify this latter interest as 'the right thing to do', at least in those places where stewardship is part of the cultural norm. The argument runs that for many producers the pride associated with stewardship makes up for limits in financial rewards (Campbell *et al.*, 1999).

In addition to stewardship motives, collective action may be necessary to implement CA on a regional basis. Cooperative arrangements govern numerous activities within village agricultural systems. Although the discussion usually focuses on common property resources, even private land use may overlay with cooperative arrangements governing various aspects of farm management (Pretty, 1995). For example, contour ploughing, stone lines and other structural works require cooperation amongst several or many farmers in order to be effective conservation strategies. Many dimensions of CA fit the cooperative model, including the formation and operation of farmers' groups, dissemination of information, pest control and the purchase of agrochemical inputs.

If CA requires collective action or high levels of social organization to help it gather momentum, then widespread adoption may be related to a society's social capital. The role of social capital in fostering or retarding the collective action needed in promoting new conservation technology is of growing interest. In the broadest sense, social

capital refers to the interconnectedness among individuals in society and considers relationships as a type of asset. Several studies have examined the influence of social capital on technology adoption in either developed or developing countries. For example, kinship, or more exactly 'connectedness to others', can influence the adoption of conservation technology. Some studies have shown that the expectation of farmland inheritance can have a bearing on conservation behaviour amongst farmers, although other studies testing for this have not shown a positive correlation. Similarly, higher levels of social capital help explain the adoption.

4.5.6 Collective action and social capital in soil and water conservation

Collective action can have benefits over individual decision making when the tasks at hand require coordinated group activity (e.g. various agricultural and conservation practices). For example, it may reduce the costs of repeated transactions amongst many individuals by establishing a single set of rules and avoiding individualized negotiation and transaction. However, collective action is not automatic in the diffusion of improved technologies such as CA, especially where information is lacking or the underlying physical processes of land degradation are slow and barely perceptible. Additionally, some individuals may benefit from collective action without contributing, and this may result in a lack of collective incentives. Using game theory to model behaviour in collective action situations, researchers have tried to understand what factors may foster collective behaviour. For example, if repetition and observability characterize group activities, the result may well be cooperation, but only if:

i. other individuals are able to retaliate in the future if one individual does not cooperate, i.e. by reducing the benefits the defector can obtain in the future; ·
ii. retaliatory threats are credible and not too costly to implement - thus, retaliation can be viewed as a collective action in itself; and,

iii. future benefits are substantial enough and sufficiently longstanding to provide an inducement to cooperate in the present - in this case, face-to-face encounters prove important as these ensure that aspects of reputation and trust enter into the incentives structure.

In general, the key variables influencing the potential success of collective action are: the number of decision-makers, especially the minimum number required to attain a collective benefit; discount rates, which influence the magnitude of future benefits from collective action; a similarity of interests among agents; and the presence of some individuals with leadership or other assets. In part, the behavior needed to foster collective or socially responsible actions may hinge on the level of social capital in a community. The World Bank (1998) reviewed various definitions of this term and found they ranged from a fairly narrow view relating to the interconnectedness among individuals, via associations, societies, etc., to a much broader view encompassing the entire social and political environment. In simple terms, if conservation activity requires cooperation, then the degree of interconnectedness and the enabling social environment may be a critical determinant. The various indicators of a community's or nation's level of social capital include the number and type of associations, homogeneity within communities, levels of trust in others, reliance on networks of support, presence of natural leaders, etc. of fertilizer and soil conservation practices in Peru (Swinton, 2000), while one study has related the success of peasant committees in Paraguayan villages to the level of social capital in these communities. Such institutions at the local level have been an important catalyst in the adoption and diffusion of CA.

In conclusion, the inconsistent and sometimes contradictory results obtained from studies of the adoption of CA-type practices tend to suggest that the decision-making process is highly variable, and that outcomes may be specific to particular people, places and situations. This makes the task of developing a policy framework to promote CA adoption particularly challenging.

4.6 IMPORTANCE OF RESOURCE CONSERVATION

Resource conservation and recovery strategies can produce significant environmental, economic, and quality of life benefits by helping governments to do the following:

Reduce GHG emissions and other pollutants. Preventing the generation of future waste, along with recycling and composting existing waste, reduces GHG emissions. These strategies decrease the consumption of fossil fuels used to manufacture, transport, and dispose of goods, and in turn, reduce the emission of GHGs, such as carbon dioxide (CO_2), methane, and nitrous oxide, as well as criteria air pollutants such as sulfur dioxide (SO_2) and nitrogen oxides (NOX). Resource conservation and recovery strategies also help reduce the amount of waste that is ultimately landfilled or combusted, which lowers methane emissions from landfills and other air pollution from MSW incinerators.

