ENVIRONMENTAL IMPACT AUDITING OF SULEJA EARTH DAM

BY

SIMONPETER ADAH

SEET/PGD AGRIC ENG/2000/124

Department of Agricultural Engineering
School of Engineering and Engineering Technology
Federal University of Technology,
Minna.

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BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT FOR THE AWARD OF POST GRADUATE DIPLOMA IN AGRICULTURAL ENGINEERING

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CERTIFICATION

This is to certify that this project was carried out by Simonpeter Adah of Agricultural Engineering Department, School of Engineering and Engineering Technology, Federal University of Technology, Minna, Niger State.

Engr. O. Chukwu Supervisor	Date
Engr. (Dr.) D. Adgidzi Head of Department	Date

DEDICATION

This project is dedicated to the three persons in One God. For "through Him all things were made; without Him nothing was made that has been made." (John 1:3 NIV).

ACKNOWLEDGEMENT

My sincere thanks go to God Almighty for His amazing grace that has seen me through the project period.

I am grateful to my Project Supervisor for his encouragement, initiative and thoroughness. He meant so well.

To my able lecturers who against all tight schedules made time to be there for me.

I will like to remember the encouragement, moral and spiritual support given me by my wife and children. They were with me in prayer.

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ABSTRACT

This study was carried out to evaluate the environmental Impacts of Suleja Earth Dam situated at Bakin Iku village. Several visits to the dam were made for visual observation, interview, and for administering a well structured questionnaire.

The areas of concern were the environmental components, namely, climate and air quality, water, geological features, soil, environmentally sensitive areas, land use and land capability, noise and vibration, visual quality, archeological/historical/cultural characteristics, and the socio-economic aspects of the dam area.

The study revealed the neglect for conservation of natural resources. During the Environmental Impact Auditing exercise, it was discovered that basic health facilities, motorable road, police post to contend with the rising crime, well equiped primary school etc. were absent. It was noted that over 70% cause of death, mainly among children were traced to one of the water-related diseases such as malaria.

Gradual desertification of the area is on-going as most settlers depend largely on firewood for cooking. There is increase incident of windstorm due to the cutting away of this natural windspeed breaker. Farmers and fishermen has to contend with accessing long distant market to sell their goods instead of creating market within their area. Though, EIA was just a year old when the dam was constructed, the set objectives as contained in the project document has not been fully implemented.

Apart from supply of water, the socio-economic components were ignored as there are little or no provision of basic amenities. This indicates that there is danger of environmental degradation if all the environmental component are not considered as a whole and as outlined in the EIA concept for sustainable development.

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CHAPTER ONE

1.0 INTRODUCTION

In recent years there has been a remarkable growth of interest in environmental issues – in sustainability and better management of development in harmony with the environment. There has been increase interest in environmental management followed by legislation from national and international agencies. This seeks to influence the relationship between development and the environment. This is a difficult hard task as developers see this as a stopper that tend to increase cost and project time. Despite these oppositions agitators seem to have made head way due to it's impending political consequences it may have on policy/law makers. (Glasson et al, 1987; 1999).

Impact evaluation/auditing from the need to identify and predict the impact on the environment and on man's health and well-being of legislative proposals, policies, programmes, projects and operational procedures, to interpretion and communication of information about the impacts. The term "environmental auditing" involves comparing the impacts predicted in an EIS with those that actually occur after implementation, in order to assess whether the impact prediction performs satisfactorily.

The audit can be of both impact predictions (low good were the predictions?) and of mitigation measures and conditions attached to the development (is the mitigation effective, are the conditions

being honoured?). This approach to auditing contrasts with environmental management auditing, which focuses on public and private cooperate structures and programmes for environmental manageemnts and associated risks and liabilities.

* **Project screening:-** This is based on local legislations/regulations on ground for assessing projects.

* **Scoping:-** Seeks to identify at early stage, from all of a project's possible impacts and from all alternatives that could be addressed. Those are the crucial/significant issues.

* The consideration of alternatives seeks to ensure that the proponents have considered other feasible approaches, locations, scales, processes, layouts, operating conditions and the "no action" option.

* The description of the project/development actions includes a clarification of the purpose and rationale of the project, and an understanding of its various characteristics including stages of development, location and process.

* The description of the environment's baseline includes the establishment of both present and future state of the environment, in the absence of the project, taking into account changes resulting from natural events and from other human activities.

* The identification of the main impacts brings together the previous steps with the aim of ensuring that all potentially significant environmental impacts (adverse and beneficial) are identified and taken

into account in the process.

* The prediction of impacts aims to identify the magnitude and other dimensions of identified changes in the environment with a project/ action, by compansion with the situation without that project/action.

* **The evaluation and assessment of significance** asseses the relative significance of the predicted impacts to allow a focus on the main adverse impacts.

* **Mitigation** involves the introduction of measures to avoid, reduce, remedy or compensate for any significant adverse impacts.

* **Public consultation and participation** aim to ensure the quality, comprehensiveness and effectiveness of impact assessment, and that the public's views are adequately taken into consideration in the decision making process.

* **EIS presentation:-** Is a vital step in the process. If done badly, much good work in the IA may be negated.

* **Review** involves a system appraisal of the quality of the EIS, as a contribution to the decision making process.

* **Decision making** on the project involves a consideration by the relevant authorities of the EIS (including consultation responses) together with other material considerations.

* **Post decision monitoring** involves the recording of outcomes as-

sociated with developmental impacts, after a decision to proceed. It can contribute to effective project management.

* **Auditing follows from monitoring.** It can involve comparing company actual outcome with predicted outcomes and can be used to assess the quality of prediction and the effectiveness of mitigation. It provides a vital step in the EIA learning process.

1.1 History of Impact Auditing

Environmental impact assessment (E.I.A) was introduced in USA in 1969. A European Community directive in 1985 accelerated the application in EU member states and since its introduction in the UK in 1988, it has been a major growth area for planning practice. The originally anticipated 20 Environmental Impact Statements (EIS) per year in the UK quickly escalated to over 300, and this is only the tip of the iceberg. The scope of EA has been growing steadily.

(Breakell, and Glasson 1981). The Directive (EU legislation) on Environmental Impact Assessment of the effects of projects on the environment was amended in 1997. Member states have to transpose the amended EIA Directive by March 1999 at the latest.

The EIA procedure ensures that environmental consequences of projects are identified and assessed before authorization is given. The public can give it's opinion and all results are taken into account in the authorization procedure of the project. The public is informed of the decision afterward. The EIA Directive outlines which project categories shall be made

subject to an EIA, which procedure shall bee followed and the content of the assessment. Europe, European Commission > Environment EIA Directive (85/337/EEC).

Since the advent of EIA, developers seem to be at war with it's policy. Many argued that it is an additional cost on development, but EIA awareness seems to be gaining upper hand.

More so, with alarming increase in rate of natural disaster, policy makers, the public and the developer are getting to accept the truth about EIA. There has been reported cases of dam failure resulting to loss of lives and property.

It is reported that companies run away from the developed countries to Africa especially Nigeria where environmental management rules seem to be laxed.

On this account the Federal Government of Nigeria, in 1993, established a Regional Environmental Monitoring Station at Oshogbo under the auspices of the Global Atmospheric Watch (GAW) programme of the World Meteorological Organization (WMO). The station was to monitor background atmospheric pollution in some major cities in Nigeria.

Similar to what is obtained in what is this Countries, Federal Environmental Protection Agency (FEPA) was established in December, 1995. It was charged with overall responsibility for monitoring, supervising and co-ordinating Environmental Impact Assessment Procedure in Nigeria.

Since then, environmental protection is accorded a lot of prominence in Nigeria. (FEPA, 2002).

1.2 Auditing in Practice

In total, auditing can make important contributions to the better planning and EIA of future project. Sadler (1988) writes of the need to introduces feedback in order to learn from experience, we must avoid the constant "reinventing of the wheel" in EIA. Auditing of outcomes can contribute to an improvement in all aspects of the EIA process, from understanding baseline conditions to the framing of effectives mitigating measures. In addition, Greene et al (1985) note that monitoring and auditing should reduce time and resource commitments to EIA by allowing all participants to learn from past experience; they should also contribute to a general enhancing of the credibility of proponents, regulatory agencies and the EIA process.

Auditing is already developing a considerable variety of types.

Tomlinson & Atkinson (1987a, 1987b) have attempted to standardize definitions with a set of terms for seven different points of audit in the "Standard" EIA process, as follow:

* Decision point audit (draft EIS) - by regulatory authority in the planning approval process;

* Decision point audit (final EIS) - also by regulatory authority in the planning approval process;

* Implementation audit - to cover start up; it could be used for scrutiny by the government and the public and focus on the proponent's compliance with mitigation and other imposed conditions.

* Performance audit to cover full operation; it could also include government and public scrutiny;

* Predictive techniques audit - to compare actual with predicted impacts as a means of comparing the value of different predictive techniques;

* Project impact audits - also to compare actual with predicted impacts and to provide feedback for improving project management and for future projects;

* Procedures audit - external review (e.g by the public) of the procedure used by the government and industry during the EIA processes.

These terms can and do overlap. The focus here is on project, performance and implementation audits. Whatever the focus, auditing faces a number of major problems. Buckley (1991) identifies the following:-

* EISS often contain very few testable predictions, which may only relate to relatively minor impacts;

* Environmental parameters that are monitored may not correspond with those for which predictions were made;

* Monitoring techniques, may not enable predictions to be tested, become internalia, time periods and locations do not match, there are too few samples etc.

* Projects are almost always modified between the design used for the EIA and in practice;

* Monitoring data provided by the developers or project operators may possibly be biased towards their interests.

Such problems may partly explain the dismal record of the Canadian EISS examined, from an ecological respective, by Beanlands and Duinker (1983), for which accurate predictions appeared to be the exception rather than the rule. There are several examples, also from Canada, of situation where an EIA has failed to predict significant impacts. Berkes (1988) indicated how an EIA on the James Bay HEP Mega Project (1971 - 85) failed to pick up a sequence of interlink impacts, which resulted in a significant increase in mecury contamination of fish.

One of the most comprehensive nationwide auditing studies of the precision and accuracy of environmental impact predictions has been carried out by Buckley (1991) in Austrialia. At the line of his study, he found that adequate monitoring data to test predictions were available for only 3 percent of the up to 1,000 EISS produced between 1974 and 1982. In general, he found that testable predictions and monitoring data were available only for large complex projects, which had often been the subject of public controversy and whose monitoring was aimed primarily are testing

compliance with standards rather than with impact predictions. Some examples of over 300 major and subsidary predictions tested are illustrated in Table 1.0.

Overall, Buckley found the average accuracy of quantified, critical, testable predictions was 44% + 5% standard error. The more severe the impact, the lower the accuracy. Inaccuracy was highest for predictions of ground water seepage. Accurancy, assessments are of course influenced by the degree of precision applied to a prediction in the first place. In this respect, the use of ranges, reflecting the probabilistic nature of may impact predictions, may be a sensible way forward and would certainly make cophaise monitoring more straight forward and less subject to dispute.

Table 1.0 Examples of Auditing of Environmental Impact Predictions

Component Parameter	Type of Development	Predicted Impact	Actual Impact	Accuracy/Precision
Surface Water quality: Salt, PH	Bauxite Mine	No detectable increase in salinity	None detected	Correct
Noise	Bauxite Mine	Blast Noise <115d BA	Only 90% <115dBA	Incorrent: 90% accurate, worse
Workforce	Alluminum Smelter	1000 during Construction	Upto 2500	Incorrect: 60% Accurate, worse

Source: Buckley, 1991

Buckley's natural survey, showing less than 50% accurancy, does not provide grounds for complacing. Indeed, as it was base on monitoring data provided by the operating corporations concerned, it may present a better result than world be generated from a wider trawl of EIS. On the other hand we are leaving from experience, and mone recent EIS may contain better and more accurate predictions.

There has not, until recently, been much emphasis in auditing studies on the important area of prediction techniques audit, and on the value of particular prediction techniques and in the measuring poison of native people. Dickman (1991) identified the failing of an EIA to pick up the

impacts of increased lead and zinc mine tailing on fish population in Garrow lake, Canada's most notherly hypersaline lake.

1.3 Statement of Problem

Suleja Earth Dam has the capability of transforming it's environs to an enviable example of proper environmental management process but unfortunately it has been an example among many national monuments and establishments constituting impediment to sustainable development.

There is the case of poor environmental management with little or no data on pre-dam and post-dam Impact Assessment of the area. The activities of the villagers and fishermen washing agric products, clothes and the use of chemicals for fishing affects water quality and the health of people.

Due to the daming of the water body, sicknesses such as malaria, dysentery, sleeping sickness seem to be prevalent among the people; disease carrying vectors are on the increase. Lack of techniques for conservation of ecological system is a contributing factor to the gradual deterioration of the environment. Many have noticed that there has been gradual disappearing of fish species since the seasonal migration of fish to the downstream has been greatly impeded. The area as visibly seem is facing a gradual desertification since a large portion was cleared and large earth removed in the course of the project. The people in the area depend heavily

on wood as source of energy. The people simply lack the basic knowledge of the danger of desertification.

It was observed that there is a vegetal removal which has initiated sheet and rill erosion. Some of the tributaries have their bed widened due to scourge of water in rainy season. All these problems are compounded by the lack of provision of basic amenities such good road, hospital, school etc.

Though compensation were said to be paid to the original settlers, but a look at the inhabitants reveals that there were no proper planning to integrate the people into the dam areas after the construction. They live in such houses that cannot withstand the harsh climate changes of the dam area nor ensure proper hygienic living.

It is all these factors that led to the study of the Environmental Assessment of Suleja Earth Dam. Information obtained from this study will be used to design effective Impact Assessment Procedure for Suleja Earth Dam and other dams in Nigerian.

1.4 Objective of Study

The objective of this study is to assess the magnitude of impacts of the Suleja Earth dam on its environment in terms of compliance to both local and international regulations.

This was carried out with several reconnaissance visit to the dam. Furthermore, a well structured questionnaire was administered to selected key persons to ascertain the magnitude of these impacts the dam may have on both socio-economic life and the physical environment of the dam area. The impact of the dam during and after construction were carefully studied.

From the analysis of these results and findings recommendation will be prefer on how to curtail or eliminate these negative impacts while optimal use of the dam can still be achieved.

1.5 Justification of the Study

Construction of dam requires huge capital involvement and at the same time poses potential consequences on the natural habitat. Sometimes, siting of dam completely change the sico-economic lifestyle of the people in that particular environment, changes in physical geography of the area. Furthermore damming of water impedes migration of fishes to the downstream. While dam can be a blessing, lack of proper identification of impact may impede rapid sustainable development. Failure of the dam itself can result into loss of lifes and properties. There is, therefore, the need to idenitify these impacts brought about by the dam during and after construction with a view to mitigate against those impact identified.

1.6 Scope and Limitation of the study

This project is to carry out the Impact Assessment of Suleja Earth Dam. This work seeks to identify these impacts on the different parameter of the environment within the host community only.

The work does not involves chemical analysis, (Water quality) soil and rock studies and other scientific evaluation due to limited resources needed to carry out such study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Impact Auditing

Impact auditing seeks to address development of natural resources as it influence the environment either positively or negatively. The introduction of Impact Auditing (IA) brings about care for the natural environment and the need to "identify predict and audit the impact on the environment and on man's health and well-being as legislative proposals, policies, programmes, projects and operational procedures and to interpret and communicate information about the impacts" Doe (1989).

There is an increasing stress on nature arising from population growth. The EIA procedure ensures that the environmental consequences of projects are identified and monitored audited after the project is executed. All these developmental activities impact on the state of the environment and have significantly contributed to environment deterioration. For sustainability, overall management of mineral and natural resources remains a primary assignment of any responsible government or community through it's various agencies. Various government agencies are waking up to ensure strict compliance with environmental laws. With comprehensive measure to mitigate any negative impact, man is set to reclaim it lost resources.

2.1.1. **Environmental Impact Statement**

The impact statement documents the information and estimates of impact derives from the various steps in the process. Prevention is better than cure; and EIS revealing many significant unavoidable adverse impacts would provide valuable information that could contribute to the abandonment or substantial modification of a proposed development action. Where adverse impacts can be successfully reduced through mitigation measures, there may be a different decision.

The non-technical summary is an important element in the documentation, EIA can be complex, and the summary can help improve communication with the various parties involved. Reflecting the potential complexity of the process, a methods of statement at the beginning, provides an opportunity to clarify some basic information (e.g who the developer is, who has produced EIS, who has been consulted as how, what method has been used, what difficulties have been encountered and what limitations of EIA are).

