ENVIRONMENTAL AUDITING OF TUNGA KAWO DAM AND IRRIGATION PROJECT

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DECLARATION

I hereby declared that this project titled Environmental impact Auditing of Tunga Kawo Dam and Irrigation Project has been conducted by me under the guidance of my supervisors in persons of Engr (Mrs) H.I Mustapha and Mr P.A Adeoye of the department of Agricultural and Bio-Resources Engineering, school of Engineering and Engineering Technology, Federal University of Technology Minna and that I have neither copy someone's work nor has someone done it for me.

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CERTIFICATION

This thesis titled Environmental Impact Auditing of Tunga Kawo Dam and Irrigation Project by Mammasani A. Usman PDG/SEET/AGRIC ENG/2006/196 meets the regulations governing the award of degree of post graduate diploma of the federal university of technology minna and is approved for its contribution to scientific knowledge and literary presentation

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DEDICATION

This project is dedicated to my wife and children for being able to manage me as husband and father for this while despite my inadequacy.

ACKNOWLEDGMENT

Glorious is the name of God, the most gracious the most merciful, who have made it possible for me to start this programme and complete it.

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ABSTRACT

Tunga Kawo resenroir provides controlled facilities for downstream irrigation of a gross area of 900 hectares as well as flood and drainage control work to reclaim about 1,125 hectares. Environmental Impact Assessment was not, carried out for this project. This work therefore examines the auditing and monitoring of Tunga kawo Dam and irrigation project. The results indicate that there is no serious threat to health as it was observed from record obtained from the hospital on water related diseases. The scheme has benefited the participating farmers as their life style has improved. There was evident of imbalance in fertilizer application as fertilizer is needed to improve yield, but effort should be made to apply it at appropriate time and quantity so that water quality within the project is not affected by excessive salt leaching. The reservoir is being threat by a number of horizontal cracks which are presented in form of plate. Also the piezometer wells are no longer functional; therefore seepage which is a generally characteristic of all earth dam cannot be monitored. There are also evidences of aquatic weeds which is interpreted to mean reservoir siltation. Appropriate mitigation measures are recommended for Tunga Kawo dam and irrigation project to minimize the effect of serious negative environmental impact auditing.

CHAPTER ONE

1.0 Introduction

1.1 Background to the Study

Various policy measures, particularly in the recent developmental plan have been directed by all level of government at improving the agricultural sector. These policies such as accelerated cassava production, ban on importation of rice, part of the current seven-point agenda of the present government are aimed at increasing as well as modernizing agricultural sector, and thereby bring the required increase in output.

Raw material needed for the country's Agro-based industries and as well as export driven economy are the primary target. The strategy is to utilize small scale farmers to whom government is giving the necessary encouragement and support via construction of large and medium dams for irrigated agriculture as well as supply of other inputs such as fertilizer and chemical. The results of all these intervention are increased in self employment and increase in income generation.

Tunga-Kawo dam and irrigation project naturally fits into these government policies as it affects the agricultural sector.

The scheme is one of the multi/-purpose projects embarked upon by the Upper Niger River Basin Development Authority to satisfy this yarning.

The project was conceived as far back as 1955 by the defunct Northern Nigeria Government as a solution to the frequent flooding of valuable agricultural land in the project area by river Ubandawaki and Bankogi. The reservoir therefore was to provide controlled facilities for down/-stream irrigation of a gross area of 900 hectares as well as flood and drainage control work to reclaim about 1,215 hectares (UNRBDA,1985).The propjet was transferred to North Western State Government in 1976 after its creation. The Niger State Government inherited the project in late 1976. The project was eventually transferred to the defunct Niger River Basin Development Authority in 1978. It was completed and commissioned in 1988.

The generic process of project level environment impact assessment (EIA) was institutionalized in the United State (US) as a requirement of the country's National Environmental Policy act (NEPA) of 1969 which was signed into law at the beginning of 1970. At the dawn of the 21st century, therefore, EIA has sufficiently developed the capacity to enable the procedure to help move forward the practical essence of environmental management from the recognition and reflection of environmental consideration at every stage of development process to addressing the causes of unsustainable development (Nwafor, 2006; Sadler, 1994; World Bank, 1997).