The complex nature of the economy and product life-cycles means that some of the emissions benefits of resource conservation and recovery may accrue outside of the municipalities implementing these practices. These “displaced benefits” arise for two basic reasons. First, since many municipalities send their waste to landfills located outside their boundaries, the emissions benefits from avoided disposal in landfills will also occur outside their jurisdictions. Second, increasing their recycling rate will reduce the upstream manufacturing energy and GHG emissions required to make new materials from virgin inputs. Those emissions reductions and other benefits are also likely to occur outside of their jurisdictional boundaries, and may not even occur in the same year as the increase in recycling.

Reduce dependence on virgin materials. By reusing and recycling materials local governments can reduce the need for manufacturers to extract virgin natural resources. Reducing reliance on virgin resources can also provide other benefits. For example, avoiding the need to cut down trees for paper and other products can increase carbon sequestration, which is the uptake and long-term storage of atmospheric carbon.

Support economic growth through job creation and market development. Local governments that invest in resource conservation and recovery can stimulate the local economy, encourage development of recycling and composting markets and businesses, and create jobs. Local governments can encourage economic development in their communities by establishing or expanding reuse centers and recycling collection, and by hosting recycling or composting processing facilities.

Reduce waste collection and landfilling costs. When local governments encourage residents to divert waste from landfills, they save money by spending less on collecting waste, transporting it to landfills, and paying a fee to landfill each ton. Not all of these savings would be realized, due to a parallel increase in costs associated with diversion of waste for recycling and composting.

Demonstrate leadership. Local governments can demonstrate environmental, fiscal, and societal leadership by adopting resource conservation and recovery policies in their own operations. Policies that mandate specific waste reduction goals, promote recycling and composting, or set minimum recycled content requirements for product purchasing can reduce waste collection and disposal and encourage the growth of local recycling and composting businesses. These policies can reduce environmental and health impacts, save money, stimulate economic development, and encourage residents and the private sector to adopt resource conservation and recovery practices.

Improve public health. Resource conservation and recovery reduces air and water pollution, providing significant human health benefits. By reducing waste, resource conservation and recovery also reduces the amount of landfill capacity needed, allowing local governments to close existing landfills earlier and convert them into beneficial public spaces.

CHAPTER FIVE

5.0 ENVIRONMENTAL IMPACT ASSESSMENT

A CASE STUDY OF THE ENVIRONMENTAL IMPACT OF HYDROPOWER DAM OPERATIONS IN NIGER, KWARA, KEBBI AND KOGI STATES

Environmental impact assessment is the formal process used to predict the environmental consequences (positive or negative) of a plan, policy, program or project prior to the decision to move forward with the proposed action. Formal impact assessments may be governed by rules of administrative procedure regarding public participation and documentation of decision making and may be subject to judicial review. An impact assessment may propose measures to adjust impacts to acceptable levels or to investigate new technological solutions.

An environmental impact assessment is essentially an identification and study of all significant environmental repercussions stemming from a course of action. For the most part, these focus on impacts that are expected to flow from a proposed decision, although retrospective EIA's are of great value also, especially when they are done to see if earlier predictions were accurate.

The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made. EIA's are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts (Holder, J. 2004)

EIA's can be carried out for any social action, public or private, industrial or domestic, local or national. They are largely the work of natural scientists, who focus on tracing

out and describing the physical impacts of projects or programs, following through the complex linkages that spread these impacts through the ecosystem. They do not directly address the issue of placing social values on these impacts.

5.1.1 Background facts

EIA was first introduced in the USA under the Environmental Policy Act (1969). Since then it has evolved and a variety of offshoot assessment techniques have emerged (focusing, for example on social, biodiversity, environmental health and cumulative effects and risk) acting as a broader impact assessment toolkit. Most countries have now introduced formal EIA systems, usually under dedicated environmental legislation, and have introduced EIA regulations (and often regulatory bodies) specifying when and for which developments an EIA is required, institutional responsibilities and procedures, and specific steps and processes to be followed.