A summary statement of key issues, up front can also help to improve communications. A more enlightened EIS would also include a monitoring programme, either here or at the and of the document. The background to the proposed development covers the early steps in the EIA process, (including clear descriptions of a project, and baseline condition including relevant planning policies and plans). With each of the topic

areas of an EIS there would normally be a discussion of existing conditions, predicted impacts, scope for mitigation and residual impacts.

EIA and EIS practices vary from study, from country to country and best practice is constantly evolving. A recent UN study of EIA practice in several countries advocated changes in the process and documentation (UN economic commission for Europe, 1991). These included going a greater emphasis to the socio economic dimension, to public participation, and to after the "decision" activity, such as monitoring.

2.1.2 **Reasons for Assessment and Auditing of Impact**

Having seen the possible consequences of failure and how they happen in earth dam, reasons for impact auditing are obvious. The followings are reason for impact assessment and auditing.

1. In decision making, impact assessment provide examination of environmental implications of a proposed action, and sometimes alternatives before decisions are taken.
2. Impact assessment is an aid to formulation of development action, because it provide framework for considering location, design issues and environmental issue in parallel. Indicating areas where a project can be modified to minimize or eliminate altogether its adverse impacts on the environment. This lead to environmentally sensitive development.

3. It provide platform for sustainable development i,e how much better it would be to mitigate the harmful effects in advance, at the planning stage, or in some cases avoid the particular development.

This is the underlying purpose of EIA as one of the instrument to achieve sustainable development: development that does not cost the earth! Existing environmentally harmful developments have to be managed as best they can. In extreme cases they have to be closed down. Prevention is better then cure. Economic and social development must be placed in their environmental context. Boulding (1966) vividly portrays the dichotomy between the "throughout economy" and the "spaceship economy" as shown in Fig 2.0, the economic goals of increased GNP, using more imputs to produce more goods and services, contains the seed of its own destruction. Increased output brings with it not only goods and services but also more waste products. Increased inputs demand more resources.

The interaction of economic and social development with the natural environment and the reciprocal impacts between human action and the biophysical world have been recognized by governments from local to international level, though these seems to be different in Africa where democratic ideas seens to be out of show due to prolong military rule.

For every large project, it's expected that impact assessment should be done for reasons stated above. This notwithstanding, the need to monitor the performance of such project cannot be overemphasised. This is how negative impact can be averted or reduced.

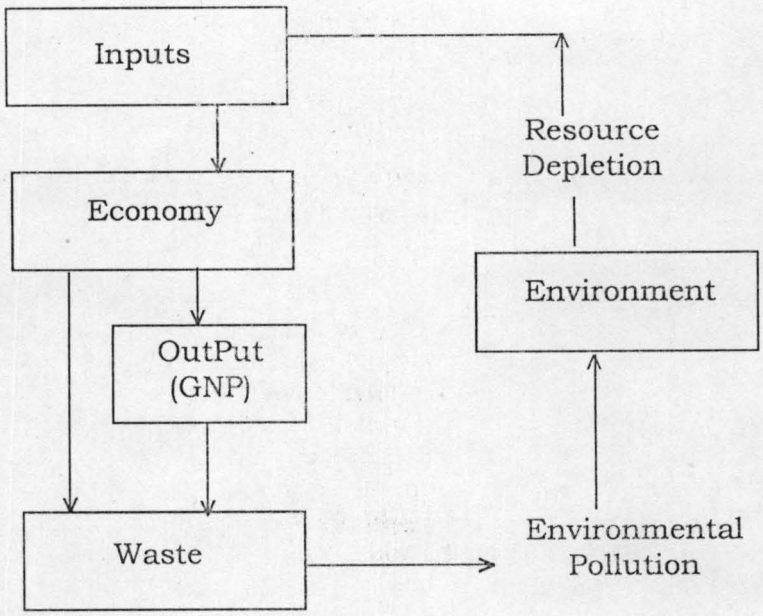


Fig. 2.0 The economic development process in its environmental context
Source: Boulding 1966

The 1987 Report of the World Commission on Environment and Development defined sustainable development as "development which meet the needs of the present generation without compromising the ability of future generations to meets thier own needs" sustainable development means handing down to future generation not only "man made capital" such as roads, school, historic buildings and "human capital such as knowledge and skills but also "natural environmental capital," such as clear air, fresh water, the Ozone layer, and biological diversity. The chart in fig 2.1 explain this concepts.

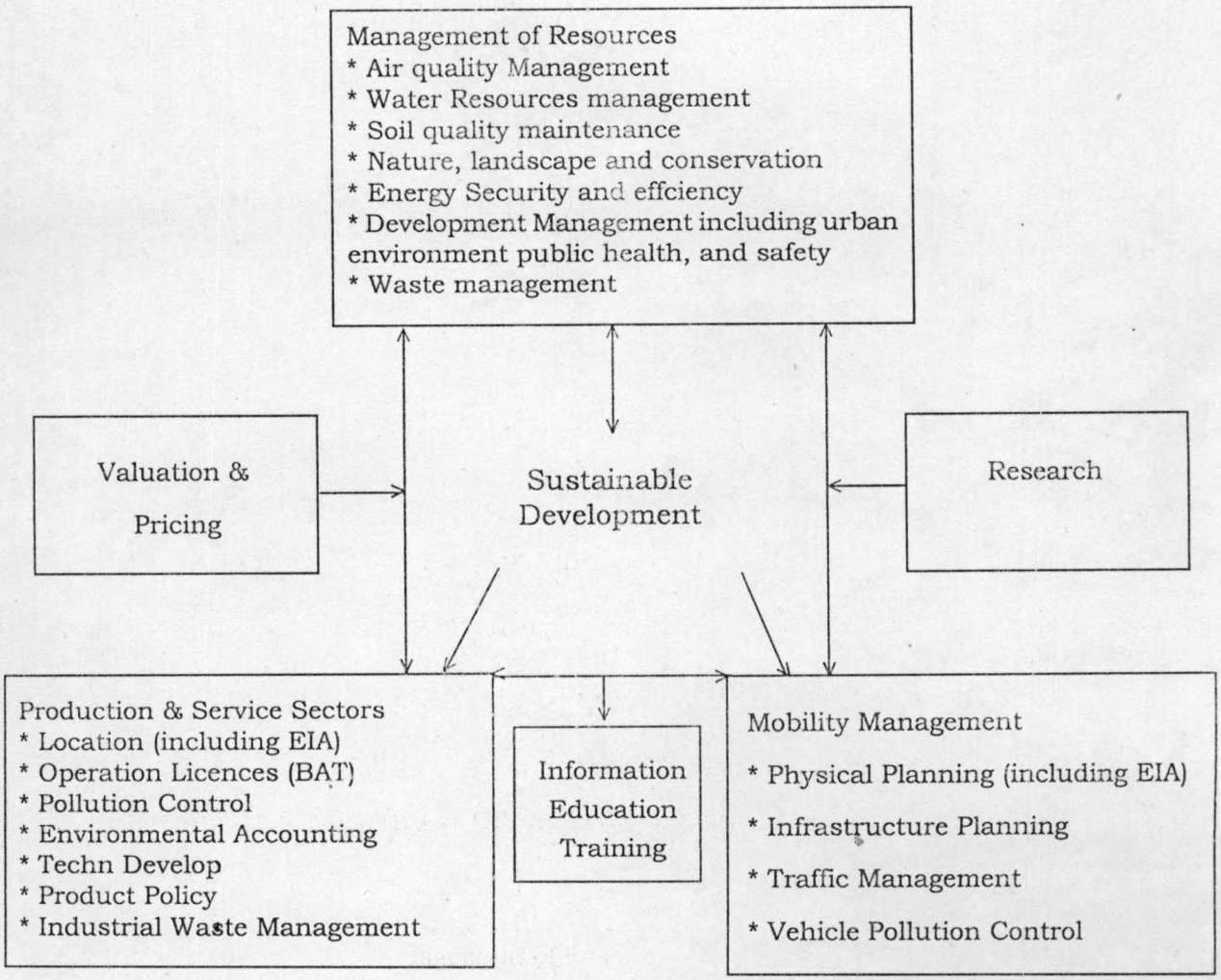


Fig. 2.1 An EC Framework for sustainable development (CEC, 1992)

2.1.3 **Project, Environment and Impacts**

The nature of major projects

Traditionally, EIA is all about projects that are small and especially bigger ones. What are major projects, and what criteria can be used to identify them. One could take Lord morely's approach to defining an elephant:

It's difficult, but you easily recognise one when you see it. In similar vein, the acronym Lulu (locally unacceptable land-uses) has been applied in the USA to many projects, such as in energy, transport and manufacturing, cleary reflecting the public perception of the negative impacts associated with such developments.

2.1.4 **Characteristics of Major projects**

- Substantial capital investment
- Cover large areas, employ large members
- Complex array of organizational link
- Wide-range of impacts (geographical & others)
- Signficant economic impact
- Requires special procedures
- Extractive and primary (including agriculture) services; infrastructure and utilities.
- Band, point – Power Station, dam or linear infrastructure includes electricity trans. Lines roads and canals.

The environment is the "Sink" for the wastes and the "source" for the resources. Environmental pollution and deplection of resources are invariably the ancillaries for economic development . The environmental impact of a project are those resultant changes in the environmental parameters in space, time and land compare with what would have happen had the project not been undertaken. These impacts are short run and long run and should be well known ahead of time.

A major project also has a planning and development life cycle, including a variety of stages. It is important to recognize such stages, because impacts can vary considerably between them. The main stages in a project's life-cycle are outlined in fig. 2.2 there may be variations in timing between stages, and internal variations within each stage, but there is a broadly common sequence of events. In EIA, and important distinction is between "before the decision" (stage A and B) and after decision" (stages C, D and E). In most cases, the monitoring and auditing of the implementation of a project following approval are often absent from the EIA process.

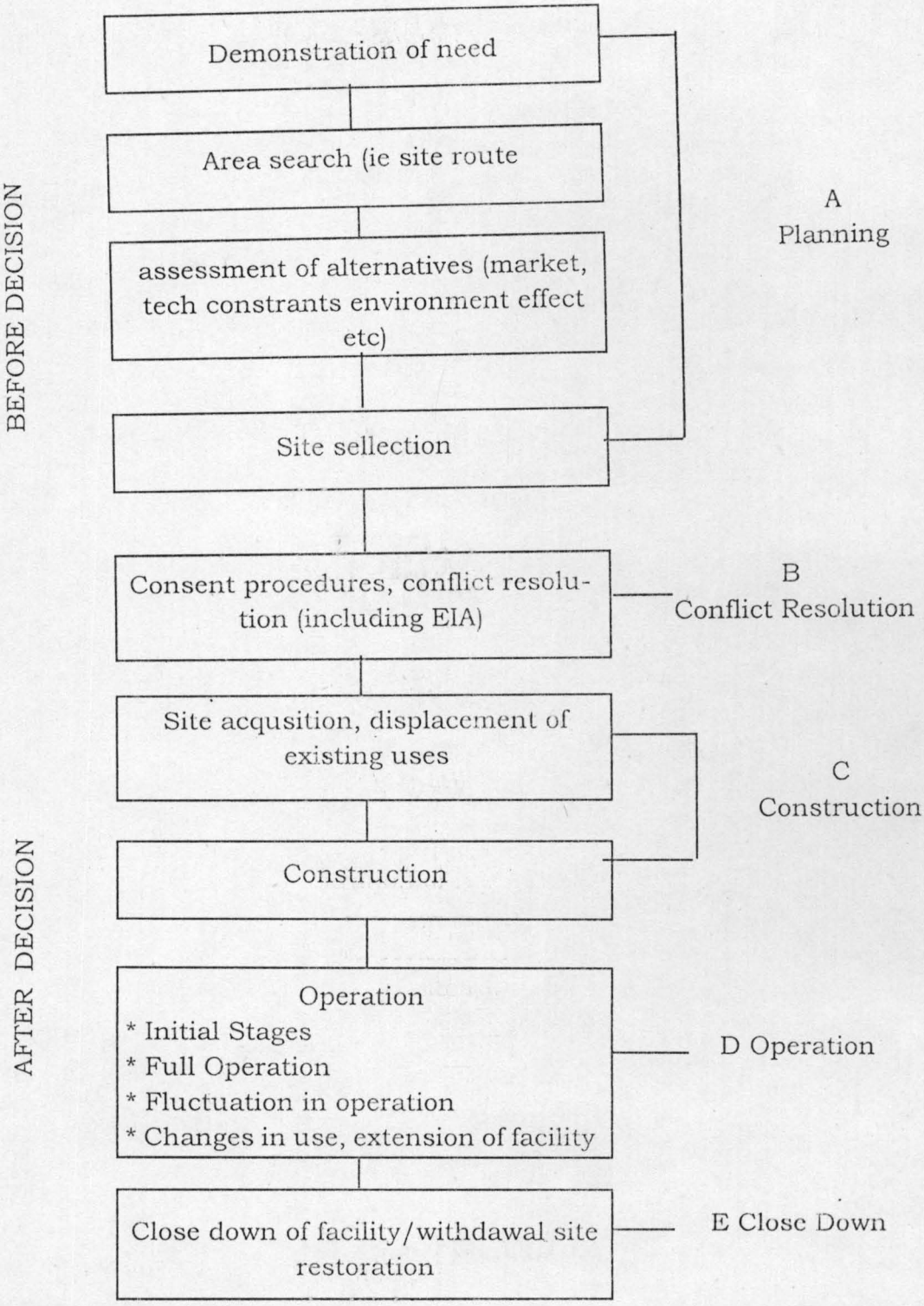


Fig. 2.2 Generalised Planning and development life-cycle for major projects
Source John G. et al (2nd ed.) London.

Environmental Components Affected by Impacts - Physical Environment

Air and Atmosphere - Air quality

Water resources and water bodies – Water quality & quantity.

Soil and Geology – classification, risk (erosion and contamination).

Flora and Fauna – Birds, mammals, fish, aquatic and terrestrial vegetation.

Human Being – Physical and metal health and well being.

Landscape – Characteristics and quality of landscape.

Cultural Heritage – Conservation areas; built heritage, historical and archeological sites.

Climate – Temperature, rainfall, wind etc

Energy – Light, Noise, Vibration etc.

Socio-Economic Environment

Economic Base – Direct employment, labour market characteristic local and non local trends.

Economic Base – Indirect – non basic and service employment, labour supply and demands.

Demography – Population structure and trends

Housing – Supply and demand

Local Services – Supply & demand of service: health, education, police

Socio-Cultural – Lifestyle, quality of life, social problems (e.g crime) community stress and conflict.

Dimensions of the Environment

The environment is structured in several/ways, including components, scale/space and time. A narrow definition of environmental components would focus primarily on the biophysical environment. Environment takes the term to include all media susceptible to pollution, including air, water, and soil; flora and fauna and human beings: landscape, urban and rural conservation and the built heritage. Fig 2.3 provides a simple, illustration of the concept:

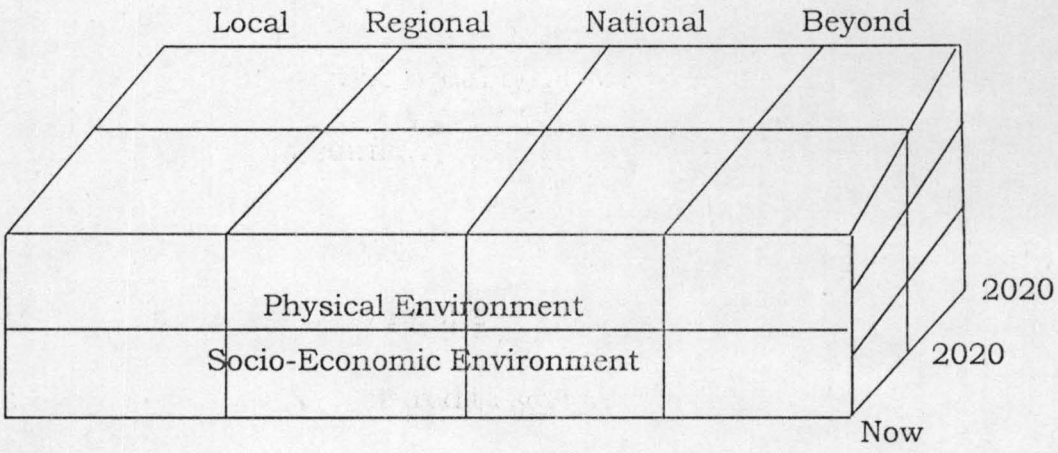


Fig. 2.3 Environment: Components, Scale and Time Dimension

The Nature of Impacts

The environmental impacts of a project are those resultant changes in environment parameters, in space and time, compared with what would have happened had the project not been undertaken. The impact auditing are those impacts that have taken place or are taking place as a result of the project. The parameters may be any of the type of environmental receptors noted previously: air quality, water quality, noise, levels of local unemployment and crime.