Nigerian is a signatory to the international environmental treaties of 1972 covered by United Nation on human environmental in Stockholm Sweden, with over 115 countries of the world which have environmental protection agencies (EPA).

Nigeria in 1988 with Decree 58 established the Federal Environmental Protection Agency (FEPA) with the responsibility of monitoring, controlling, and regulating activities related to the environment with intention of safe guarding the environment. The necessary legal framework has been put in place for its implementation.

At the state level are State Edicts and Regulation (SER). Degree 86 of 1992 established the Environmental Impact Assessment (EIA) as a compulsory pre-requisite for any major economic activity operating before during and after such operation with an aim of protecting the environment from adverse consequences.

The main objective of Tungan Kawo dam is to harness the surface water of about $166km^2$ of its catchment area for purpose of dry season farming and also for control of flood in the vicinity of the project area. It has a secondary objective of providing drinking water for the villages bordering the scheme, namely, the Wushishi town, Bankogi, Kassan Kogi, Dankwagi, Kanko, Kodo, Tunga Kawo villages, although the facilities to treat water and distribute it were never in place.(UNRBDA,1985)

Reservoir storage and irrigation infrastructures are known to have impacts on the environment within which such project use situated. These effects transcend beyond the immediate region of the project to a wider boundaries.

Some of these effects include the displacement of human settlement for the project which may result in lost cultural value, ancestral objects of importance etc. The reservoir in place can serve, as breeding grounds for emergence and spread of various kinds of diseases. It is on the basis of these legislations that Environmental Impact Assessment (EIA) become necessary before the commencement of the construction so that the likely adverse effect of the dam and its component on the local, regional and even international environment will be evaluated and mitigated against.

The legislation also provide for assessment of an existing project whose EIA was not done prior to the establishment of the decree on EIA. Tungan kawo falls under this description, and therefore, the effect of the project on its environment since it was commissioned in 1988 can be evaluated and useful solution proffered.

1.2 Statement of Problem

The Environmental Auditing shall be conducted to identify the various environmental hazard associated with project of its kind, which are in most cases environmental/location dependent. It is intended to be valuable information that will assists the community to live a better life than it is obtain now. The supervising agent will find the report useful by readjusting their implementation strategy to be community friendly.

1.3 Objectives

To indentify environmental risk and uncertainty of the Tunga Kawo Dam project area

To fulfill environmental legislation and standards that applies to the project in accordance to guideline of 2000.

To recommend for environmental management and mitigation as it affect land, water and people.

1.4 Justification

Most projects, whether be reservoir, irrigation project or oil and gas project have both the advantages and the disadvantages aspects. The advantage aspects are those that affect the people live positively, while the disadvantage aspect affects the people's life negatively. Most atime project benefits are discussed and high lighten while the negative consequence are not mentioned at all as if they don't exist even though they are there.

This research is expected to provide information on both the positive and the negative impact of the project site which will help the relevant agency to work out the necessary mitigation measures.

1.5 Scope of study

The scope of this work is limited to Tunga kawo scheme. The study commenced in August 2008. It is hope that environmental auditing will be valuable information that will assist the community. The checklist method will be used to asses these information, which includes oral interview, questionnaire, photograph and information available from the supervising agent.

Efforts will be made to discuss the problem within the context of available data, and proffer solution or mitigation method to checkmate the problem identified.

CHAPTER TWO

2.0 Literature Review

Several Environmental Impact Assessment (EIA) methods have been developed. Each of these methods has its own objective and consequently needs to be matched by appropriate usage method for accomplishing it. Numerous methods, available for Environmental Impact Assessment are: Check list, interaction matrix, overlay mapping, networks, and simulation modeling (Nwafor, 1999).

There are numbers of points that need to be considered for better understanding and effective application of methods for impact assessment studies. They comprises the following according to (Canter, 1986; loran, 1975, Nwafor, 1999);

It is not necessary to use a mythology in its entirety in an impact study, rather it may be instructive to use portion of methodology for certain requisite activities.