5.1.2 Origin of EIA

Before the First World War, rapid industrialization and urbanization in western countries was causing rapid loss of natural resources. This continued to the period after the Second World War giving rise to concerns for pollution, quality of life and environmental stress. In early 60s, investors and people realized that the projects they were under taking were affecting the environment, resources, raw materials and people. As a result of this, pressure groups formed with the aim of getting a tool that can be used to safeguard the environment in any development. The USA decided to respond to these issues and established a National Environmental Policy Act in 1970 to consider its goal in terms of environmental protection. The USA became the first country to enact legislation on EIA. This was the first time that EIA became the official tool to be used to protect the environment. The United Nations Conference on the Environment in Stockholm in 1972 and subsequent conventions formalized EIA. At present, all developed countries have environmental laws whereas most of the

developing countries are still adopting it (Lee, 1995). Multilateral and bilateral lenders included EIA requirements in their project eligibility criteria (OECD, 1996).

5.1.3 EIA in developing countries

Until recently, EIA as a new concept was not readily understood and accepted as a tool in developing countries. Developers resisted and argued that it was anti-development because laws and policies supporting it dictated that lands developments causing negative impacts should be discontinued. In a nutshell, EIA was considered just another bureaucratic stumbling block in the path of development. Secondly, it was conceived as a sinister means by which industrialized nations intend to keep developing countries from breaking the vicious cycle of poverty. Thirdly, the experts in the developing countries were foreigners who were viewed as agents of colonization. The need for EIAs has become increasingly important and is now a statutory requirement in many developing countries.

Historically, the choice of new projects was primarily based on one criterion: economic viability. Today, a second and a third choice criteria, environmental and social impact, have become a strong yardstick, hence the triple bottom-line approach (economic, environmental and social) to project viability (Modak & Biswas, 1999).

5.2 EIA LEGAL, POLICY & INSTITUTIONAL FRAMEWORK

EIA takes place within the legal and/or policy and institutional frameworks established by individual countries and international agencies. EIA provision and procedure can contribute to successful implementation of project if these frameworks are adhered to.

EIA in International Environmental Law Context

Key Multilateral Environmental Agreements (MEAs) have seen review and improvements in EIA legal, policy and institutional arrangements. The key agreements are discussed below.

a) Convention on Environmental Impact Assessment in a Trans-boundary Context (Espoo, 1991).

This is the first multi-lateral EIA treaty. It looks at EIA in a trans-boundary context and entered into force in 1997. The Espoo Convention sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across borders.

Apart from stipulating responsibility of signatory countries with regards to proposals that have trans-boundary impacts, it describes the principles, provisions, procedures to be followed and list of activities, contents of documentation and criteria of significance that apply.

b) Rio Declaration (1992).

Principle 17 of Rio Declaration on Environment and Development calls for use of EIA as a national decision making instrument to be used in assessing whether proposed activities are likely to have significant adverse impact on the environment. It also emphasized the role of competent national authority in the decision making process. The other principle (15) of this declaration that is relevant to EIA practice is the application of the precautionary principle.

Agenda 21, which was also as a result of this convention, proposes that governments should:

"Promote the development of appropriate methodologies for making integrated energy, environment and economic policy decisions for sustainable development, inter alia, through environmental impact assessment.

Develop, improve and apply environmental impacts assessment, to foster sustainable industrial development.

Carry out investment analysis and feasibility studies including environmental assessments for establishing forest based processing enterprises.
Introduce appropriate EIA procedures for proposed projects likely to have significant impacts upon biological diversity, providing for suitable information to be made widely available and for public participation, where appropriate, and encourage the assessment of impacts of relevant policies and programs on biological diversity.

Agenda 21 sets the framework within which countries can establish their national environmental laws.

c) **UN Convention on climate change and Biological Diversity (1992)** cited EIA as an implementing mechanism of these conventions (article 4 and 14 respectively).

d) **Doha Ministerial Declaration** encourages countries to share expertise and experience with members wishing to perform environmental reviews at the national level (November, 2001).

e) **UNECE (Aarhus) Convention** on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters (1998) covers the decisions at the level of projects and plans, programs and policies and by extension, applies to EIA and SEA.

f) United Nations Conference on the Environment in Stockholm 1972.