These are often seen as synonymous with adverse and beneficial. Thus, new developments may produce harmful wastes but also produce much needed jobs in areas of high unemployment. However, the correlation does not always apply.

A project may bring physical benefits when, for example, previously polluted and derelict land is brought back into productive use; similarly the socio-economic impacts of a major project on a community could include pressure on local health services and on the local housing market, increase in community conflict and crime. Projects may also have immediate and direct impacts that give rise to secondary and indirect impact later.

A reservoir based on a river system not only takes land for immediate body of water but also may have severe downstream implication for flora and fauna and for human activities such as fishing and sailing. The direct

and indirect impacts may sometimes correlate with short and long run impacts. For some impacts the distinction between short-run and long-run may also relate to the distinction between a project's construction and its operational stage; however, other construction stage impacts, such as change in land use, are much more permanent. Impacts also have a spatial dimension. One distinction is between local and strategic, the latter covering impacts on areas beyond the immediate locality. These are often regional, but may sometimes be of national or even international significant.

Environmental resources cannot be replaced once destroyed, some may be lost forever. The distinction between reversible and irreversible impacts is a very important one, and the irreversible impacts not susceptible to mitigation, can constitute particular significant impact in an EIA. It may be possible to replace, compensate for or reconstruct a lost resource in some cases, but substitutions are really ideal. Although a particular project may be assessed as bringing a general benefit, some groups and/or geographical area may be receiving most of the adverse effect, the main benefits going to others elsewhere. Finally, all impacts should be compared with the "do-nothing" situation, and the state of the environment predicted without the project. This can be widened to include companions with anticipated impacts alternative development scenarios for an area When project initiated, its operation has either adverse or positive impact on the

the enviroment. These impact on the environment can be demonstrated by the fig. 2.4. (Source John G. et al (2nd ed.) London.

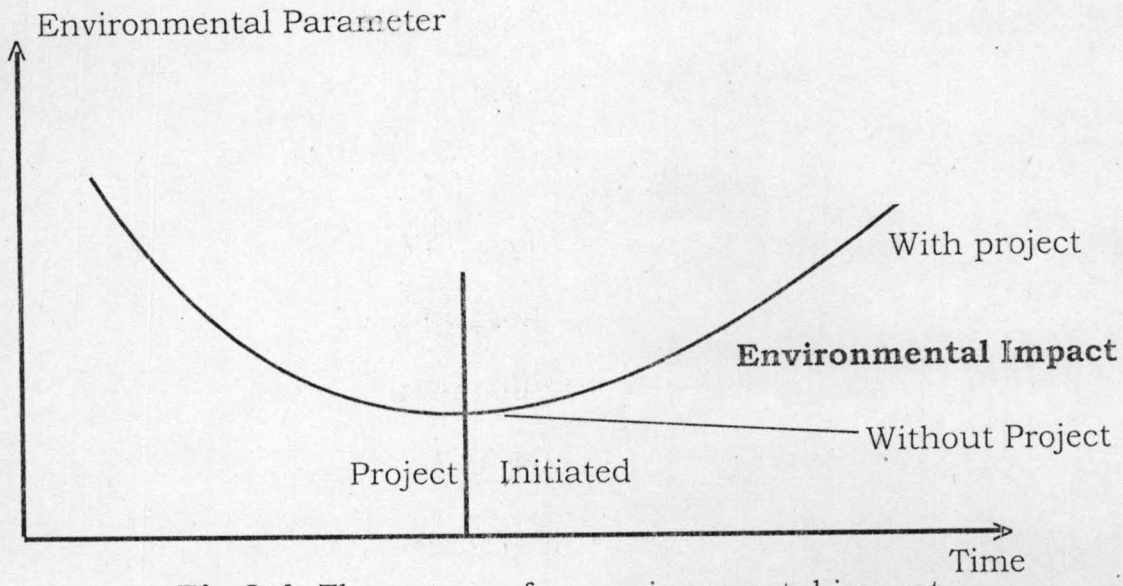


Fig 2.4 The nature of an environmental impact

2.1.4 Impact Identification

Aims and Method

Impact identification brings together project characteristics and baseline environmental characteristics with the aim of ensuring that all potentially significant environmental impacts (adverse or favourable) are identified and taken into account in the EIA process. A wide range of methods have been developed. "Should be considered as a healthy condition in a newly formed and growing discipline." When choosing a method, the analyst need to consider more specific aims, some of which conflict.

- To ensure compliance with regulations;
- To provide a comprehensive coverage of all range of impacts, includ-

ing social, economic and physical;

- To distinguish between positive and negative, large or small long term and short terms, reversible and irreversible impacts;
- To distinguish between significant and insignificant impacts;
- To allow a companion of alternative development proposal;
- To consider impacts within the constraints of an area's carrying capacity;
- To incorporate qualitative as well as quantitative information;
- To be easy and economical to use;
- To be unbiased and to some consistent results
- To be use in summarizing and presenting impacts in the EIS.

Many of the methods were developed in response to the NEPA and have since been expanded and refined. The simplest involve the use of lists of impacts to ensure that none has been forgotten. The most complex include the use of interactive computer programme, networks showing energy flows and schemes to allocate significance weightings to various impacts. Many of these complex methods were developed for (usually US) government agencies that deal with large numbers of fairly similar project types (eg the US Bureau of Land Reclamation and the US forest service).

The section presents range of these methods from simplest check lists needed for complained with regulations to complex approaches that developers, consultants and academics who aim to further "best practice"

may wish to investigate further. These are:

- Checklists
- Matrices
- Quantitative Methods
- Networks
- Overlay maps

The discussion of the methods here relates primarily to impact identification, but most of the approaches are also considerable (and sometimes more) use in other stages of the EIA process in impact prediction, evaluation, communication, mitigation, presentation, monitoring and auditing.

CHECKLIST

Decriptive Checklist gives guidance on how to access impacts. They can include data requirements, information sources and predictive techniques (An Schaeman 1976). A example is shown in Table 2.0.

Table 2.0 PART OF DESCRIPTIVE CHECKLISTS

DATA REQUIRED	INFORMATION SOURCES PREDICTION TECHNIQUES
Nuisance Changes in occurrence of odour, smoke, haze, etc, and number of people affected.	Expected industrial process and traffic volumes, citizen surveys
Water Quality For each body of water, changes in water uses, and number of people affected	Current water quality, current and expected effluent.
Noise Change in noise levels, frequency of occurrence, and number of people bothered.	Current noise levels, changes in traffic or other noise sources, changes in noise mitigation measures, noise propagation models citizen survey.

Source: Schaeman, 1976

Most checklists are based on a list of special biophysical, social and economic factors that may be affected by a development. The simple checklist can help only the identify impacts and ensure that impacts are not

over looked. Checklists do not usually include direct cause-effect links to project activities. Nevertheless, they have the advantage of being easy to use. A simple examples of checklist is the table below:

Questionnaire Checklist are based on a set of questions to be answered. Some of the questions may be concern indirect impacts and possible mitigation measures. They may also provide a scale for classifying estimated impacts, from highly adverse to highly beneficial. See Table 2.2

TABLE 2.2: Part of a questionnaire checklist adapted from US agency for internal development (1981).

Disease Vectors	
(a) Are there known disease problem in the project area transmitted through vector species such as mosquitoes, flies, snail, etc.?	Yes no not known
(b) Are these vector species associated with • Acquatic habitat? • Forest habitat • Agricultural habitat	 Yes no not known Yes no not known Yes no not known
(c) Will the project provide opportunities for vector control through improved standard of living? Estimate impact on disease vector High adverse --- insignificance ---high benefits	Yes no not known

Source: Us Agency for Development (1981)

Threshold of Concern Checklist

Consist of a list of environmental components and for each component, a threshold at which those assessing a proposals can be seen by examining the number of lines that an alternative exceeds the threshold of concern. For example, fig – shows part of a checklist developed by the US forest service, if compares three alternative development proposals on the basis of various components. For the component of economic efficiency, a benefit cost ratio of 1:1 is the threshold of concern; for spotted

owls, 35 pairs is the threshold. In the example, alternative X cause two threshold of concern to be exceed, alternative Y one, alternative Z four, this would indicate that alternative Y is the least detrimental. Impacts are also rated according to their duration. A for 1 year or less, B for 1 – 10 years, C for 10 – 50 yrs, and D for irreversible impacts of the impacts listed, a reduction in the number of spotted owls would be irreversible, and the other impacts would last 10 – 50 yrs (Sassman 1981).

Table 2.2: Part of a threshold of concern TOC checklists (Sassaman 1981).

Environmental Component	Criterion	TOC	AHX Imp/imp> TOC?	AHY Imp/imp> TOC?	AHZ Imp/imp> TOC?
Air Quality	Emission Standard	1	2 C yes	1 C no	RC yes
Economic	Benefits: cost ratio	1:1	3:1 no	4:1 no	2:1 no
Endangered species	No. paris of spotted owls	35	50D no	35D no	20D no
Water Quality	Water quality standard	1	1C no	2C yes	2C yes
Recreation	No camping site	5000	2800C yes	5000C no	3500C yes

Source: Sassaman, 1981

Matrices

Matrices are the most commonly used method of impact identification in EIA. Simple matrices are merely two dimensional charts showing environmental components on one axis and development actions on the other. They are, essentially, expansions of checklists that acknowledges the fact that various components of a development project (e.g construction, operation, de-comissioning, building, access road) have different impacts. An action likely to have an impact on an environmental component is identified by placing across in the appropriate cell.

The main advantage is the incorporation of causes effect relationships. The example show below is a simple matrix. Three dimentional matrices have also been developed in which the third dimension refers to economic and social institutions: such an approach identifies the institution from which data are needed for the EIA process, and highlights areas in which knowledge is lacking.

The time dependent matrix (e.g parker and Haward 1987) includes a number sequence to represent the time scale of the impacts (e.g one figure per year) The below example in fig. 2.3 shows an examples, where magnitude is represented by numbers from O (none) to 4 (high), over the course of seven years.

Environmental comonent	Project action				
	Construction (3 years)		Operation (25 years, evens out after 4 years)		
	Utilities	Residential and commercial buildings	Residential buildings	Commercial buildings	Parks and open spaces
Soil and geology	211	321	0000	0000	0001
Flora	221	422	1223	1111	1123
Fauna	221	311	1100	1100	1122
Air quality	000	000	0123	0034	0011
Water quality	010	022	1223	0111	0000
Population density	011	112	2344	0222	0011
Employment	120	342	1111	1334	1111
Traffic	220	332	2333	2333	1111
Housing	010	121	2344	0000	0000
Community structure	010	232	2344	1111	1233

Figure 2. 5 Part of a time-dependent matrix.

Environmental comonent	Project action				
	Construction		Operation		
	Utilities	Residential and commercial buildings	Residential buildings	Commercial buildings	Parks and open spaces
Soil and geology	•	•			
Flora	•	●			○
Fauna	•	•			○
Air quality				•	
Water quality	○	•	•		
Population density			○	○	
Employment		○		○	
Traffic	•	•	•	●	
Housing			○		
Community structure		•	○		○

• = small negative impact
● = large negative impact
○ = small positive impact
○ = large positive impact

Figure 2. 6 Part of a magnitude matrix.

Magnitude matrices (go beyond the mere identification of impacts by describing medium, or long-term (fig 2.6). - is an example of a magnitude matrix. The best known type of quantified matrix is the Leopold et al. (1971). It is based on a horizonal list of 100 project actions and a vertical list of 88 environmental components.Fig. 2.7 (Parker & Howards, 1977).

Fig. 2.7 shows a section of this matrix and lists all its elements of the 8,800 possible interactions between projects action and environmental components Leopold et al. estimated that an individual project is likely to result in 25 – 50. In each appropriate cell, two numbers are recorded, the number in the top left hand corner represents the impact's magnitude, from +10 (very positive) to – 10 (very negative). That in the bottom right-hand corner represents the impact significance, from 10 (very significant) to 1 (insignificant); there is no negative significance is important: and impact could be large but insignificant, or small but significant for instances, in ecological terms, paving over a large field of intensively used farmland may be quite insignificant compared with the destruction of even a small area of a SSSI.

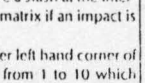
The Leopold matrix is easily understood can be applied to a wide range of developments, and is reasonably comprehensive for first – order, direct impacts. However, it has disadvantages. The fact that it was designed for use on any one project. It cannot reveal indirect effects of developments. Like checklists and most other matrices, it dose not relate environmental components that lead to indirect impacts are not assessed. The inclusion of magnitude/significance scores has additional drawbacks: it gives no indication whether the data on which these values are based are qualitative or quantitative; it does not specify the probability of an impact occurring; it excludes distant of the techniques used to predict impacts; and

the scoring system is inherently subjective and open to bias. People may also attempt to add the numerical values to produce a composite value for the development's impacts and compare this with that for other developments; this should not be done because the matrix does not assign weighting to different impacts to reflect their relative importance.

Weighted Matrices were developed in an attempt to respond to some of the above problems. Importance weightings are assigned to environmental components, and sometimes to project components. The impact of the project (component) on the environmental component is then assessed and multiplied by the appropriate weighting(s), to obtain a total for the project Table 2.6 shows a small weighted matrix that compares three alternative project importance weighting (a) relative to other environmental components; in the example, air quality is weighted 21 percent of the total environmental components. The magnitude (c) of the impact of each project on each environmental component is then assessed on scale 0 –10, and multiplied by (a) to obtain a weighted impact (a) x (c) for instance, site A has AC impact of 3 out of 10 on air quality, which is multiplied by 21 to give the weighted impact, 63. For each site with the lowest total in this case is site B, is the least environmentally harmful.