Additional methodologies are being tested. Therefore there is no universally accepted method which can be applied to all projects in all environmental settings.

Accordingly the most appropriate perspective is to consider mythologies as tool which can be used to aid the impact assessment process.

Every method should be project and location specific with the basic concept desirable from existing methodologies.

Methodologies do not provide-complete answers to all question related to the impacts of a potential project.

Methodologies must be selected based on appropriate evaluation and professional judgment, and they must be used with the continuous application of judgment relative to data inputs as well as analysis and interpretation of results.

2.1 Check lists

Check list range from simple listings of environmental factors, and development action likely to cause impacts to descriptive approach. These include information on measurement production and interpretation of changes for identified environment.

Checklist may also involve scaling or ranking of impact of alternative on each of environmental factor under consideration. The several basic formats for check list as arranged by (Bisset, 1987) fall into four major types namely, simple checklist, description checklist, scaling checklist and scaling weighing checklist.

2.1.1 Simple checklist

It represents a listing of potentially affected environmental factors which should be addressed. Because simple checklist merely represent list of environmental factors, they have a number of weaknesses as a methodology of choice for impact assessment. Some identified weaknesses include the following.

Simple checklist provides no guideline or information on how various factor are all to be measured, no information is provided on specific data needs such as method for measurement, or impact prediction and assessment. The use of the questionnaire checklist will indicate which one of the following three options applies, use of checklist indicates that there are no significant environment issues for consideration that is no environmental analysis needed, use of checklist indicates that there is some significant environmental issue that should be assessed with the project feasibility study that is there is need for environmental analysis and use of the checklist indicates that there are serious environmental studies: need for EIA study.

2.1.2 Descriptive Checklist

It is a methodology that includes lists of environmental factors along with information on measurement and impact prediction Nwafor, Canter, 1986). This results in a more adequate method of data collation with both the potential impact and its constituents being considered.

A good number of descriptive checklists have been developed for environmental assessment of water resources. The approach by (Nwafor ,Canter and Hill, 1979) suggested a list of 62 environmental factors related to the environmental quality account used for project evaluation in the United State. For each factor, information is included on their definition and measurement, prediction of impacts and functional curves for data interpretation.

Another example of the application of descriptive checklist methodology is for transportation and land development projects. A highly interesting aspect of this method is the overt concern for social-economic aspect which is usually the weakness component in EIA. Social impact include those related to community cohesive accessibility of facilities and services, and displacement of people. Economic impact are related to those on employment, income and business activity, residential activity, property taxes, regional and community plans growth and resource. Physical impacts address changes in aesthetics and historic values, terrestrial and aquatic ecosystem, air quality, noise and vibration. For each of the identified environmental factors, workable state of the art methods and techniques for impact identification data collection, analysis and evaluation are included.

2.1.3 Scaling or Ranking Checklist

Scaling checklist are similar to descriptive checklists but with the addition of information, basic to subjective scaling of parameter values. They list all of the pertinent factors and then estimate the magnitude and the importance of the impacts. This, in the scaling checklist criteria for evaluation are incorporated into the listing, usually in the form of a subjective rating.

This procedure results in a more adequate method. of data collection, with both the potential impact and its constituent element being considered. Scaling refers to the assignment of an algebraic or letter scale to the impact of each alternative being evaluated on each environmental factor. On the other hand, ranking checklists refer to these approaches in which alternative are ranked from best to worst in terms of their potential impacts on identified environmental factors (Nwafor,1999). This type of checklist is useful for comparative evaluation of the preferred alternatives.

Table 2.1: Application of Scaling Checklist Methodology

	Development scaling checklist	Area of application
1	Fitzsimmon, stuart and woiff (1975)	Social well being account of water resources project
2	Adkins and Burke (1974)	Evaluation of transport route alternatives
3	Voorhees and associates (1995)	Housing and urban development
4	Duke et al. (1977)	Water resources project

Table 2.2 Scales for Water Quantity Impact in Housing and Urban Development Methodology