5.3 Multilateral And Bilateral Financial Institutions Environmental Safeguards

Investment banks like African Development Bank (AfDB), Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Japanese Bank for International Cooperation (JBIC), World Bank (WB) have environmental safeguards to ensure that financing of projects is not only based on the precautionary principle, preventative action rather than curative

treatment but sustainable development (WBCSD,2005). Although their operational policies and requirements vary in certain respects, the development banks follow a relatively standard procedure for the preparation and approval of an EIA report. Borrowing countries are responsible for the preparation of the EIA, and this requirement possibly more than any other has influenced the introduction and development of EIA in many developing countries. The EIA should examine project alternatives and identify ways of improving project selection, siting, planning, design and implementation by preventing, minimizing, mitigating and compensating for adverse environmental impacts.

Just like other banks, the World Bank has criteria for screening projects as follows:

Category A: If the project likely to have significant environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect an area broader than the communities benefiting from infrastructure investments.

Category B: If the projects potential adverse environmental impacts on human populations or environmentally important areas are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category A projects.

Category C: If the project is likely to have minimal or no adverse environmental impacts. Once the project is assessed and determined as Category C, no further action would be required. Some examples of Category C projects include: Education (i.e. capacity-building, etc., not including school construction) Family planning (World Bank 1999) etc.

All projects financed by the Banks should also comply with the requirements of relevant multilateral environmental agreements (MEA) to which the host country is a party, including the Montreal Protocol (on ozone depleting substances), the UN Convention on Climate Change and the Kyoto Protocol (on greenhouse gas emissions) and the Aarhus Convention (on environmental information).

All international organizations and bilateral agencies frequently update their procedures and it is important to obtain the current version from the organization.

National legislations

National legislation may include a statutory requirement for an EIA to be done in a prescribed manner for specific development activities. Most legislation lists projects for which EIA is a mandatory requirement. The statutory requirement to carry out an EIA for specific projects will, for example, require registered experts to carry out the study, the authority with the help of lead agencies and technical committees to review the EIA and approve the project.

Other national legal requirements that govern the use and protection of resources like water, fisheries, forests, wildlife, public health etc must be identified and complied with during an EIA. Institutional framework

EIA institutional systems vary from country-to-country and reflecting different types of governance. In some countries, either the Ministry of Environment or a designated authority or Planning Agency administers EIA.

Environmental issues also involve many disciplines and many government bodies with general environmental and resource management laws. Data will therefore have to be collected and collated from a wide range of technical ministries, other government authorities and parastatals where applicable.

5.4 PREPARATION OF TERMS OF REFERENCE (TOR)

ToR sets out what is expected of a practitioner or a consultant when carrying out an EIA. ToRs can be simple or elaborate but elaborate ToRs are usually not recommended. There are no universal formats for terms of reference, which will be suitable for every study. However, there are general rules, which should be observed when preparing ToR for the EIA.

The ToR should commence with a brief description of the program or project. This should include a plan of the area that will be affected either indirectly or directly.

The study should ensure that the consultants or practitioners focus on the major issues and the most serious likely impacts identified during scoping e.g. air emission, waste water discharge etc. The opportunities for enhancing any positive benefits from the project should also be highlighted. This component of ToR is usually submitted to designated authority for scrutiny and approval.

The ToR should contain explicit references to which safeguard policies may be relevant and which legal requirements should be applied.

The ToR should give an indication of the team considered necessary for the study and a team leader identified. Depending on the scope of the study this may be multi-disciplinary. However, as the team should not be rigidly imposed on the consultant.
If international experts are doing the EIA, it is important to make provision for local capacity building in the ToR. Apart from enabling in-country expertise to be built up, this will promote more involvement and understanding of the issues raised by the study. As most EIA studies are of relatively short duration, this is probably best achieved through the attachment of project proponent to the consultants during the study or an insistence on the use of local staff personnel for some of the tasks.

The expected date of commencement and time limit should be given and consultants program of work must be within the given time limit.

The budget limit should be given in the ToR. The type of experts, and whether foreign or local, and the duration of their inputs will usually be the deciding cost factors although a large field survey or measurement program with laboratory analysis could

significantly increase costs. Any assistance to be provided by the Client to reduce costs should be clearly stated in the ToR.

Consultant payments proposal should be made and tied to specific milestones e.g. the consultant will be paid 20% of their fee upon receipt of draft report by client etc.

Reporting requirements should be clearly stated and should comply with local or international reporting guidelines. The format of EIS must be clear and the number of copies in soft and hard must be stated.

ToR should make provision for the consultants to improve the terms of reference in order to improve the quality of EIA.