(a)

1. Identify all actions (located across the top of the matrix) that are part of the proposed project
2. Under each of the proposed actions, place a slash at the intersection with each item on the side of the matrix if an impact is possible
3. Having completed the matrix, in the upper left hand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact; 10 represents the greatest magnitude of impact and 1, the least (no zeroes). Before each number place + (if the impact would be beneficial). In the lower right hand corner of the box place a number from 1 to 10 which indicates the IMPORTANCE of the possible impact (e.g. regional vs. local); 10 represents the greatest importance and 1 the least (no zeroes)
4. The text which accompanies the matrix should be a discussion of the significant impacts, those columns and rows with large numbers of boxes marked and individual boxes with large numbers



Sample matrix

			A. Modification of regime													B. Land transformation and construction																			C. Resource extraction						
			a. Exotic flora or fauna introduction	b. Biological controls	c. Modification of habitat	d. Alteration of ground cover	e. Alteration of ground water hydrology	f. Alteration of drainage	g. River control and flow modification	h. Canalization	i. Irrigation	j. Weather modification	k. Burning	l. Surface or paving	m. Noise and vibration	a. Urbanization	b. Industrial sites and buildings	c. Airports	d. Highways and bridges	e. Roads and trails	f. Railroads	g. Cables and lifts	h. Transmission lines, pipelines, corridors	i. Barriers including fencing	j. Channel dredging and straightening	k. Channel revetments	l. Canals	m. Dams and impoundments	n. Piers, seawall, marinas and sea terminals	o. Offshore structures	p. Recreational structures	q. Blasting and drilling	r. Cut and fill	s. Tunnels and underground structures	a. Blasting and drilling	b. Surface excavation	c. Subsurface excavation and retorting	d. Well drilling and fluid removal	e. Dredging	f. Clear cutting and other lumbering	g. Commercial fishing and hunting
	Proposed actions																																							
CHEMICAL CHARACTERISTICS	1. Earth	a. Mineral resources																																						
		b. Construction material																																						
		c. Soils																																						
		d. Land form																																						
		e. Force fields and background radiation																																						
		f. Unique features																																						
	2. Water	a. Surface																																						
		b. Ocean																																						
		c. Underground																																						
		d. Quality																																						
		e. Temperature																																						
		f. Recharge																																						
		g. Snow, ice and permafrost																																						

(b)

Part 1. Project actions

A. Modification of regime
a) exotic flora or fauna introduction
b) Biological controls
c) Modification of habitat
d) Alteration of ground cover
e) Alteration of groundwater hydrology
f) Alteration of drainage
g) River control and flow modification
h) Canalization
i) Irrigation
j) Weather modification
k) Burning
l) Surface or paving
m) Noise and vibration

B. Land transformation and construction
a) Urbanization
b) Industrial sites and buildings
c) Airports
d) Highways and bridges
e) Roads and trails
f) Railroads
g) Cables and lifts
h) Transmission lines, pipelines and corridors
i) Barriers, including fencing
j) Channel dredging and straightening
k) Channel revetments
l) Canals
m) Dams and impoundments
n) Piers, seawalls, marinas, and sea terminals
o) Offshore structures
p) Recreational structures
q) Blasting and drilling
r) Cut and fill
s) Tunnels and underground structures

C. Resource extraction
a) Blasting and drilling
b) Surface excavation
c) Subsurface excavation and retorting
d) Well drilling and fluid removal
e) Dredging
f) Clear cutting and other lumbering
g) Commercial fishing and hunting

D. Processing
a) Farming
b) Ranching and grazing
c) Feed lots
d) Dairying
e) Energy generation
f) Mineral processing
g) Metallurgical industry
h) Chemical industry
i) Textile industry
j) Automobile and aircraft
k) Oil refining
l) Food
m) Lumbering
n) Pulp and paper
o) Product storage

E. Land alteration
a) Erosion control and terracing
b) Mine sealing and waste control
c) Strip-mining rehabilitation
d) Landscaping
e) Harbour dredging
f) Marsh fill and drainage

F. Resource renewal
a) Reforestation
b) Wildlife stocking and management
c) Groundwater recharge
d) Fertilization application
e) Waste recycling

G. Changes in traffic
a) Railway
b) Automobile
c) Trucking
d) Shipping
e) Aircraft
f) River and canal traffic
g) Pleasure boating
h) Trails
i) Cables and lifts
j) Communication
k) Pipeline

H. Waste emplacement and treatment
a) Ocean dumping
b) Landfill
c) Emplacement of tailings, spoil and overburden
d) Underground storage
e) Junk disposal
f) Oil well flooding
g) Deep well emplacement
h) Cooling water discharge
i) Municipal waste discharge, including spray irrigation
j) Liquid effluent discharge
k) Stabilization and oxidation ponds
l) Septic tanks, commercial and domestic
m) Stack and exhaust emission
n) Spent lubricants

I. Chemical treatment
a) Fertilization
b) Chemical de-icing of highways, etc.
c) Chemical stabilization of soil
d) Weed control
e) Insect control (pesticides)

J. Accidents
a) Explosions
b) Spills and leaks
c) Operational failure

Others

Part 2. Natural and human environmental elements

A. Physical and chemical characteristics
1. Earth
a) Mineral resources
b) Construction material
c) Soils
d) Landform
e) Force fields and background radiation
f) Unique physical features
2. Water
a) Surface
b) Ocean
c) Underground
d) Quality
e) Temperature
f) Recharge
g) Snow, ice and permafrost
3. Atmosphere
a) Quality (gases, particulates)
b) Climate (micro, macro)
c) Temperature
4. Processes
a) Floods
b) Erosion
c) Deposition (sedimentation, precipitation)
d) Solution
e) Sorption (ion exchange, complexing)
f) Compaction and settling
g) Stability (slides, slumps)
h) Stress-strain (earthquakes)
i) Air movements

B. Biological conditions
1. Flora
a) Trees
b) Shrubs
c) Grass
d) Crops
e) Microflora
f) Aquatic plants
g) Endangered species
h) Barriers
i) Corridors
2. Fauna
a) Birds
b) Land animals, including reptiles
c) Fish and shellfish
d) Benthic organisms
e) Insects
f) Microfauna
g) Endangered species
h) Barriers
i) Corridors

C. Cultural factors
1. Land use
a) Wilderness and open spaces
b) Wetlands
c) Forestry
d) Grazing
e) Agriculture
f) Residential
g) Commercial
h) Industrial
i) Mining and quarrying
2. Recreation
a) Hunting
b) Fishing
c) Boating
d) Swimming
e) Camping and hiking
f) Picnicking
g) Resorts
3. Aesthetics and human interest
a) Scenic views and vistas
b) Wilderness qualities
c) Open space qualities
d) Landscape design
e) Unique physical features
f) Parks and reserves
g) Monuments
h) Rare and unique species or ecosystems
i) Historical or archaeological sites and objects
j) Presence of misfits
4. Cultural status
a) Cultural patterns, lifestyle
b) Health and safety
c) Employment
d) Population density
5. Man-made facilities and activities
a) Structures
b) Transportation network (movement access)
c) Utility networks
d) Waste disposal
e) Barriers
f) Corridors

D. Ecological relationships, such as
a) Salinization of water resources
b) Eutrophication
c) Disease – insect vectors
d) Food chains
e) Salinization of surficial material
f) Brush encroachment
g) Other

Others

(a) Part of Leopold Matrix; (b) Leopold Matrix elements.

Fig. 2.7 Part of Leopard Matrix and its elements

Table 2.5 Weighted Matrices

Environmental Component	(a)	Alternative Sites					
		Site A		Site B		Site C	
		(c)	ax c	(c)	ax c	(c)	ax c
Air Quality	21	3	65	5	105	3	63
Water Quality	42	6	252	2	84	5	210
Noise	9	5	45	7	63	9	81
Ecosystem	28	3	140	4	112	3	84
Total	100		500		364		438

(a) = Relative weighting of environment component total (100)

(c) = Impact of project at particular site on environmental component (0 – 10)

Quantitative methods attempts to compare the relatives importance of all impacts by weighting, standardizing and aggregating them to produce a composite index. The best known of these methods is the environmental evaluation system (EES), densed by the battele coulombs lab. For the Bureau of land Reclamation to assess water resources developments, highways, nuclear power plants and other projects, (Dee et al. 1973). It consist of checklist of 74 environmental, social and economic parameters that may be effected by a proposal; these are shown in fig 2.7 it assumes that these parameters can be expressed numerically and that they represent an aspect of environmental quality. For instance, the concentration of dissolved oxygen is a parameter that represents an aspect of the quality

of an aquatic environment. For each parameter functions were designed by experts to express environmental quality on a scale 0 – 1 (degraded – high quality stream with more 10mg/I of dissolved oxygen is felt to have a high level of environmental quality (1.0), where as one with only 4mg/l is felt to have an environmental quality of 0.35. Impacts are measured in terms of the likely change in environmental quality for each parameter two environmental quality scores are determined for each parameter, for the current state of the environment and one for the state predicted once the current state of the environment and one for the state predicted once the project is in operation. If the post development score is lower than the pre-development score, the impact is negative, and vice versa. To enable impacts to be compared directly, each parameter is given an importance weighing, which is the multiplied by the appropriate environmental quality score. The important weighting are determined by having a panel of experts distributed 100 points among the parameters.

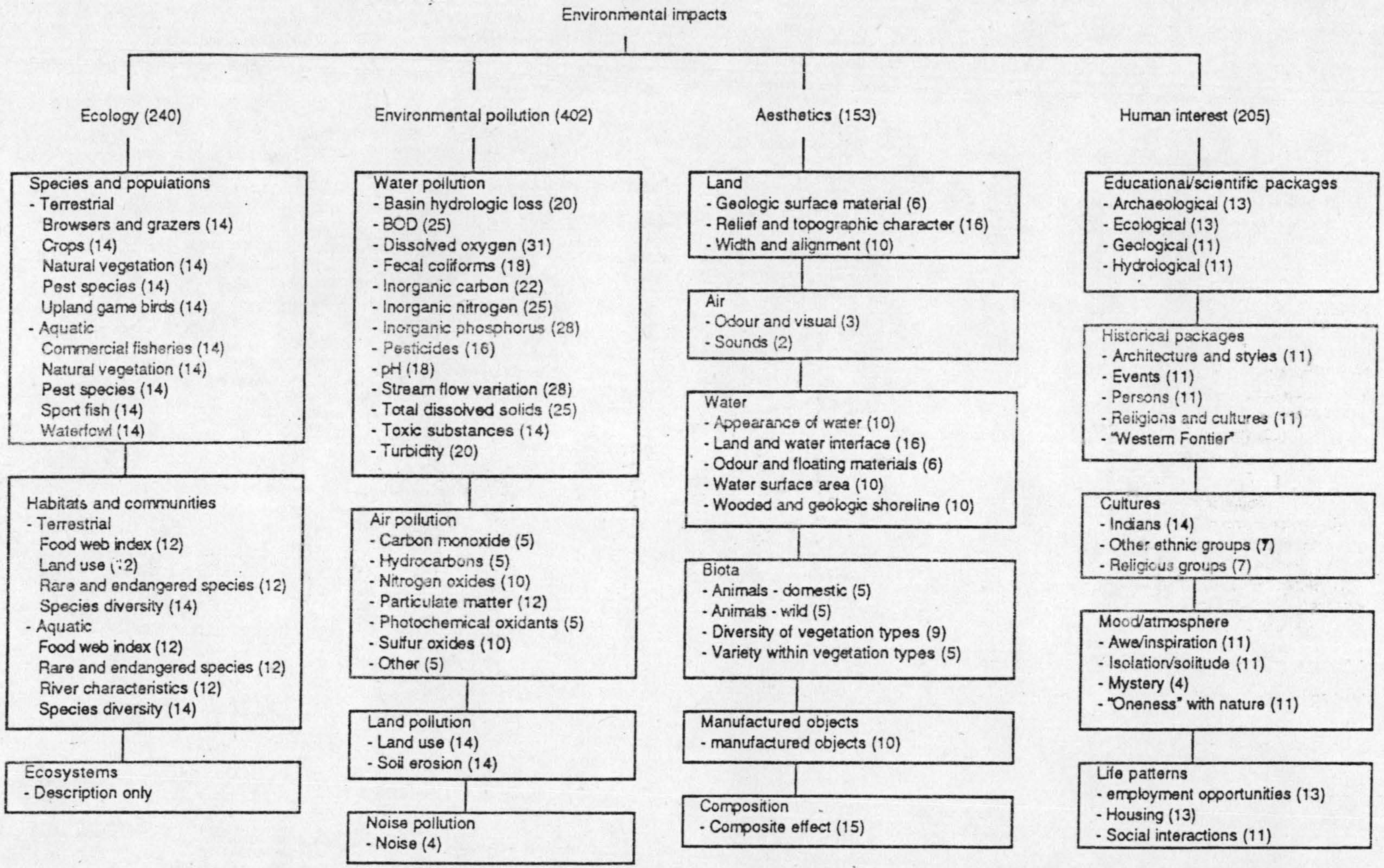


Fig. 2.8 Framework for the Battelle Environmental Evaluation system.
(Source: John G. et al (2nd ed.), London

Assessment of Effects as outlined in UK regulations

Assessment of Effect (including direct and indirect, secondary, commulative, short, medium, and long-term, permenant and temporary, positive and negative effects of projects).

Effects on Human Beings, Building and man-Made features

1. Changes in populations arising from development, and consequential environmental effect.
2. Visual effect of the development on the surrounding area and landscape.
3. Levels of effect on emission from the development during normal operation.
4. Levels and effect of noise from the development
5. Effects of the development on local roads and transport
6. Effects of the development on building, the architectural and historical heritage, archeological features, and other human artifacts e.g through pollutants, visual intrusion, vibration.

Effects on Flora, Fauna and Geology

7. Loss of, and damage to, habitants and plants and animal species
8. Loss of, and damage to, geological, palaeotological and physiographic features.
9. Other ecological consequences

Effects on Land

10. Physical effects of the development e.g changes in local topography, effect on earth moving on stability, soil erosion, etc.

11. Effects of chemical emissions and deposits on soil of site and surrounding land.

Land-use/resources effects

12. (a) Quality and quantity of agricultural land to be taken.

(b) Sterilization of mineral resources

(c) Other alternative use of the site, including the "do nothing" option.

(d) Effects on surrounding land-uses including agriculture.

(e) Waste Disposal

Effect on Water

13. Effects of development on drainage pattern in the area.

14. Changes to other hydrographic characteristics e.g ground water level, water courses, flow of underground water.

15. Effects of coastal or estuarine hydrology

16. Effects of pollutants, waste, etc on water quality.

Effects on Air and Climate

17. Level and concentration of chemical emissions and their environmental effects.

18. Particulate matter

19. Offensive odours

20. Any other climatic effects.

Other Indirect and Secondary effects associated with Projects

21. Effects from traffic (road, rail, air, water) related to the development.

22. Effects arising from the extraction and consumption of materials, water, energy or other resources by the development.

23. Effects of other development associated with the project of new roads, sewers, housing, power lines, pipelines, telecommuncations, etc.

24. Effects on association of the development with other existing or proposed development.

25. Secondary effects resulting from the interaction of separate direct effects listed above.

If a dam is faithfully built it will have a very long life though it may not last indefinitely. It's ability to cope with forces around is a major determiner of its lifespan.

In construction of dam, not only the above should be a major factor, but tax prayers who clamour for quick returns and economic evaluation should play dominant role when choosing and constructing a dam. A dam definitely has both negative and positive impact on the host environment even though no one can create a condition which he purposely know will

destroy him or the environment. Most at time in solving a problem another problem is created.

Environmental consequences of dams refer to the chemical, physical, organic and non-organic dangers in the environment as a result of dam development. By stopping or retarding temporarily the flow of water alters the local environment, quantitatively and qualitatively of the river.

Impounding of water causes alteration in the modes of existence of the flora, fauna and other organisms. This also changes the physical and the chemical characteristic of water temporarily and partially. In evaluating the environmental consequences of damming, it is important to consider the entire stretch of the catchment areas upstream and the discharged areas downstream of the river basin. There are three areas of influences of a dam and these include:

1. The reservoirs and catchment upstream
2. The dam embarkment including foundations and abutments
3. The downstream river and off-river areas.

2.1.7 Extending EIA to project operations: environmental management system and environmental audits

1. Less inspiring, but considerably more implemented is the application of environmental management system (EMS) and environmental auditing. EMS, Like EIA, is a tool which helps organizations to

take more responsibility for their actions, by determing their aims, putting them into practice and monitoring whether they are bing achieved. However, in contrast with the orientation of EIA to future development actions, EMS involves the review, assessment and incremental effect EMS can thus be seen as a continuation of EIA Principle not the operational stage of a project. EMS has envolved from environmental audits, which were first carried out in the 1970s by private firms in the USA for financial and legal reasons, as an extention of financial audit. Auditing later spread to private firm in Europe as well and in the late 1980s, to local authorities in response to public pressure to be "green". In the early 1990s environmental auditing was strengthened and expanded to encompass a total quality approach to organizations' operation through EMS. EMS is now seen as good practice and has existing standard on EMS, briefly discusses the applications of EMS and environmental auditing by both private companies and local authorities and concludes my considering the links between EMS and EIA.

2. Standards and regulations on EMS

Three EMS famous standards apply in the UK. British Standard 7750 of early 1992 (updated and revised in early 1994). The EC Eco-management and Audit Scheme (EMAS) of 1993, and the International Standard Organization's 150 series 1400. The three are

compatible with one another, but often in their requirements.

BS 7750 is a direct evolution from the well known British standard 5750 on quality systems where as BS 5750 addressed an organisation's productions and services, BS 7750 focuses more on by-products such as wastes and emission's. Both standards establish criteria for improving the organisation's management system.

Fulfilment of BS 7750 entails the following steps:

* A committment by the organization to undertake the audit.
* A preparatory review and assessment of relevant regulatory requirements, environmental effects, environmental management practice and procedures, and feedback from investigations of previous incidents and non-compliance;
* The formation of an environmental policy.
* A full inventory and assessment of the organisation activities and environmental effects;

In fig. 2.8, a comprehensive approach to EMS is depicted by the circular figure. The system is meant to detail information and show committment to check impact in an audit system approach.