Scale	Comment
A+	Clearly beneficial effect are likely to occur
A	Water quality standard are met for water uses intended by the project. Waste water will be discharge into waste water treatment system
B	Water quality standard are met for with use intended by the project .Waste water may received best available treatment
C	Existing water quality is at or below official standard. project may cause pollution of ground water
C^-	Project will causes surface or ground water quality standard

Sources: Voorhess and associate 1975

2.1.4 Weighting scaling checklist

This refer to methodologies which have been devised to enable all adverse as well as beneficial import for a single project, or more usefully alternative projects to be compared in the form of quantitative indices. The result has been the formulation of quasi-mathematical methods in which impacts are weighted in terms of relative importance, transformed into units from a common national scale and finally manipulated mathematically to form impact indices,(Nwafor, (Bisset, 1986). Thus they represent a scaling checklist with information provided as to the subjective evaluation of each parameter with respect to every other parameter. Weighting scaling checklist methodologies embody the assignment of relative important weights to environmental factors and impact scales for each alternative relative to each factor. On the other hand weighting-ranking checklist involve important weight assignments and the relative ranking of the alternatives from best to worst in terms of their impacts on each environmental factor. The most well-known of these method is the Environmental Evaluation System (EES) described by Dee et al (1973).

The method was devised for water resources project, but can be applied to other projects. The EES is a scaled checklist which assigned scores (value function) relating to the impact of each of the 78 (most of environmental) parameters relating to ecology environmental pollution aesthetic and human interests. These cores are then transformed into a single overall value representing the predicted impact for each project alternative.

Standardized graph are used to perform these data transfer and the key idea behind the EES approach is to identify the parameters mostly sensitive to impact as a result of the proposed project (Canter 1986).

2.2.0 Interaction Matrix Methodologies

A matrix is a diagram which links environmental features, or potential environmental impacts on these features, with action associated with a proposed project. Interaction matrices were one of the earliest types of methodologies which were developed as a result of desired to link environmental factors with project activities. A simple matrix refers to a display of project action or activities along one axis, with appropriate environmental factors listed along the other axis of the matrix.(Nwafor, Pierrce, 1998) have described the interaction matrix technique as a two dimensional listing of existing characteristic and conditions of the environment and detailed proposed actions that may affect it.

Shopley and Fuggle, (1984) described matrices as grid diagrams with one set of factors on the horizontal axis and another on the vertical. The interaction between components on the opposing axis is recorded in the cell common to both in either a presentational manner using symbol or numerical scores or in mathematical manner, using algebraic functions.

2.2.1 The Leopold Matrix

Many variants of the simple interaction matrix including stepped matrices have been utilized in environmental impact studies. According to (Nwafor, 2006) sum of the numerous applications of interaction matrices in impact assessment include those by Fish and Davies, (1973), Leopold (1971), Moore (1973), Phillips and Defilippi (1976), Schlesinger and Daerz (1973), Schwind (1977), Whilatch (1976) and York (1978) of these methods the Leopold matrix is retained as the methodologies of choice for the discussion on the application of interaction matrices in Environmental Impact Assessment.

The method involves the use of a matrix, which lists 100 specified (possible) actions such as modification of habitat, urbanization, surface excavation, dam, off shore structure etc within 10 general categories on the horizontal axis and a listing of 88 environmental factors such as soil, land-use flora, floods erosion etc within categories on the vertical axis. An impact is identified at the interaction between an action and environmental items. Where an impact is anticipated the matrix is marked with diagonal line in the interaction box. The second step in using the Leopold matrix is to describe the interaction in terms of its magnitude and importance.

2.2.2 Matrices Developed by Panel of Expert on Environmental Management (PEEM) for Health Impact Assessment

This matrices developed at the third meeting of the panel of experts on environmental management (PEEM) for vector control held in Rome, 1983 under the auspices of the World Health Organization (WHO) and reviewed by Canter (1986) were of great importance because of their potential to expand the methodological horizon of E.I.A student and practitioners in developing countries. One of such matrices is for the assessment of environmental health risks on different population. It can be used at various stages in any water development project to evaluate the health status of the population and to derive the disease potential. The two dimensions used in the matrix are population categories and environmental health risks.