5.5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

The first phase of an environmental assessment is called an Initial Environmental Examination (IEE) and the second is Environmental Impact Studies (EIS) or simply detailed EIA.

a) **Initial Environmental Examination (IEE)**

IEE is carried out to determine whether potentially adverse environmental effects are significant or whether mitigation measures can be adopted to reduce or eliminate these adverse effects. The IEE contains a brief statement of key environmental issues, based on readily available information, and is used in the early (pre-feasibility) phase of project planning. The IEE also suggests whether in-depth studies are needed. When an IEE is able to provide a definite solution to environmental problems, an EIA is not necessary. IEE also requires expert advice and technical input from environmental specialists so that potential environmental problems can be clearly defined.

b) Environmental Impact Assessment (EIA)

EIA is a procedure used to examine the environmental consequences or impacts, both beneficial and adverse, of a proposed development project and to ensure that these effects are taken into account in project design. The EIA is therefore based on predictions. These impacts can include all relevant aspects of the natural, social, economic and human environment. The study therefore requires a multi-disciplinary approach and should be done very early at the feasibility stage of a project. In other words, a project should be assessed for its environmental feasibility.

EIA should therefore be viewed as an integral part of the project planning process. Unlike the environmental audit (EA), which is conducted on existing projects, the EIA is applied to new projects and the expansion aspects of existing projects.

Screening

EIA process kicks off with project screening. Screening is done to determine whether or not a proposal should be subject to EIA and, if so, at what level of detail. Guidelines for whether or not an EIA is required are country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full EIA. Development banks also screen projects presented for financing to decide whether an EIA is required using their set criteria.

The output of the screening process is often a document called an **Initial Environmental Examination or Evaluation** (IEE). The main conclusion will be a classification of the project according to its likely environmental sensitivity. This will determine whether an EIA is needed and if so, to what detail.

Scoping

The aim of EIA is not to carry out exhaustive studies on all environmental impacts for all projects. Scoping is used to identify the key issues of concern at an early stage in the planning process. The results of scoping will determine the scope, depth and terms of reference to be addressed within the Environmental statement. Scoping is done to:

i. Identify concerns and issues for consideration in an EIA
ii. Ensure a relevant EIA
iii. Enable those responsible for an EIA study to properly brief the study team on the alternatives and on impacts to be considered at different levels of analysis
iv. Determine the assessment methods to be used
v. Identify all affected interests
vi. Provide an opportunity for public involvement in determining the factors to be assessed, and facilitate early agreement on contentious issues
vii. Save time and money
viii. Establish terms of reference (TOR) for EIA study

Scoping should be an ongoing exercise throughout the course of the project.

The following environmental tools can be used in the scoping exercise:

Checklists – Checklists are standard lists of the types of impacts associated with a particular type of project. Checklists methods are primarily for organizing information or ensuring that no potential impact is overlooked. They comprise list questions on features the project and environments impacts. They are generic in nature and are used as aids in assessment.

Matrices - Matrix methods identify interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities. A matrix of potential interactions is produced by combining these two lists (placing one on the vertical axis and the other on the horizontal axis). They should preferably cover both the construction and the operation phases of the project, because sometimes, the former causes greater impacts than the latter. However, matrices also have their disadvantages: they do not explicitly represent spatial or temporal considerations, and they do not adequately address synergistic impacts.

Networks – these are cause effect flow diagrams used to help in tracing the web relationships that exist between different activities associated with action and environmental system with which they interact. They are also important in identifying

direct and cumulative impacts. They are more complex and need expertise for their effective use.

Consultations – with decision-makers, affected communities, environmental interest groups to ensure that all potential impacts are detected. However there can be danger in this when excessive consultation is done and some unjustifiable impacts included in the ToR.

Baseline data collection

The term "baseline" refers to the collection of background information on the biophysical, social and economic settings proposed project area. Normally, information is obtained from secondary sources, or the acquisition of new information through field samplings, interviews, surveys and consultations with the public. The task of collecting baseline data starts right from the period of project inception; however, a majority of this task may be undertaken during scoping and actual EIA.

Baseline data is collected for two main purposes :

i. To provide a description of the current status and trends of environmental factors (e.g., air pollutant concentrations) of the host area against which predicted changes can be compared and evaluated in terms of significance, and
ii. To provide a means of detecting actual change by monitoring once a project has been initiated.

Impact analysis and prediction

Predicting the magnitude of a development likely impacts and evaluating their significance is core of environmental assessment process (Morris & Therivel, 1995). Prediction should be based on the available environmental baseline of the project area. Such predictions are described in quantitative or qualitative terms.