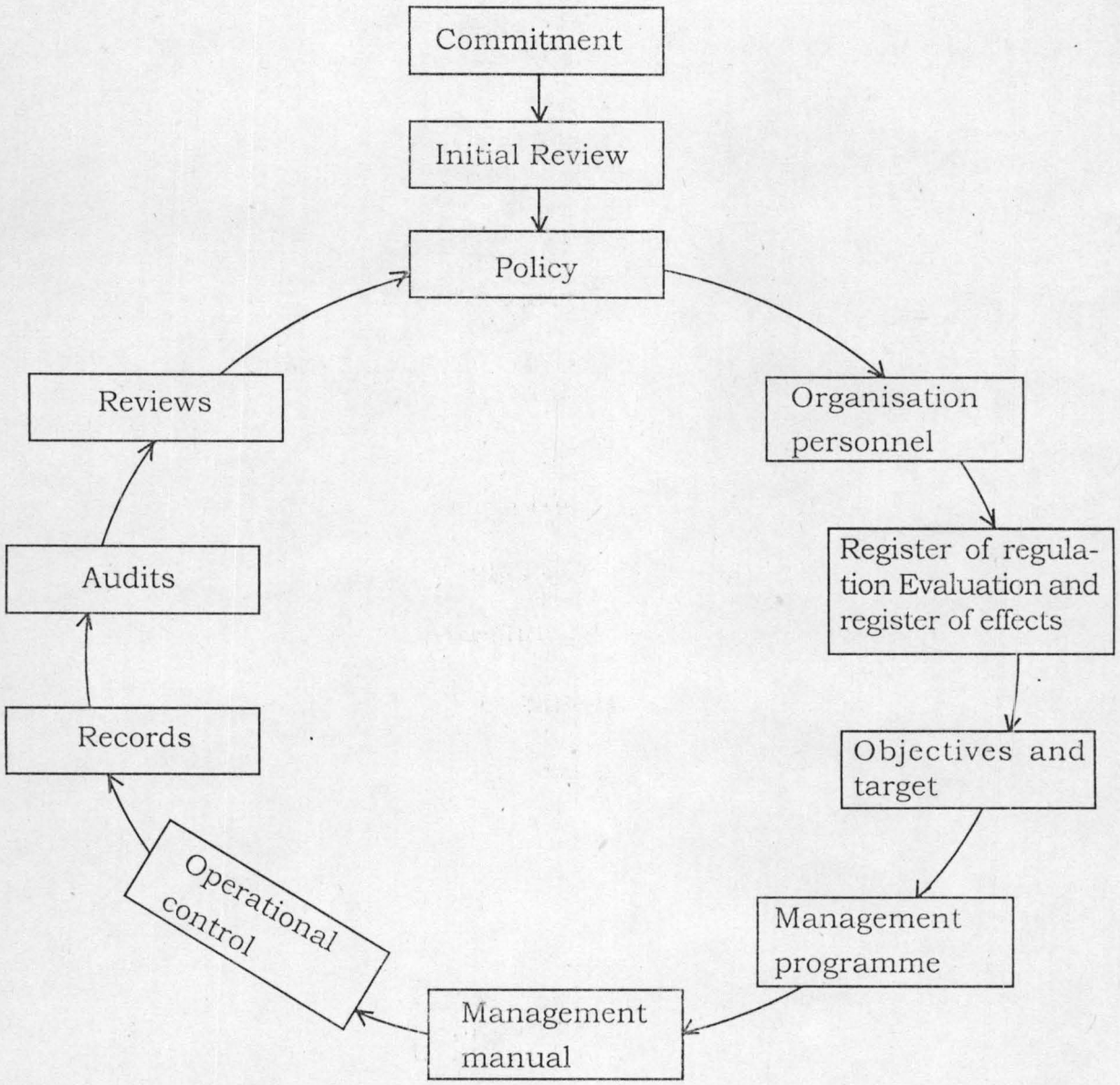


Fig. 2.8 Outline of the environmental audit process

* An assessment of whether the activities conform to relevant regulations and requirements.

* The formation of targets and objectives;

* The development of an environmental management programme and supporting manual.

* The application of the management plan in the organisation operations and record keeping.

* An audit to test whether the organisation achieves its targets and objectives which feeds back into environmental policy formulations to form a cycle. The Fig 2.8 summaries the process. Alhough, early environmental audits carried out by private sector firms varied widely depending on the audit process - they included acquisitiong/ divertiture audits' risk audits, compliance audits and audits of individual sites - the practice of EMS is bearing more consistent as a result of the new standards. Private companies see this as away of reducing their costs through good management practices such as waste reduction and energy of efficiency. The sees EMS as good publicity and, less directly, as a way of boosting employees's morale. However, private companies still have problems implementing EMS owning to commercial confidentialy legal liability, cost, and lack of commitment. EMS in local authorities initially had a more consistent format than in the private sector, primarily became they all aimed to do the samething: provide information on baseline conditions in the relevant area and suggest ways in which they could change their operations to become "greener". Generally, these audits included in varying levels of depth:

* A state of the environmental report, which reviews baseline environmental completions in an area, preferably conjunction with a

regularly updated environmental data base;

* A policy impact statement, which evaluates the local authorities policies and practices and suggests actions to improve matters where necessary.

* An EMS like that of private firms, to implement, monitor and review the audit findings.

2.2.0 Suleja Earth Dam

Suleja is one of the oldest town in Niger State, located South East of Niger State. It is divided into 10 administrative wards namely Kwamba, Wambai, Dankurka, Dawaki, Bakini-Iku, Bamburu, Chaza, Madalla Diko and Gauraka. It has in the past played host to the Federal Capital Development Authority and has as a result witnessed increasing stress on it's social and physical structures. The Dam is located along the eastside of A2 (Kaduna – Okene Road) across river Iku.

The physical development of Suleja is constrained by a ridge of solid granite rock to the West and pockets of hills to the East. River Bakin Iku, Kantoma Iku, Dawaki, Wuchichiri and Kinya are physical constraints.

The choice to developed across the A2 were adopted became of the interest of the people to expand on to the Eastern side of the road.

2.2.1 Objectives of Suleja Earth Dam

The Suleja Dam project is to provide a multipurpose reservoir with an active storage capacity of 48.5 million cubic metres.

1. **Water Supply**

The storage from the reservoir would provide water supply requirement for Suleja upto a capacity of 100 million litres per day (22 million gallons per day). Suleja Town could be supplied by a 8km long pipeline from the reservoir by gravity and no pumping would be necessary.

2. **Irrigation**

The storage available from the reservoir could command an irrigation project of 400 hectares (1000 acres.)

3. **Secondary Benefits**

Other project benefits are fisheries, flood control, recreation and the improvement of the living conditions of the people in the project area.

2.2.2 **Basic Specifications**

Average Annual Precipitation		
Catchment Area	-	$144km^2$
Average Annual run off (estimated)	-	$40 \times 10^6 m^3$
Type of Dam	-	Zoned earthful
Crest length	-	512m
Crest level	-	467.00m
Free Board	-	3.0m
Maximum Flood level	-	465.30m
Full supply level	-	464.00m
Crest width	-	10.0m
Max. structural height	-	27.80m
Hydraulic height	-	24.80m
Max with of Base	-	155.00m
Total storage capacity	-	$52 \times 10^6 m^3$
Dead Storage level	-	450.00m
Dead storage capacity	-	3.5 x 106m
Active storage capacity	-	$48.5 \times 10^6/m^3$
Surface Area of the lake	-	740 ha
Total volume of earth work	-	$585.000m^3$
Total volume of excavation	-	$230\ 000m^3$

SPILLWAY: Uncontrolled concrete skin – type separate from the dam body 100m long with crest elevation of 464.00 OD.

INTAKE TOWER:- 2 x 24" diameter steel pipe penstock with guard and control valves.

CONSTRUCTION PERIOD:- Two dry seasons.

Estimated cost of Dam and headwork including resettlement #6,759, 410

2.2.3 Assessment of the Likely or Potentially Environmental Impacts

Impact of Failure of Dam on the Environment Down Stream

In most cases, dam gives little or no warning before failure. Uptill date, no one has come up with a design for a dam that would show signs of impending failure just like an elastic structure would do. It is often observed that generalization in design without regard to peculiar nature of the area where dam is to be situated constitute a threat. According to Thomas H.H. 1976, "the failure of a dam is a national catastrophe!

Statistical analysis from many part of the world of the causes of failure of dam can be summarized as follows:

About 45%: Attributed to hydraulic condition (flood, seepage, piping and uplift)

About 30%: Attributed to type of structure and construction (hydraulic fill, see page through poor concrete, inadequate design)

About 7%: Attributed to geology

About 6%: Attributed to consequences (decay, abandonment, induced earth quake).

The Suleja dam was constructed across river Bakin Iku and has an active storage capacity of 48.5 milion cm^3. This is situated just less than 3km to the express way where development is rapid. In event of collapse of the dam, a flood of about 48.5 million m^3 will be released between the dam site and the express way (A2 Kaduna-Abuja express way) the flood

will move at faster speed. The distance of less than 3km will be submerged in less than 1 minute. The extent of the flood may be up 7 - 10km on both side - implying that some part of Suleja will be submerged spared. This impact can only be averted if the routine monitoring programme is adhered to.

Stability Analysis of Dam Foundation

Since the dam has not shown any possible sign of failure, the time is set for the stipulated period to service the earth dam. The emphasis I learnt will be focused on the foundation and those areas in constant contact with water, the drastic increase in hydrostatic pressure within the rock masses after the impounding of the dam may lead to the displacement of some block of jointed rocks masses.

Some limnological Studies

There will be some aspect of periodical measurement of these water quality parameter. These are water temperature, dissolved oxygen, PH, total hardness, Ammonia, alkalinity, nitrate, nitrite.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Design of the Study

This study design was based on investigative survey Research Approach (ISRA) (Chukwu, 1994). This involves schedules of visit to Suleja Earth Dam site with the aims of:

(a) Administering and completing of structured questionnaires with inhabitants of the dam location.

(b) Interviewing relevant and competent staff of the Dam.

(c) Physical Observation of the environment

Two types of data were sought for. They were practically based on two information levels: Baseline information and screening information based on the investigative survey Research Approach.

3.2 Description of Questionaire

The Questionnaire for this study contained first, baseline information and secondly the screening information with the various environmental components in mind as regard the suppose impact of the Suleja Earth dam (before and after the dam).

3.3. **Method of Analysis**

An important aspect of the auditing of environmental impacts of the Suleja Earth dam is the analysis based on the baseline and the screening information provided and administered through the questionnaires. This was carried out and average of impact on particular environmental component weighted by "percentage" or stated as "positive" or otherwise.

The questionnaire were distributed to 3 persons who have a good background knowledge about the dam and the environment before and after the dam. Average of these three (3) information supplied was considered to determined impact.

The assessment were carried out on the components of the physical environment and on the socio-economic environment. The key environmental elements considered include:-

(a) Climate and Air Quality

(b) Water

(c) Geology

(d) Soil

(e) Environmentally Sensitive Areas

(f) Land Use and Land Capability

(g) Noise and Vibration

(h) Visual Quality

(i) Archeological, Historical and Cultural Characteristics

A. CLIMATE AND AIR QUALITY

Local wind direction

Local wind speed

Unusual condition of wind flow

Factors responsible for wind channeling

State High risk areas

Extreme temperature (Low/High)

Naturally projected wind breakers/height

Unusual condition of rainfall

High risk area

Odour Characteristic

(a) Odour

(b) Type

(c) Intensity

(d) Duration

Condition of local precipitation/ rainfall humidity pattern

Unusual rainfall leading to damage

B. WATER

Nature of Hydrology

Ground water regime

(a) Quality

(b) Quantity

(c) Time of recharge of major well

(d) Time of depletion of major well

(e) Extent of major well

Sources of water in the area

Nature of drainage/ sediment influx

Erosion potential of soil

Out break of water related diseases

Water quality standards

Source (s) water pollution

Threat to aquatic life

Effect of dry weather characteristic

C. GEOLOGY

Tectonic/ Seismic/ volcanic activity

Geological features

Threat to Geological features

Resources of potential Weathering

Physical/ chemical weathering

History of subsidence

D. SOIL

Soil erosion affected by

(a) Wind erosion

(b) Water erosion

Risk to damage to life, structures or services due to settlement

Soil properties

(a) Strength of soil

(b) Ground condition

(c) Strength of rock

Alteration to existing condition

(a) Water regime

(b) Topography

(c) Landscaping

If yes, what is responsible?

Species of plants and animals

Species providing food and cover for wildlife

Species susceptible to human activities

Species of plant and animal distribution

Plant communities of Scientific value

Impaired productivity of land

E. ENVIRONMENTALLY SENSITIVE AREAS

Prime agricultural area.

Was the area a forestry land?

Solid waste disposal near the area

F. LAND USE AND LAND CAPABILITY

Land use classification

Land capability

Land degrading evidence

Proposed purpose of land

F. NOISE AND VIBRATION

External noise level due to

(a) transportation

(b) Construction of dam

Sensitive land users.

G VISUAL QUALITY

Content of scene

Coherence of the area

H. ARCHEOLOGICAL HISTORICAL AND CULTURAL CHARACTERISTICS

Archeological, Historical and Cultural site

Tourism activities.

Existing and desirably pattern of access.

I. SOCIO-ECONOMIC ENVIRONMENT

Population estimate

Age distribution

Sex distribution

Rural –Urban population distribution

Ethnic constituent

Population dynamics

(a) Birth rate

(b) Death rate

Estimate of

(a) Birth in a year

(b) Death in a year

Prevailing pattern of migration

Predominant land tenure system

Population settlement pattern

Area inhabitancy

Area in multiple use

Size of working population

Skills of working population

Level of training of working population

Working population area of specialization

Experience of working population

Propensity for trade and commerce

Propensity for entrepreneurial activities

Dependence on primary economic activities

Economic linkage

Nature of local economic

Range of income distribution

Propensity for comsumption

Degree of stability of social organization

Willingness to incoperate new members

Homogeneity of population

Rate of urbanization

Complexity of social relationships

Crime rate

Comment of crucial dynamic factors

(a) Changes in Birth rate

(b) Changes in Death rate

(c) Changes in level of health

(d) Changes in level of nutrition

(e) Changes in distribution of ethnic groups

(f) Changes in existing patterns of employment

(g) Changes in rates of Our-migration

(h) Changes in rates of In-migration

(i) Imbalances or stress evident on social structure

(j) Cultural changes, and increased secularization

Advantages of dam.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

4.1.1. Interview

During the visit interview was granted to about four persons, (two generation gap.) There seems to be a general consensus about government neglect in providing other basic amenities to the area. The road leading to the dam area is in worst condition than when the dam was under construction. Within the dam site there is no clinic. According to them, the dam is a mixed blessing.

4.1.2 Observation

One would expect to see strict policy on conservation of natural resources around the dam site because of it's economic importance. The case here was different. The primary concern and purpose seems to be geared towards harvesting water without adequate attention given to other components of the environment.

There is a gradual desert encroachment with unrestricted cutting of tree for fire wood. There nothing on the ground to show that water is being analysis to determined it's unharmfulness.

4.1.3 Climate and Air Quality

The local wind direction has not change considerably except that it has increased in speed moderately. Mostly affect during storm is the resi-

dential boulding. The temperature of the area has drop considerably with the increase humidity. There has not been overflow or damage as a result of the dam but was reported to be a seasonal thing before the construction of the dam.

4.1.4 **Water**

Thought the dam impound million of litres of water some people living around can not boast of drinkable water. They still depend on wells and boreholes. There is virtually no source of effluent other than the washing of clothes, and chemical used for local fishing. Aquatic life are under threat constantly resulting from lack of skill for fish harvest.

4.1.5 **Geology**

There were no record of volcanic incident or any history of subsidence in the area. The topography only reveal a change due to the presence of the dam structure. Upto date there is no known mineral of economic value in a substantial quantity in the area.

4.1.6 **Soil**

Years ago, the land was cleared for the construction of the dam. This clearing has drastically reduce vegetative cover, exposing the soil to erosion. Moreover, the villages depend largely on fuel fire wood for cooking and for commercial gain. Alternative to existing condition in terms of water regime, topography and landscaping is evident.

4.1.7 **Ecology**

During operation, there were noise and other movement which can result running into other places some vital game animals. It is possible too, that heavy equipment movement, grease and oil from vehicle can resist vegetable growth. It is obvious that vegetable soil were replaced back making if difficult for trees to grow in the area.

4.1.8 **Environmentally Sensitive Areas**

There is no industry discharging waste into the river or around the dam areas. The area has been purely an agricultural land. Uptil date, agriculture play prominent role in the area, in providing job and food for both domestic and commercial use.