Environmental health impacts are identified and their magnitude estimated on a 1-5 scales, where is the least magnitude and 5 the greatest. This approach is also considered to be good on account of the fact that it include the time element and mechanism for measurement and interpretation of impacts through impact scores.

2.3 Overlay Mapping

Overlay mapping is an approach based on the principle of land capability. However methodology has a long history in a wide variety of planning activities. The application and description of overlay mapping technique in EIA has been traced by both Bisset (1986) and Smith (1993) among others to the pioneering work of McHarg (1968, 1969). In his book littled a comprehensive highway route selection method.

This method was first used manually. According to the description by Bisset (1986) overlays are transparent maps showing components of the existing environment and the changes which may result from a proposed development project. A transparent overlay sheet is prepared as the base map showing the location of the project and the boundaries of the area to be considered. A transparent overlay is prepared for each feature, for example beaches being assessed.

The degree of impact on each feature can be shown by the intensity of shading taken from a specific black/white colour code.

2.3.1 Improvement in overlay Mapping through Geographic Information

Since in late 1970s, the remarkable innovation technology which succeeded each other with amazing rapidity have progressively addressed the technical and conceptual problems which beset overlay mapping.

The revolutionary transformations were brought about by the advent of micro-electronic technology and the personal computer (PC), digital technology, the convergence of the computer and cartography and the emergence of Geographic Information System (GIS). It has provided a means for computer-assisted categorizing as well as a powerful tool for collecting, storing, retrieving and transforming information at will (Nwafor, 2001). These technological innovations and advances have, as they unfolded, progressively brought profound improvement to overlay mapping.

The first phase was the application of computer to cartography. The technical restraint and constraints on overlay mapping were largely overcome through the use of computer and computerized overlay.

The second phase is the incorporation of overlay mapping within Geographic Information System (GIS). Further developments of improvements in overlay approach are expected as it makes better use of GIS.

2.4 Networking Method

Net workings are an extension of matrices incorporating prediction of long-term impacts of project activities. Environmental components are generally inter-connected and form relays or network, and an ecological approach in often demanded in identifying secondary and tertiary impacts. Networks, therefore refer to those methodologies which attempt to integrate impact causes and consequences through identifying interrelationship between causal actions and the impacted environmental factor including these representing secondary and tertiary effects (Canter, 1986).

The network method was developed to identify the links between different impacts and the ways in which aspect of the environment might be affected by more than one impact.

In summary networks was developed expressly to link the secondary and tertiary impact to the primary impact. Some of the strong points of network include the following.

Networkers can be useful because they identify direct and interrelated impact.

They have ability to identify and guide analysis to the indirect impact which may arise from the project

They are particularly useful in identifying anticipated impact associated with proposed project

They also have the capacity to provide a visual understandable representation of those impact

Networks can also aid organizing the discussion of anticipated project impact

Network displays are useful in community information about environmental impact study to interested public

They contain conceptual elements of value in the development of impact assessment methodologies. This is especially significant as impart assessment must seek to address higher order impacts.

Despite above strong point of networks, they still have not been able to lend themselves to wide spread and frequent application, the reasons are.

Network do not contain criteria to determine impact significance and they are similar to other impact assessment methods in that they are still primarily a tools for identifying impacts, not evaluating them (Hyman and Stiftel, 1988).

Networks also identify many more high order impacts that are likely to occur, differentiating those that will occur from those that will not occurs, requires more information than is available, consequently networks are rarely utilized except in a highly abbreviated format because of information constraint and high cost implicit in their use.

2.5 Simulation and Modeling Application

The application of simulation modeling represent EIA methodology of great promise for number of reasons. It has the capacity to extend network methodology via the application of mathematical and other sciences to the modeling of environmental system (Nwafor, 2006). It also has the in-built capacity to expand the scientific frontier of EIA by enabling the procedure to deal meaningfully with its key failings, particularly the problems posed by uncertainty in impact prediction and date.

Simulation model have three basic characteristics first they are simplified representation of the systems under investigation second they are explicit assumption regarding the behavior of those systems and thirdly, simulations models are open to misinterpretation, especially if used out of context,(Munn, 1983). Models have a great many uses n diverse intellectual discipline in both formal and non-formal sciences. They are concerned with simplification, reduction, concretization, experimentation, action, extension, globalization theory formation, description, explanation and prediction(Apostel, 1961).