Considerations In Impact Prediction

- **Magnitude of Impact:** This is defined by the severity of each potential impact and indicates whether the impact is irreversible or, reversible and estimated

potential rate of recovery. The magnitude of an impact cannot be considered high if a major adverse impact can be mitigated.

- **Extent of Impact:** The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific or limited to the project area; a locally occurring impact within the locality of the proposed project; a regional impact that may extend beyond the local area and a national impact affecting resources on a national scale and sometimes trans-boundary impacts, which might be international.
- **Duration of Impact:** Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered. An impact that generally lasts for only three to nine years after project completion may be classified as short-term. An impact, which continues for 10 to 20 years, may be defined as medium-term, and impacts that last beyond 20 years are considered as long-term.
- **Significance of the Impact:** This refers to the value or amount of the impact. Once an impact has been predicted, its significance must be evaluated using an appropriate choice of criteria. The most important forms of criterion are:

i. Specific legal requirements e.g. national laws, standards, international agreements and conventions, relevant policies etc.
ii. Public views and complaints
iii. Threat to sensitive ecosystems and resources e.g. can lead to extinction of species and depletion of resources, which can result, into conflicts.
iv. Geographical extent of the impact e.g. has trans- boundary implications.
v. Cost of mitigation
vi. Duration (time period over which they will occur)
vii. Likelihood or probability of occurrence (very likely, unlikely, etc.)
viii. Reversibility of impact (natural recovery or aided by human intervention)
ix. Number (and characteristics) of people likely to be affected and their locations
x. Cumulative impacts e.g. adding more impacts to existing ones.

xi. Uncertainty in prediction due to lack of accurate data or complex systems. Precautionary principle is advocated in this scenario.

Impact prediction methodologies

Several techniques can be used in predicting the impacts. The choices should be appropriate to the circumstances. These can be based on:

a. Professional judgment with adequate reasoning and supporting data. This technique requires high professional experience.
b. Experiments or tests. These can be expensive.
c. Past experience
d. Numerical calculations & mathematical models. These can require a lot of data and competency in mathematical modelling without which hidden errors can arise
e. Physical or visual analysis. Detailed description is needed to present the impact.
f. Geographical information systems,
g. Risk assessment, and
h. Economic valuation of environmental impacts

Analysis of alternatives

Analysis of alternative is done to establish the preferred or most environmentally sound, financially feasible and benign option for achieving project objectives.

The World Bank directives requires systematic comparison of proposed investment design in terms of site, technology, processes etc in terms of their impacts and feasibility of their mitigation, capital, recurrent costs, suitability under local conditions and institutional, training and monitoring requirements (World bank 1999). For each alternative, the environmental cost should be quantified to the extent possible and economic values attached where feasible, and the basic for selected alternative stated. The analysis of alternative should include a NO PROJECT alternative.

Mitigation and impact management

Mitigation is done to avoid, minimize or offset predicted adverse impacts and, where appropriate, to incorporate these into an environmental management plan or system. For each potential adverse impact the plan for its mitigation at each stage of the project should be documented and costed, as this is very important in the selection of the preferred alternative.

The objectives of mitigation therefore are to:

a) find better alternatives and ways of doing things;
b) enhance the environmental and social benefits of a project
c) avoid, minimise or remedy adverse impacts; and
d) ensure that residual adverse impacts are kept within acceptable levels

5.6 Environmental Management Plan (EMP) & Environmental Monitoring

Environmental Management Plan (EMP)

An Environmental Management Plan (EMP) is a detailed plan and schedule of measures necessary to minimize, mitigate, etc. any potential environmental impacts identified by the EIA (World Bank 1999). Once the EIA the significant impacts have been identified, it is necessary to prepare an Environmental Management Plan.

An EMP should consist of a set of mitigation, monitoring and institutional measures to be taken during the implementation and operation of the proposed project to eliminate adverse environmental impacts, offset them or reduce them to acceptable levels. The EMP should also include the actions needed to implement these measures, including the following features:

Mitigation based on the environmental impacts reported in the EIA, the EMP should describe with technical details each mitigation measure.