4.1.9 **Land Use and Land Capability**

The land is predominantly and agricultural land. Other usage include seasonal grazing by the Fulani cattle rearer. There evidence is that the presence of the dam has not change the use of land. Areas where operation were not extended seems to be a good land for farming activities.

The production of yam is becoming important.

4.1.10 **Noise and Vibration**

The atmosphere can be described as quiet. Noise and vibration could be hardly imagined before the dam and after the dam. Interaction reveal that noise and vibration were two common happening during the construction period. There is no record of any impact of noise. Though, record

abounds that construction workers suffers from sound effect during their old age, That, means that noise impact on health it gradually built over time.

4.1.11 Visual Quality

There is reported visual blurredness during the everning time. Suleja is fash becoming a big town with the high record of gas emission. Humidity in the dam area with it's hilly nature does not permit a free flow of gaseous movement. This case was not as bad as it is today.

4.1.12 Archeological, Historical and Cultural Characteristics

There were no records of archeological, historical, and cultural charactertistics present in the area. It is only true to say that agriculture was their way of life. Farming was a predominant culture. There was an old road going out from Suleja to Bwari across the area which provide the only access to the dam site. Presently, the road is in shape bad making it difficult to believe there is dam in the area.

4.1.13 Socio-Economic Environment

A part from the compensation paid to the inhabitants, there were no plan to integrate the people into the project, though, the community was a farming one, but studies shows that many of them are beginning to shows great interest in fishing. Majority of the full time fishermen are settlers. That constitute only to about, 10% of the population. The population had increase considerably. Most traders are petty in nature as re-

veal in our studies. Birth rate had increased upto 35 numbers in a years. Amazingly, the area witness large influx of farmer during the rainy season. Lands are given on rent, some are purchased while members of the community acquire land by inheritance and lease hold.

It is observed that only 5 – 15% of the people are working class, out of which only about 5% had acquired skills with little experience.

The areas is poorly linked to Suleja main town with only one untarred access road. This is considered as one of the factor affecting rapid growth of the areas. It is worthy of note, that there is the willingness by the people to incorporate new members into the area. As a result of this act, the area which was considered predominantly village based is fast becoming a multiplex relationship Crime rate is low even though police post is far from the dam area.

Though death rate has increased, village confessed what they called strange disease they claim is associated with big water bodies. The truth is that, there little or no health facility on the ground. With increase interest on irrigation, farmers will be more vulnerable to diseases. Water can serve as transfer medium and a habitat for vectors and intermediate host.

Majority of the people agrees that they couldn't imagine a better place without the dam. It them reveals that government and policy makers have not taken into account the impact of the dam on the immediate environment.

4.2 **Discussion of Results**

4.2.1 **Impacts**

The environmental impacts of a project are those resultant changes n environmental parameter. This study demonstrates from both the General information, a baseline information and much aspect of the screened environmental components reveals a gradual and less significant impact to the present is a major concern. Every components in the study has either had a negative or positive impact. On the whole, majority is negative.

The presence of the dam has affected virtually all segment of the environment though little is done to curtail these impacts. The climate and the air quality is affected positively. Additions of water vapour in the air may produce clouds and precipitation. Water is surplus but little is done to control pest and disease vector normally associated with large body of water.

Large body of soil is lost through the turbulent nature of storm from tributaries and desertification which enhances direct impact of rain drop on the soil resulting to soil erosion. On the ecological front, greater percent of game animals has been lost due to noise associated with construction leaving room for animals associated with large body of water – nothing has been done to remediate the lost.

The construction of Suleja Earth Dam and the consequent formation of a reservoir would affect down fisheries in several ways. First, the sea-

sonal flood to which fish have adopted to for migration down stream is impeded. Villagers asked at the down stream confirmed this situation.

The magnitude of this impact is great and will definitely lead to decline in marketable species. (Futmin.consult, 1998), impact assessment of Kagara Dam).

There is an increase growth in the population without a corresponding provision of amenities. Children treek long distance to available school of thier parent choice. Death records were traced to malaria as a result of the large body of water hhosting mosquitoes. It is expected that more people will move to settle in the dam area during and after construction. There were visible evidences of migration of cattle rearers to the area specially during the dry season. Going by what was observed in the course of this study, the dam posses the capacity to positively change the socio-economic well-being of its environ. Greater percentage of rural dwellers can benefit through abundant supply of folder for their livestock from year round availability of good portable water and pasture. Many can make a living from the sales of livestock.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this study, the environmental components as structural in the questionnaire were carefully administered. It is evident that Suleja Earth Dam though serving half of it's purpose, but has failed to draw the required rate of development to it's host environment. This is because Environmental Impact Assessment (EIA) was not accorded the required attention.

While the dam remains a blessing for now, lack of basic amenities will jeopardize the very purpose of its existence. While, Suleja town continue to expand towards the dam area, one would expect that condemned oil, water from township drainage, lack of proper care for waste disposal will lead to flowing of the same into dam. Out of eleven (10) components screened each has been affected either positively or negatively. Those negative impacts especially on the socio-economic lives of the dam area is a potential source of environmental degradation. The study has been an eye opener to insensitivity of our policy maker to adapt to EIA programmes, though extensive work should be carried out on the quality of water.

5.2 Recommendation

The management do understand that there were short comings do to her inability to finance Environmental Impact Assessment (EIA). Practical

effort through inspection of the environment is be carried out to check effluents and other negative activities that might contradict the purpose of the dam.

In addition to the above measure, the following recommendations are made;

1. The authority should endeavour to secure an EIA guidelines for Dam project as to enable it monitor and audit performance of the dam in relation to the environmental components.
2. There should be a proper resettlements policy plan with proper awareness on health education for settlers near the dam.
3. Government should provide of basic social amenities to enhance the socio-economic well being of the people in the area. Such as school hospital, good road et etc.
4. Adequate attention should be given to conservation of other natural resources such as trees, land and rocks of the dam area.
5. This can be a source of revenue. The dam has enormous tourism potential. There can be private sector participation geared towards making the place a resort centre.
4. The authority must ensure it complies with FEPA guideline here at home.
5. Lastly, the authority should establishment an environmental management system office so as to ensure feedback from operation. This is to test whether the dam is achieving its purpose and as well to help in policy formulation.

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APPENDICES

Appendix A

DEPARTMENT OF AGRICULTURAL ENGINEERING
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

A STUDY ON ENVIRONMENTAL IMPACT ASSESSMENT
(EIA) OF AN EARTH DAM

QUESTIONNAIRE: DETAILS

Questionnaire Administrator: Simonpeter Adah
Dept. of Agric. Engineering
Federal University of Technology
Minna.

Dear Respondent(s)

Feel free to answer the question asked, for a very objective assessment of the earth Dam in your area.

PART 1: GENERAL

1. Name of the Earth Dam
2. Year Established
3. Location (Host Community)
4. Various Section of the Dam
   (i)
   (ii)
   (iii)
   (iv)
5. Number of Employees
   (i) Permanent
   (ii) Temporal
   (iii) Casual
6. Purpose of the Dam
   (i) Fishing
   (ii) Drinkable water
   (iii) Farming/Irrigation
   (iv) Industrial
   (v) Flood control, recreation
7. What is the capacity/storage of the Dam
8. State the busiest activity in the Dam since the construction.
9. How has the dam been maintained?
10. What contribution have the dam been able to make within its host environment?

(i) (ii) (iii) (iv)

11. What are the negative activities recorded as a result of the dam?
    (i) (ii) (iii)
    (iv) None
12. What is the level of these activities (as in No 11)
    High
    Moderate
    Low
    Nil.
13. How do you handle these activities?
14. What are the infrastructural requirements of the dam.
    (a) Power requirement (i) Electricity
    (ii) LNG
    (iii) Petrol
    (iv) Diesel
    (b) Transportation (i) Motorbike
    (ii) Car
    (iii) Public transport system
    (c) Housing (i) Rented
    (ii) Dam's own house
    (iii) Others (specify)
15. State number of towns the Dam is serving
16. What contribution has the dam made to the Nigerian economy?
    (i) (ii) (iii) (iv)
    (v) (vi) (vii)
    (viii)
    (ix) (x)
17. Age of the Respondent
18. Type of employment of the Respondent.
19. Rank of the Respondent
20. Marital Status
21. Number of dependants
22. Educational background (Highest)
23. Gross earning per annum N : K
24. Describe your work schedule i.e. from start to close in a day.
25. How interesting is the work?
    (i) Highly
    (ii) Moderate
    (iii) Poorly
26. What is responsible for this outcome?

27. Date of Appointment/if employed by the management of the Dam.

28. State benefits as a staff of the Management.

29. Tick as appropriate items that have been sited in the area since the dam was constructed.

- ☐ Motor park
- ☐ Electricity
- ☐ Road
- ☐ School
- ☐ Police Post
- ☐ Hospital
- ☐ Market
- ☐ Court
- ☐ Others, specify

PART 2: BASELINE ENVIRONMENT: PHYSICAL AND SOCIO-ECONOMIC ASSESSMENT

The purpose of this part of the questionaire is to furnish information on the baseline environment (i.e the environment without the Dam.). The baseline environment is described in terms of its pre-project characteristics.

A. CLIMATE AND AIR QUALITY

30. What was the local wind before in terms of Direction
    (i) E-W (ii) W-E (iii) N-S (iv) S-N
31. Give an idea of the wind speed
    (i) Very high (ii) high (iii) moderate (iv) low
32. Were there unusual conditions of wind flow in terms of
    (i) Tornadoe (ii) Strong wind (iii) Gale (iv) Huricane (v) Typhoon
    (vi) Others, specify.
33. What is responsible in terms of channelling of wind in the area? (a) Rocky hills, (b) Tree (c) Others, specify.
34. Based on question QNo. 32, was there "a highrisk" area? Yes/No
35. What were the extremes of temperature in the area
    (i) Lowest_____°C/F
    (ii) Highest_____°C/F
36. Were there naturally projected wind breakers in the area, if yes state the height.
37. Did the area ever experience unusual conditions of rainfall. e.g
    (a) Flood (b) Flash floods (c) Acid rain
38. Based on question 37, was there a "high risk area"?
    Yes/No. If yes, state it
39. Before the dam, was there any odour characteristic of the area? Yes/No If yes
    (a) Type__irritating/offensive/chocking/pungent (b) Intensity___High/moderate/sligh
    (c) Duration__High/moderate/short/very short.
40. What was the condition of the local precipitation/rainfall humidity pattern.
    (a) Early, but high (b) Early, but moderate (c) Early, but low
    (d) Late, but high (e) Late, but moderate (f) Late, but low
    (g) Others, specify.
41. Has there been unusual condition of rainfall leading to river overflow or damage? Yes/No.

B. WATER

42. What was the nature of the hydrology of the area in terms of source of water?
    (i) Ground water (ii) Surface water (iii) Others, specify
43. What was the ground water regime in terms of
    (a) Quality (i) good/hard (ii) bad/hard (iii) good/soft.
    (b) Quantity (i) High (ii) Low
    (c) Time of recharge of major wells (i) fast (ii) slow
    (d) Time of depletion of major wells (i) fast (ii) slow
    (e) Extent of major well (i) deep (ii) shallow
44. Name sources of water in the area
    (i) (ii) (iii)

45. What is the nature of drainage in the area and does it carry any effluent/sediment influx into the area water bodies? Yes/No
46. What is the erosion potential of the soil? (i) High (ii) Moderate (iii) Low (iv) Nil
47. Has been out break of water related diseases before the siting of the dam. Yes/No
48. Does existing water quality standards meet intended use of WHO, FEPA?
    (i) Drinking (ii) Industrial purpose (iii) Irrigation
49. What are the point and non-point sources of surface water pollution in the area?
    (a) Industry (b) Sewage system
    (c) Storm water run-off (d) Salt (e) Brackish water infusion (f) Agriculture
50. Has there been threat to aquatic life in the area? Yes/No If yes state it
51. What has been the effect of the dry wheather characteristic of the area?
    (i) High (ii) Moderate (iii) Low

C. GEOLOGY

52. Was there an incident of tectonic/seismic activity and/or volcanic activity ever reported in the area? Yes/No
53. List geological features of educational, scientific aesthetic and human interest in the area
    (a) Rock (b) Parks (c) Garden (d) Shrines (e) Sacred land/forest land
54. Has there been any threat to these feature(s)? Yes/No
55. Were there mineral resources of potential value in the area? Yes/No If yes, name them
56. Were there rocks susceptible to physical/chemical weathering in the area? Yes/No
57. Was there any history of subsidence before the siting of the dam? Yes/No

D. SOIL

58. How was soil erosion affected by
    (a) **Wind erosion** - greatly/sparsely/Nil
    (b) **Water erosion** - greatly/sparsely/Nil
59. Before the Dam, has there been risk of damage to life, structure or services due to settlement/ leave? Yes/No
60. What are the soil properties of the area in terms of
    (a) **Strength of soil** - Strong/weak
    (b) **Ground condition** - Strong/weak
    (c) **Strength of rock** - Strong/weak
61. Was there an atteration to exisitng condition in terms of
    (a) Water regime -)
    (b) Topography -)Yes/No
    (c) Landscaping -)
    If yes, state what was responsible

E. ECOLOGY

62. Before the dam, what species of plant and animal were in the area?
    (a) Unusual species---
    (b) Rare species---
    (c) Endangered species---
63. What species provided food and cover for wild life?
    (i) (ii) (iii) (iv) Others, specify.

64. Were there species particularly susceptible to human activities? If yes, name them
65. What were the different species of plants and animals and their distribution over the area?
66. Were there unsual plant communities populations of scientific value at the area? Yes/No
67. Was there anything that impaired productivity of land in the sorrounding area? If yes state it

F. ENVIRONMENTALLY SENSITIVE AREAS

68. Was the area a prime agricultural land? Yes/No
69. Was the area formerly a forestry land? Yes/No
70. Was there any solid waste disposal site near the river? Yes/No

G. LAND USE AND LAND CAPABILITY

71. What was the land use classification on and near the area before the dam was sited?
    (a) Food production
    (b) Quarrying
    (c) Grazing
    (d) Silviculture
    (e) Development
    (f) Others, specify
72. What was the land capability on and near the area before the Dam was sited?
    (a) Crop land
    (b) Range land
    (c) Forest
    (d) Pasture land
    (e) Others, specify
73. Was there record of land degrading evidence before the dam was sited in the area. Yes/No.
74. Was the area specially meant for/or proposed for any project? Yes/No.

H. NOISE AND VIBRATION

75. Was there any medical record of (a) tension (b) brain wave scanning (c) other internal noise problem suffered by the people in the area before the dam was sited. Yes/No
76. Classify the area without the dam into
    (a) Very quiet
    (b) Quiet
    (c) Noisy
    (d) Very noisy
77. What can be said about external noise level due to
    (a) **Transportation before the dam** Low/loud
    (b) **Construction before the dam** Low/loud
78. Were there sensitive land users within (1 mile or 5/8 km) of the area before the dam. Such noise-sensitive land users are:-
    (a) Educational Building
    (b) Hospital
    (c) Churches
    (d) Mosques
    (e) Recreational areas
    (f) Others, specify

I. VISUAL QUALITY

79. Describe the content of the scene percieved by the residents of the area before the dam.
    (i) Not clear (ii) Clear (iii) Very clear
80. Describe the coherence of the surrounding area before the dam
    (a) Consistent (b) Not consistent.

J. ARCHEOLOGICAL, HISTORICAL, AND CULTURAL CHARACTERISTICS

81. Were there regional/local archeological sites and structures in the area before the dam was sited? (a) Meseum (b) Monuments (c) Stature (d) Others, specify.
82. What were the tourism activities at the archeological historic/cultural structures/sites in the area before the dam? (a) Seriously disrupted (b) Partialy disrupted (c) Completely stopped (d) Others, specify
83. What were the existing and desirable future pattern of access prior to sitting the dam in the area? Answer in terms of (a) Statisticism mobility (b) Associational pattern (c) Recreational pattern.