The EMP should then include monitoring objectives that specifies the type of monitoring activities that will be linked to the mitigation measures. Specifically, the monitoring section of the EMP provides:

- A specific description, and technical details, of monitoring measures that includes the parameters to be measured, the methods to be used, sampling locations, frequency of measurements, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions;
- Monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and to furnish information on the progress and results of mitigation.
- The EMP should also provide a specific description of institutional arrangements i.e. who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting, and staff training).
- Additionally, the EMP should include an estimate of the costs of the measures and activities recommended.
- It should consider compensatory measures if mitigation measures are not feasible or cost effective.
- EMP must be operative throughout the whole Project Cycle.

Environmental Monitoring

Environmental monitoring is the systematic measurement of key environmental indicators over time within a particular geographic area (World Bank, 1999). Monitoring should focus on the most significant impacts identified in the EIA. Various types of monitoring activity are currently in practice. The main types are briefly described below:

- **Baseline Monitoring:** A survey should be conducted on basic environmental parameters in the area surrounding the proposed project before construction

begins. Subsequent monitoring can assess the changes in those parameters over time against the baseline.

- **Impact Monitoring:** The biophysical and socio-economical (including public health) parameters within the project area, must be measured during the project construction and operational phases in order to detect environmental changes, which may have occurred as a result of project implementation e.g. air emission, dust, noise, water pollution etc (European Commission, 1999).
- **Compliance Monitoring:** This form of monitoring employs a periodic sampling method, or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards.
- Monitoring should be regular and performed over a long period of duration. Interruptions in monitoring may result in generating insufficient data to draw accurate conclusion concerning project impact.
- The main aim of EIA monitoring is to provide the information required to ensure that project implementation has the least possible negative environmental impacts on the people and environment.

What to avoid in monitoring:

- ❖ Overestimation of data needed as this can lead to drowning in data without information.
- ❖ Under-estimation of time and cost for data analysis
- ❖ Weak coordination between the data collection with project time table and seasonal factors
- ❖ Ignoring requirements for baselines

Environmental Impact Statement (EIS)

The final EIA report is referred to as an Environmental Impact Statement (EIS). Most national environmental laws have specified what the content of EIS should have. Multilateral and bilateral financial institutions have also defined what should be contained in an EIS. Ideally, the content of an EIS should have the following:

- Executive Summary
- Policy, Legal and Administrative Framework
- Description of the environment
- Description of the Proposed Project in detail
- Significant Environmental Impacts
- Socio-economic analysis of Project Impacts
- Identification and Analysis of Alternatives
- Mitigation Action/Mitigation Management Plan
- Environmental Management Plan
- Monitoring Program
- Knowledge gaps
- Public Involvement
- List of References
- Appendices including Reference documents, photographs, unpublished data and Terms of Reference, Consulting team composition, and Notes of Public Consultation sessions

Decision making

At each stage of EIA, interim decisions are made. These decisions influence final decisions made about the EIA.

The EIS is submitted to designate authority for scrutiny before the final decision. The authority, together with technical review panel determines the quality of EIS and gives the public further opportunity to comment. Based on the outcome of the review, the designated authority or lending institution will accept, reject or make further modifications to avoid future confrontation. If the EIS is accepted, an EIA license is

issued and if otherwise, additional studies or recommendations are made before issuance of a license. The decision making process should be autonomous so that the outcome of the review is seen as fair enough. The duration of this process is usually set in the EIA legal framework.

Effective EIA follow-up

In practice, an EMP, which is submitted with the EIS report, should be used during implementation and operation of the project. The link between EIA process and project implementation stage is often weak especially in developing countries (Welford, 1996). Despite this, they may still be no better than intentions unless an independent check is made to ensure that the developer is acting as intended.

These weaknesses could be attributed to:

- Deficiencies in environmental management plans prepared during the EIA.
- Deficiencies in monitoring and enforcing compliance through use of legal instruments and financial penalties (most EIAs end after environmental clearance has been received from the environmental management authority).
- Timing of some projects especially in developing countries are implemented several years after the EIA and the EMP. In such scenarios, an update of the EIA should be done and a new EMP developed.

EIA GUIDING PRINCIPLES

International Association for Impact Assessment (IAIA, 1999) and others have developed guiding principles for EIA/IA. The principles listed below are a selection of some of the documented ones.

- **Participative:** The process should provide appropriate opportunities to inform and involve the interested and affected publics and incorporate their input in decision-making.
- **Transparency:** Assessment process, outcomes & decisions should be open and accessible.

- **Certainty:** The process and timing of the assessment should be agreed in advanced and followed by all participants.
- **Accountability:** The decision-makers and project proponents are responsible to all parties for their action and decisions under the assessment process.
- **Credibility:** Assessment is undertaken with professionalism and objectivity.
- **Cost-effectiveness:** The assessment process and its outcomes will ensure environmental protection at the least cost to the society.
- **Practical** - the process should result practical outputs, which can be implemented by proponent.
- **Relevant -** the process should focus information that is relevant for development planning and decision-making.
- **Focused** - the process should concentrate on significant environmental effects and key issues that need to be taken into account in making decisions.
- **Interdisciplinary** - the process should ensure that the appropriate techniques and experts in the relevant disciplines are employed, including use of traditional knowledge as relevant.
- **Integrated** - the process should address the interrelationships of social, economic and biophysical aspects.

5.7 EIA RELATED STUDIES

Social Impact Assessment (SIA)

Social Impact Assessment (SIA) includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions and any social change processes invoked by those interventions (Vanclay, 1999). The analysis should include the use of land, culture, the main economic activities e.g. tourism, agriculture, employment levels and impact on

service provision e.g. education, water use, traffic, energy use etc. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment. Social Impact Assessment assumes that social, economic and biophysical impacts are interconnected. Social Impact Assessment (SIA) is therefore done to ensure that there is no mismatch between the development and socio-cultural and economic of the project area.

Health Impact Assessment (HIA)

- Health is a state of complete physical, mental and social well-being and not merely absence of disease or infirmity (WHO, 1946).
- In most EIAs, HIA is usually included under SIA. HIA is now emerging as a key component of EIA because health is determined by a multiplicity of factors including socio-economic and environmental factors. There is no clear definition about where health concerns end and where environmental or social concerns begin. HIA is a broad concept that may be interpreted in different ways by a range of different users but all imply an interest in the safeguarding and enhancement of human health and a concern that human activities and decisions, in the form of development projects, plans, programs and policies can affect human health in both positive and negative ways.

Strategic Environmental Assessment (SEA)

- SEA is undertaken much earlier in the decision-making process than EIA - it is therefore seen as a key tool for sustainable development. Strategic Environmental Assessment aims to incorporate environmental and sustainability considerations into strategic decision making processes, such as the formulation of policies, plans and programs.

CASE STUDY

The establishment of hydro electric dams served as developmental projects for the country, but the communities where the dams are located are facing annual flooding which are made worse when the authorities of the Power Holding Company of Nigeria (PHCN) open the dams to let off water at the peak of rains. This has caused havoc on several communities on the flood plain of the River Niger, threatening their entire livelihood and bringing untold hardship upon them. It has been reported that in 1997 and 1998, properties worth over N500 million were destroyed by floods in Borgu and Mokwa local Government areas of Niger state. Several houses and farmlands were submerged by the surging water, the victims were forced to move from their houses to public buildings like primary schools and their economic, social and educational lives were disturbed. It was also reported that rabba rice irrigation scheme located near Mokwa has been abandoned since 1994 due to floods. Another report in 1999 stated that about 200 communities were affected by flood which kills over 1000 people. About 1,500 houses and 52 primary schools were rendered inhabitable. Also thousands were rendered jobless and homeless in Niger, Kwara and Kogi states. The News Watch Magazine (October 25, 1999) reported that the Niger state government has taken PHCN to court over issues ranging from flooding to non-payment of adequate compensation to the flood victims

Changes in water quality are potential outcomes from locating a dam in a river. Effects are often experienced both upstream and downstream of a dam. Some of the effects can be increased or decreased dissolved oxygen, increases in total dissolved gases, modified nutrient levels, thermal modification and heavy metal levels. The occurrence of floods has great effect on the sugar cane fields located at the downstream of jebba dam because it leads to the damage of irrigation and water conveyance structures, sugar cane loss and additional cost of maintenance. The cost of rehabilitation due to floods, in 1994, 1998 and 1999 about N1.3 billion. The incessant flooding and the lack of attention and adequate compensation to the victims has led the clamour by the four states (Kebbi, Niger, Kwara and Kogi) worst hit by the flood to advocate for the

establishment of a Hydropower Areas Development Commission (HYPADEC). The National Assembly is presently considering a bill on HYPADEC

The construction of dams in the country is given too much of structural or engineering consideration with little or no environmental impact assessment of the operations after the design and construction. The environmental problems as a result of operation are usually devastating thus the need for impact assessment.

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