K. SOCIO-ECONOMIC ENVIRONMENT

84. What was the population estimate before the dam was sited
85. What were the three predominant age distributions (in years) of the area?
    1 - 10 Years
    11 - 20 Years
    21 - 30 Years
    31 - 40 Years
    41 - 50 Years
    51 - 60 Years
    Above 60 Years
86. State the sex distrbution of the population before the dam
    (a) Predominantly males
    (b) Predominantly females
    (c) The same numbers of males and females
87. Comment on the rural - urban population distribution of the area before the dam.
    (a) Majority stay in the urban area
    (b) Only few stay in the urban area
    (c) About equal number.
88. What were the different ethnic groups found in the area?
    (a) Ibos (b) Hausa (c) Yoruba (d) Gwari (e) Others, specify.
89. What population dynamics existed in the area in terms of
    (a) **Birth rates:** High, moderate, low
    (b) **Death rates:** High, moderate, low
90. Give an estimate of the number of
    (a) Births in a year.....
    (b) Deaths in a year.....
91. What are the prevailing pattern of migration in the area? (a) Seasonal (b) Cycle (c) Progressive
92. What was/were the predominant land tenure system(s) practiced in the area?
    (a) Communal (b) Inheritance (c) Lease hold/tenancy (d) Rent
    (e) Purchase (f) Free-gift

93. What was the population settlement pattern within the area? (a) Sparse (b) Clustered (c) Scattered
94. Was there people living in the area before the dam was sited? Yes/No
95. Were there areas in multiple use (e.g areas used by both nomadic pastoralists and sedentary agriculturalists sharing the same region but using different land types, adopting constrasting settlement practices and interacting at certain localities owing to a mutual dependence. Yes/No If yes no, explain.....
96. What is the estimates of the size of the working population of the area before the dam.
    (a) 5 - 15%
    (b) 16 - 30%
    (c) 31 - 45%
    (d) 40 - 60%
    (e) > - 60%
97. Comment on the skill of the working population (a) Skilled (b) Semi -skilled (c) Unskilled
98. Comment on the level of training of the working population (a) Well-trained (b) Moderately trained (c) Poorly trained (d) No formal training
99. The working population is predominantly in (a) Agriculture (b) Commerce (c) Production (d) Industry (e) Craft (f) Others, specify.
100. What type of experience has the working population before the dam?
101. Was there a propensity for trade and commerce in the area? Yes/No.
102. Was there a propensity for enterpreneurial activity in the area? Yes/No.
103. Was there the dependence of primary economic activities on services and goods produced locally? Yes/No
104. Comment on the economic linkage of the area with other areas before the siting of the plant.
    (a) poor road network
    (b) few trade routes
    (c) completely absent
    (d) mostly rural based
    (e) others, specify
105. What was the nature of the local economy of the area before the dam?
    (a) Exclusively based on trade and commerce
    (b) Strong local tradition of craft production confined to domestic source
    (c) Combination of (a) and (b)
106. What was the range of income distribution related to ownership of
    (a) **resources** (i) depleted resources (ii) resources unaffected
    (iii) increased value of resources
    (b) **employment pattern** (i) loss of jobs (ii) creation of jobs (iii) change of jobs
    (c) **overall social structure** (i) improved (ii) reduced (iii) widened the gap
107. Was there a propensity for consumption patterns to stimulate secondary economic activity? Yes/No.
108. What was the degree of stability of social organisation within the area?
    (a) strong
    (b) weak
    (c) passive
109. Comment on the willingness of the people to incorporate new members into the area.
    (a) strong

(b) weak
(c) partial

110. Comment on the homogeneity of population of the area
(a) strong
(b) weak
(c) cohesive
(d) non-cohesive

111. Comment on the rate of urbanisation and contact with urban society before the siting of the dam.
(a) fast
(b) slow

112. What are the complexity of social relationships before the siting of the dam in the area
(a) predominantly village-based
(b) multiplex relationship
(c) urban-based more selective relationships

113. What was the crime rate like before the siting of the dam?
(a) high
(b) moderate
(c) low
(d) nil

114. Comment on the following crucial dynamic factors before the siting of the dam.

(a) changes in birth rate (resulting from birth control policies, health provision improvements, etc.) (increased/decreased/no effects)

(b) changes in death rate (resulting from - birth control policies, health provision improvement etc.) (increased/decreased/no effects)

(c) changes in levels of health (increased/decreased/no effects)

(d) changes in levels of nutrition (increased/decreased/no effects)

(e) changes in distribution of ethnic group (increased/decreased/no effects)

(f) changes in existing patterns of employment and economic activity (e.g. from subsistence agriculture and craft production to cash crops and factory production) (increased/decreased/no effects)

(g) changes in rates of out-migration (increased/decreased/no effects)

(h) changes in rates of in-migration (increased/decreased/no effects)

(i) Imbalances or stress evident in the social structure e.g. changes in family organisation from extended to nuclear, a widening generation gap owing to participation in different cultural domains (traditional and modern), a change in economic fortune or involvement of one social group or class relative to another - (increased/decreased/no effects)

(j) Any cultural changes or imbalance, such as an increased secularization within a population or an adoption of alien industrial values in place of traditional, rural orientation and norms. (increased/decreased/no effects)

115. Give as many advantages you have imagined without the dam.
(i)
(ii)
(iii)
(iv)
(v)
(vi)

PART 3: SCREENING/PRELIMINARY ASSESSMENT: PHYSICAL AND SOCIO ECONOMIC ASSESSMENT

This require an assessment of potential environment impacts. It involves the isolation of elements and sub elements of the environment upon which the activities of the dam has severe or important impact.

A. CLIMATE AND AIR QUALITY

116. From what direction does the wind start and move? (i) E - W (ii) W - E (iii) N - S (iv) S - N
117. Give an idea of the wind speed (i) Very high (ii) High (iii) Moderate (iv) Low
118. Were there unusual conditions of wind flow in terms of (i) Tornadoe (ii) Strong wind (iii) Gale (iv) Huricane (v) Typhoon (vi) Others, specify.
119. Has the dam modified the local wind behaviour in terms of channelling? Yes/No
120. Base on question 32, was there **'a high risk area'**? Yes/No
121. What were the extremes of temperature in the dam area. (i) Lowest_____°C/F (ii) Highest _____°C/F
122. State the height of the dam structure and the area it covers
123. Did the area ever experience unusual/conditions of rainfall? (a) Floods (b) Flash flood (c) Acid rain
124. Based on question 37, was there a "high risk area"? Yes/No If yes, state it
125/ Was there any odour characteristic reported after the dam was constructed? Yes/No If yes (a) **Type** - irritating offensive/choking/pungent (b) **Intensity** - High/moderate/slight. (c) **Duration** - High/moderate/short/very short
126. What is the condition of the local precipitation/rainfall humidity pattern of the dam area? (a) Early, but high (b) Early, but moderate (c) Early, but low (d) Late, but high (e) Late, but moderate (f) Late, but low (g) Others, specify.
127. Has there been unusual condition of rainfall leading to river/dam -over-flow or damage? Yes/No

B. WATER

128. What was the nature of the hydrology of the area in terms of source of water?
    (a) Ground water (b) Surface water (c) Other's specify
129. What was the ground water regime in term of
    (a) **Quality** (i) good/hard (ii) bad/hard (iii) good/soft
    (b) **Quantity** (i) High (ii) Low
    (c) **Time of recharge of major well** (i) Fast (ii) slow
    (d) **Time of depletion of major well** (i) Fast (ii) slow
    (e) Extent of major well (i) deep (ii) shallow
130. Apart from the Dam, name other sources of water in the area
    (i) (ii) (iii)
131. What is the nature of drainage in the area? and does it carry any effluent into the dam? Yes/No
132. What is the erosion potential of the soil after the dam has been constructed and as a result of drains leading to the dam. If yes, what is the rate (i) High (ii) Moderate (iii) Low (iv) Nil
133. Has there been any outbreak of water-related diseases since the siting of the dam? Yes/No
134. Does existing water quality standards meet intended use of WHO, FEPA?
    (i) Drinking (ii) Industrial Purpose (iii) Irrigation
135. What are the point and non-point sources of surface water pollution in the area?

(a) Industry (b) Sewage system (c) Storm water run-off (d) Salt (e) Blackish water infusion (g) Agriculture

136. Has there been any threat to aquatic life by the dam? Yes/No If yes, how
137. What is the effect of the dry weather characteristic of the area with the siting of the dam.
(i) High (ii) Moderate (iii) Low

C. GEOLOGY

138. Was there an incident of tectonic/seismic activity and/or volcanic activity ever reported since the siting of the dam in the area? Yes/No
139. List geological features of educational/scientific/aesthetic and human interest at or adjacent to the dam. (a) Rock (b) Parks (c) Garden (d) Shrines (e) Sacred/forestland
140. Has the siting of dam affected the uniqueness of these features? Yes/No. If yes, state how
141. Are there mineral resources of potential value and activities of local miners in the area near the dam? If yes name them?
142. Were there rocks susceptible to physical/chemical weathering in the area? Yes/No

D. SOIL

143. How has the construction of the dam and its operational practices affected loss of soil by erosion
(a) **Wind erosion** - greatly/sparsely/Nil
(b) **Water erosion** - greatly/sparsely/Nil
144. Has there been risk to life, damage to structure due to sudden failure of soil if yes, explain
145. What are the soil properties of the area in terms of
(a) **Strength** - strong/weak
(b) **Ground condition** - strong/weak
(c) **Strength of Rock** - Strong/weak
146. Was there an alteration to existing condition in term of (a) water regime (b) Topography (c) Landscaping. Yes/No

E. ECOLOGY

147. What are the categories of species in the dam area (a) Unusual species (b) Rare species (c) Endangered species
148. What species providing food and cover for wild life
(i) (ii) (iii) (iv) Others, specify.
149. Are there species particularly susceptible to human activities? If yes, name them.
150. What are the different species of plants animals and their distribution over the area?
151. Were there unusual plant communities population of scientific value at the Dam area? Yes/No
152. How has the dam affected/impaired agricultural and other activities at the down stream.

F. ENVIRONMENTALLY SENSITIVE AREAS

153. Is the dam located on or near a forestly land? Yes/No
154. Is the dam location near to any industry or closer to disposed waste material? Yes/No

G. LAND USE AND LAND CAPABILITY

155. What was the land use classification in and near the dam area. (a) Agricultural (b) Quarrying (c) Grazing (d) Silviculture (e) Development (f) Others, specify
156. What is the land capability on and near the dam site (a) Crop land (b) Range land (c) Forest land (d) Pasture land (e) Others, specify
157. Has the dam degraded land capability type? Yes/No.
158. Has the dam conflicted with existing or propose land use? Yes/No

H. NOISE AND VIBRATION

159. Was there a recorded case(s) of hearing loss by workers during construction Yes/No
160. Classify the area during the construction of the dam.
(a) Very quiet (b) Quiet (c) Noisy (d) Very noisy
161. What can now be said about external noise level after the construction of the dam.
(a) **Transportation after the dam** Low/loud
(b) **Dam activities as presently seen** Low/loud
162. Were there sensitive land users within (1mile or 5/8 km) of the area. (a) Educational Building (b) Hospital (c) Churches (d) Mosques (e) Recreational areas (f) Others, specify.

I. VISUAL QUALITY

163. State how the content of the scene perceived by the residents of the surrounding area has been adversely affected by the dam. (i) Not clear (ii) Clear (iii) Very clear
164. Describe the coherence of the surrounding areas after the dam has been sited
(a) consistent (b) Not consistent

J. ARCHEOLOGICAL, HISTORIC AND CULTURAL CHARACTERISTICS

165. What are the regional/local archeological sites and structure in the dam site? (a) Museum (b) Monuments (c) Statues (d) Others, specify
166. How have tourism activities at archeological, historic,/cultural structure sites of the area affected due to the establishment of the dam (a) Seriously disrupted (b) Partially disrupted (c) Completely stopped (d) Others, specify
167. Have existing and desirable future pattern of access for siting of the dam been disrupted? Answer in terms of (a) Statistism mobility (b) Associational pattern (c) Recreational pattern

K. SOCIO-ECONOMIC ENVIRONMENT

168. What is the current population estimate of the dam area?
169. State the predominant age distribution (in years) of the area.
1 - 10 yrs
11 - 20 yrs
21 - 30 yrs
31 - 40 yrs
41 - 50 yrs
51 - 60 yrs
Above 60 yrs

170. State the sex distribution of the population (a) Predominantly males (b) Predominantly females (c) The same numbers of males and females

171. Comment on the rural -urban population distribution of the area ie estimate of the population that move to the urban area and those that remain in the area.
   (a) Majority stay in the urban area
   (b) Only few stay in the urban areas
   (c) About egual number

172. State the different ethnic groups that are found in the area
   (a) Ibo
   (b) Hausa
   (c) Yoruba
   (d) Gwari
   (e) Other, Specify.

173 What population dynamics exist in the area in terms of,
   (a) **Birth rates:** High/Moderate/Low
   (b) **Death rates:** High/Moderate/Low

174 Give an estimate of the number of
   (a) Births in a year_____
   (b) Deaths in a year_____

175 State the prevailing pattern of migration in the area.
   (a) Seasonal
   (b) Cyclic
   (c) Progressive

176 What is/are the land tenure systems currently practiced in the area?
   (a) Communal
   (b) Inheritance
   (c) Lease hold/tenancy
   (d) Rent
   (e) Purchased
   (f) Free gift

177 What was the population settement pattern within the area
   (a) Sparse
   (b) Clustered
   (c) Scattered

178 Was there any displacement of population as a result of the sitting of the dam in the area? Was compensation paid the displacid People Yes/No

179 Has the dam conflcted with areas in multiple use (e.g areas use by both nomadic pastoralists and sedentary agriculturalists sharing the same region but using different land types, adopting contrasting settlement practices and interracting at certain localities owing to a natural dependence?) Yes/No If yes, explain

180. What is the current estimate of the working population? (a) 5 - 15% (b) 16 - 30% (c) 31 - 45% (d) 40 - 60% (e) > - 60%

181. Comment on the skill of the working population
   (a) Skilled (b) Semi - skilled (c) Unskilled

182. Comment on the level of training of the working population (a) Well trained
(b) Moderately trained (c) poorly trained (d) No formal training
183. The working population is predominantly in (a) Agriculture (b) Commerce
(c) Production (d) Industry (e) Craft (f) Others, specify
184.. What type of experience has the working population acquired from the dam?
(a) industrial employment (b) wage-labour (c) shift work
185. How has the dam affected the propensity for enterpreneurial activity in the area?
(a) created more awareness
(b) stimulated secondary economic activity
(c) both (a) and (b)
186. Has the dam affected the propensity for trade and commerce in the area? Yes/No
187. How has the dam affected the dependence of primary economic activities on services and goods produced locally?
(a) stimulated secondary economic activity
(b) improved quality of goods and services
(c) both (a) and (b)
188. State the effects of the dam on economic linkage of the area with other areas.
(a) greatly improved local trade
(b) opened up more trade routes
(c) improved road network
(d) all of a, b, and c
(e) Others, specify
189. How has the dam affected the local economy of the area hitherto based exclusively on trade and commerce?
(a) now oriented towards manufacturing
(b) now oriented towards industrial activity
(c) now oriented towards sufficient food production
(d) both (a) and (b)
190. Comment on how the dam has affected the range of income distribution related to ownership of
(a) **resources** (i) depleted resources (ii) resources unaffected (iii) increased value of resources
(b) **employment pattern** (i) loss of jobs (ii) creation of job (iii) change of jobs
(c) **overall social structure** (i) improved (ii) reduced (iii) widened the gap
(iv) reduced the gap (v) remain the same.
191. Was there a propensity for consumption patterns to stimulate secondary economic activity? Yes/No.
192. How has the dam affected the degree of stability of social organization within the area?
(a) strengthened it
(b) weakened it
(c) no effect
193. Comment on the willingness of the people to incorporate new members into the area. (a) Strong (b) Weak (c) Partial
194. How has the dam affected homogeneity of population of the area? (a) stratified it
(b) not stratified
195. Comment on the rate of urbanization and contact with urban society since the dam was established. (a) increased (b) decreased (c) encouraged (d) discouraged

196. Comment on the complexity of social relationships since the establishment of the dam in the area (a) predominantly village-based (b) multiplex relationships
(c) urban-based more selective relationships.

197. What was the crime rate like after siting the dam (a) high (b) Moderate (c) Low (d) Nil.

198. Comment on the following crucial dynamic factors since the establishment of the Dam in the area

(a) changes in birth rate (resulting from birth control policies, health provision improvements, etc.) (increased/decreased/no effect)

(b) changes in death rate (resulting from birth control policies, health provision improvements, etc.) (increased/decreased/ no effect)

(c) changes in levels of health (increased/decreased/no effect)

(d) changes in levels of nutrition (increased/decreased/no effect)

(e) changes in the distribution of ethnic groups (increased/decreased/no effect)

(f) changes in existing pattern of employment and economic activity (e.g. from subsistence agriculture and craft production to cash crops and factory production) (increased/decreased/no effect).

(g) changes in rates of out-migration (increased/decreased/no effect)

(h) changes in rates of in-migration (increased/decreased/no effect)

(i) imbalances or stress evident in the social structure e.g. changes in family organisation from extended to nuclear, a widening generation gap owing to participation in different cultural domains (traditional and modern), a change in economic fortune or involvement of one social group or class relative to another (increased/decreased/no effect)

(j) Any cultural changes or imbalance, such as an increased secularization within a population or an adoption of alien industrial values in place of traditional, rural orientation and norms (increased/decreased/no effect)

199. Give as many advantages resulting from the siting of the dam in the area.
(i)
(ii)
(iii)
(iv)
(v)
(vi)

ITEM	ELEMENTS	BASELINE INFORMATION S1	S2	S3	AVERAGE
	A. CLIMATE AND AIR QUALITY				
30	Local wind direction				
31	Local wind speed				
32	Unusual condition of wind flow				
33	Factors responsible for wind channelling				
34	State High risk areas				
35	Extreme temperature (Low/High)				
36	Naturally projected wind breakers/height				
37	Unusual condition of rainfall				
38	High risk area				
39	Odour Characteristic				
	(a) Odour				
	(b) Type				
	(c) Intensity				
	(d) Duration				
40	Condition of local precipitation/rainfall/humidity pattern				
41	Unusual rainfall leading to damage				
	B. WATER				
42	Nature of Hydrology				
43	Ground water regime				
	(a) Quality				
	(b) Quantity				
	(c) Time of recharge of major well				
	(d) Time of depletion of majorwell				
	(e) Extent of major well				
44	Sources of water in the area				
45	Nature of drainage/sediment influx				
46	Erosion potential of soil				

ITEM	ELEMENTS	BASELINE INFORMATION			
		S1	S2	S3	AVERAGE
47	Out break of water related diseases				
48	Water quality standards				
49	Source(s) of water pollution				
50	Threat to aquatic life				
51	Effect of dry weather characteristic				
	C. GEOLOGY				
52	Tectonic/Seismic/volcanic activity				
53	Geological features				
54	Threat to Geological features				
55	Resources of potential weathering				
56	Physical/chemical weathering				
57	History of subsidence				
	D. SOIL				
58	Soil erosion affected by				
	(a) Wind erosion				
	(b) Water erosion				
59	Risk to damage to life, structures or services due to				
	settlement				
60	Soil properties				
	(a) Strength of soil				
	(b) Ground condition				
	(c) Strength of rock				
61	Alteration to existing condition				
	(a) Water regime				
	(b) Topography				
	(c) Landscaping				
62	If yes, what is responsible?				
63	Species of plants and animals.				

ITEM	ELEMENTS	BASELINE INFORMATION			
		S1	S2	S3	AVERAGE
64	Species providing food and cover for wildlife				
65	Species susceptible to human activities				
66	Species of plant and animal distribution				
67	Plant communities of Scientific value				
68	Impaired productivity of land				
	F. ENVIRONMENTALLY SENSITIVE AREAS				
69	Prime agricultural area.				
70	Was the area a forestry land?				
71	Solid waste disposal near the area				
	G. LAND USE AND LAND CAPABILITY				
72	Land use classification				
73	Land capability				
74	Land degrading evidence				
75	Proposed purpose of land				
	H. NOISE AND VIBRATION				
76	Medical record available				
77	Area classification				
78	External noise level due to				
	(a) Transportation				
	(b) Construction of dam				
79	Sensitive land users				
	I. VISUAL QUALITY				
80	Content of scene				
81	Coherence of the area				
	J. ARCHEOLOGICAL HISTORICAL AND CULTURAL CHARACTERISTICS				
82	Archeological, Historical and Cultural site				
83	Tourism activities				

ITEM	ELEMENTS	BASELINE INFORMATION S1	S2	S3	AVERAGE
84	Existing and desirably pattern of access.				
	K. SOCIO-ECONOMIC ENVIRONMENT				
85	Population estimate				
86	Age distribution				
87	Sex distribution				
88	Rural - Urban population distribution				
89	Ethnic constituent				
90	Population dynamics				
	(a) Birth rate				
	(b) Death rate				
91	Estimate of				
	(a) Birth in a year				
	(b) Death in a year				
92	Prevailing pattern of migration				
93	Predominant land tenure system				
94	Population settlement pattern				
95	Area inhabitancy				
96	Area in multiple use				
97	Size of working population				
98	Skills of working population				
99	Level of training of working population				
100	Working population area of specialisation				
101	Experience of working population				
102	Propensity for trade and commerce				
103	Propensity for enterpreneural activities				
104	Dependence on primary economic activities				
105	Economic linkage				
106	Nature of local economy				

ITEM	ELEMENTS	BASELINE INFORMATION			
		S1	S2	S3	AVERAGE
107	Range of income distribution				
108	Propensity for comsumption				
109	Degree of stability of social organisation				
110	Willingness to incoperate new members				
111	Homogeneity of population				
112	Rate of urbanisation				
113	Complexity of social relationships				
114	Crime rate				
115	Comment of crucial dynamic factors				
	(a) Changes in Birth rate				
	(b) Changes in Death rate				
	(c) Changes in level of health				
	(d) Changes in level of nutrition				
	(e) Changes in distribution of ethnic groups				
	(f) Changes in existing patterns of employment				
	(g) Changes in rates of Out-migration				
	(h) Changes in rates of In-migration				
	(i) Imbalances or stress evident in social structure				
	(j) Cultural changes, and increased secularisation				
116	Advantages of dam				

	A. CLIMATE AND AIR QUALITY				
30	Local wind direction				
31	Local wind speed				
32	Unusual condition of wind flow				
33	Factors responsible for wind channelling				
34	State High risk areas				
35	Extreme temperature (Low/High)				
36	Naturally projected wind breakers/height				
37	Unusual condition of rainfall				
38	High risk area				
39	Odour Characteristics				
	(a) Odour				
	(b) Type				
	(c) Intensity				
	(d) Duration				
40	Condition of local precipitation/rainfall/humidity pattern				
41	Unusual rainfall leading to damage				
	B. WATER				
42	Nature of Hydrology				
43	Ground water regime				
	(a) Quality				
	(b) Quantity				
	(c) Time of recharge of major well				
	(d) Time of depletion of major well				
	(e) Extent of major well				
44	Sources of water in the area				
45	Nature of drainage/sediment influx				
46	Erosion potential of soil				

47	Out break of water related diseases				
48	Water quality standards				
49	Source(s) of water pollution				
50	Threat to aquatic life				
51	Effect of dry weather characteristic				
	C. GEOLOGY				
52	Tectonic/Seismic/volcanic activity				
53	Geological features				
54	Threat to Geological features				
55	Resources of potential weathering				
56	Physical/chemical weathering				
57	History of subsidence				
	D. SOIL				
58	Soil erosion affected by				
	(a) Wind erosion				
	(b) Water erosion				
59	Risk to damage to life, structures or services due to settlement				
60	Soil properties				
	(a) Strength of soil				
	(b) Ground condition				
	(c) Strength of rock				
61	Alteration to existing condition				
	(a) Water regime				
	(b) Topography				
	(c) Landscaping				
62	If yes, what is responsible?				
63	Species of plants and animals.				

ITEM	ELEMENTS	SCREENING INFORMATION S1	S2	S3	AVERAGE
64	Species providing food and cover for wildlife				
65	Species susceptible to human activities				
66	Species of plant and animal distribution				
67	Plant communities of Scientific value				
68	Impaired productivity of land.				
	F. ENVIRONMENTALLY SENSITIVE AREAS				
69	Prime agricultural area.				
70	Was the area a forestry land?				
71	Solid waste disposal near the area				
	G. LAND USE AND LAND CAPABILITY				
72	Land use classification				
73	Land capability				
74	Land degrading evidence				
75	Proposed purpose of land				
	H. NOISE AND VIBRATION				
76	Medical record available				
77	Area classification				
78	External noise level due to.				
	(a) Transportation				
	(b) Construction of dam				
79	Sensitive land users				
	I. VISUAL QUALITY				
80	Content of scene				
81	Coherence of the area				
	J. ARCHEOLOGICAL HISTORICAL AND CULTURAL CHARACTERISTICS				
82	Archeological, Historical and Cultural site				
83	Tourism activities				

ITEM	ELEMENTS	SCREENING INFORMATION S1	S2	S3	AVERAGE
84	Existing and desirably pattern of access.				
	K. SOCIO-ECONOMIC ENVIRONMENT				
85	Population estimate				
86	Age distribution				
87	Sex distribution				
88	Rural - Urban population distribution				
89	Ethnic constituent				
90	Population dynamics				
	(a) Birth rate				
	(b) Death rate				
91	Estimate of				
	(a) Birth in a year				
	(b) Death in a year				
92	Prevailing pattern of migration				
93	Predominant land tenure system				
94	Population settlement pattern				
95	Area inhabitancy				
96	Area in multiple use				
97	Size of working population				
98	Skills of working population				
99	Level of training of working population				
100	Working population area of specialisation				
101	Experience of working population				
102	Propensity for trade and commerce				
103	Propensity for enterpreneural activities				
104	Dependence on primary economic activities				
105	Economic linkage				
106	Nature of local economy				

ITEM	ELEMENTS	SCREENING INFORMATION			
		S1	S2	S3	AVERAGE
107	Range of income distribution				
108	Propensity for comsumption				
109	Degree of stability of social organisation				
110	Willingness to incoperate new members				
111	Homogeneity of population				
112	Rate of urbanisation				
113	Complexity of social relationships				
114	Crime rate				
115	Comment of crucial dynamic factors				
	(a) Changes in Birth rate				
	(b) Changes in Death rate				
	(c) Changes in level of health				
	(d) Changes in level of nutrition				
	(e) Changes in distribution of ethnic groups				
	(f) Changes in existing patterns of employment				
	(g) Changes in rates of Out-migration				
	(h) Changes in rates of In-migration				
	(i) Imbalances or stress evident in social structure				
	(j) Cultural changes, and increased secularisation				
116	Advantages of dam				

ITEM	ELEMENTS	BASELINE INFORMATION AVERAGE	SCREENING INFORMATION AVERAGE	IMPACT
	A. CLIMATE AND AIR QUALITY			
30	Local wind direction			
31	Local wind speed			
32	Unusual condition of wind flow			
33	Factors responsible for wind channelling			
34	State High risk areas			
35	Extreme temperature (Low/High)			
36	Naturally projected wind breakers/height			
37	Unusual condition of rainfall			
38	High risk area			
39	Odour Characteristic			
	(a) Odour			
	(b) Type			
	(c) Intensity			
	(d) Duration			
40	Condition of local precipitation/rainfall/humidity pattern			
41	Unusual rainfall leading to damage			
	B. WATER			
42	Nature of Hydrology			
43	Ground water regime			
	(a) Quality			
	(b) Quantity			
	(c) Time of recharge of major well			
	(d) Time of depletion of major well			
	(e) Extent of major well			
44	Sources of water in the area			
45	Nature of drainage/sediment influx			
46	Erosion potential of soil			

ITEM	ELEMENTS	BASELINE INFORMATION AVERAGE	SCREENING INFORMATION AVERAGE	IMPACT
47	Out break of water related diseases			
48	Water quality standards			
49	Source(s) of water pollution			
50	Threat to aquatic life			
51	Effect of dry weather characteristic			
	C. GEOLOGY			
52	Tectonic/Seismic/volcanic activity			
53	Geological features			
54	Threat to Geological features			
55	Resources of potential weathering			
56	Physical/chemical weathering			
57	History of subsidence			
	D. SOIL			
58	Soil erosion affected by			
	(a) Wind erosion			
	(b) Water erosion			
59	Risk to damage to life, structures or services			
	due to settlement			
60	Soil properties			
	(a) Strength of soil			
	(b) Ground condition			
	(c) Strength of rock			
61	Alteration to existing condition			
	(a) Water regime			
	(b) Topography			
	(c) Landscaping			
62	If yes, what is responsible?			
63	Species of plants and animals.,			

ITEM	ELEMENTS	BASELINE INFORMATION AVERAGE	SCREENING INFORMATION AVERAGE	IMPACT
64	Species providing food and cover for wildlife			
65	Species susceptible to human activities			
66	Species of plant and animal distribution			
67	Plant communities of Scientific value			
68	Impaired productivity of land			
	F. ENVIRONMENTALLY SENSITIVE AREAS			
69	Prime agricultural area.			
70	Was the area a forestry land?			
71	Solid waste disposal near the area			
	G. LAND USE AND LAND CAPABILITY			
72	Land use classification			
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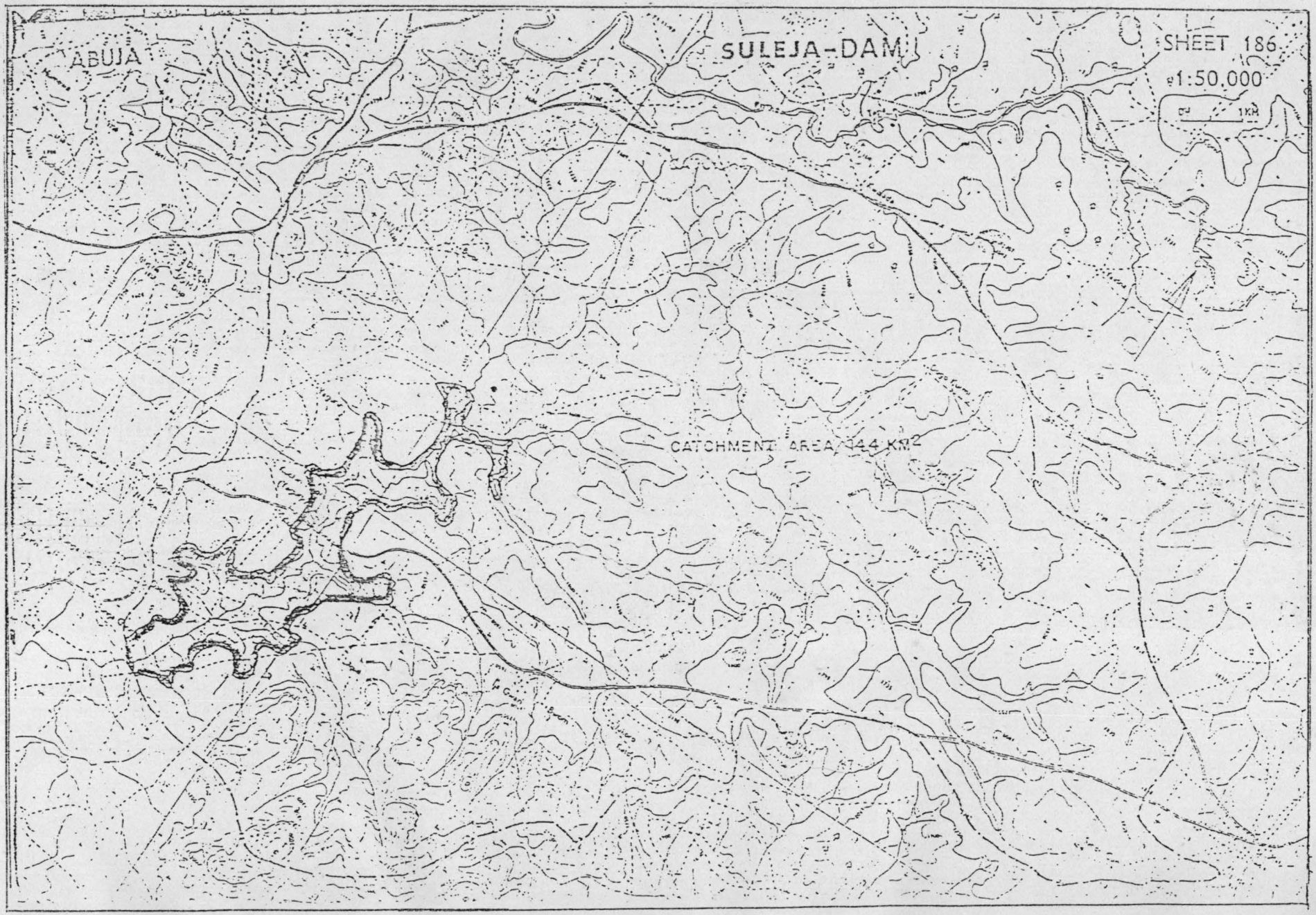
116	Advantages of dam			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