Thus model may be used to describe explain and/or predict characteristics of environmental system. Amongst other uses of great interest to impact assessment studies is that models have an organizational function with respect to data and allow the maximum amount of information to be squeezed out of the data. Thus the greatest utility of models in environmental impact assessment is in situation where there are few available data, considerable uncertainty as to the dynamic interrelationships between variables and the simulation mode is employed at an early investigation stage to aid in the conceptualization of the impact assessment study (Mun, 1963).

The two tables below shows the summary of international and national legislation on environment.

Table 2.3: International legislation.

S/No	Legislation	Year
1	African convention on the conservation of nature and natural resource	1968
2	Convention concerning the protection of the world cultural and national heritage (world heritage convention)	1972
3	Protocol concerning co-operation in combating pollution in cases of emergency in the west and central African region	1981
4	Convention for the protection of ozone layer	1985
5	Protocol on substances that deplete ozone layer	1987
6	Convention on the control of trans-boundary movement of hazardous waste and their disposal	1998
7	UN framework convention on climate change	1992
8	UN convention on biological biodiversity	1994
9	World bank environmental assessment source books	1998

Source: EIA AunaDam 2008

Table 2.4: National legislation

S/No	Legislation	Year
1	FEPA harmful waste provision Decree 42	1988
2	National guideline and standard for environmental pollution control in Nigeria	1990
3	National pollution abatement in industries and facilities generating waste regulations	1991
4	Waste management and hazardous waste regulations	1991
5	Degree 86, 1992 environmental impact assessments	1992
6	E.I.A sectoral guide line infrastructure	2000
7	National guideline and standard on environmental audit in Nigeria	2000
8	Blueprint on municipal solid waste management in Nigeria	2000
9	The print on handbook on waste management	2000

Source EIA Auna Dam 2008

2.6 Summary of Environmental Impact Assessment of some Dams in Nigeria

A lot of studies have been conducted on the Environmental Impact Assessment of several dams in Nigeria. These are Kagara Dam, Auna Kontagora dam, Jibya dam, Galma dam, and several others. The purpose of such studies is to look at the positive impact and negative impact of such dam. This is because apart from storing sufficient water for all the year farming to bring about required food sufficiency and security. There are the other sides of the coins such as migration problem, diseases associated with water bodies, and other.

The knowledge that an impounded reservoir could be a health risk may allow the government to bring health centre to such community to address these problems.

The finding of environmental assessment from these dams have concession finding as presented in the shown below. The remedial approaches to some of these problems are similarly agreed as a solution.

Table 2.5 General Concession on Environmental Impact Assessment of Dams

S/No	Problem	Effect	Recommended remedy
1	Dam failure	Catastrophic flooding houses, farmland, animal, railway, road telecommunication can be effected	Routine monitoring of the stability of the dam. Establishment of early warning system (instrument)
2	Damming process	Alteration of seasonal flood. Decline in fish species fish fauna instability	Occasional release of water from reservoir provision of fish get gate controlled fishing ranching
3	Construction works	Deforestation alteration of communication Route Dusts, noise through rock blasting. Loss of natural habitat	Watershed management of the irrigation scheme
4	Migration	Increased pressure on land resources, introduction of new culture and disease	Good management of the irrigation scheme as already planned for
5	Work bodies	Increased incidence of disease such as water borne disease water based, water washed and water vector diseases	Disease monitoring and control
6	Displacement of local inhabitant	Psychological problems, problems of readjument to new settlement or location	Priority alternation during allocation of irrigation scheme provision of basic facilities. Organization to form co-operation

Source: EIA Kagara Dam; 2006

CHAPTER THREE

3.0 Material and Methods

3.1 Material

The Tungan Kawo dam and irrigation scheme has reservoir capacity of 22 million cubic matres ($22m^3$) and a gross irrigation area of 900 hectares, comprising 800 hectares under gravity irrigation and the remaining 100 hectare under little irrigation.

The purpose of this study is to carryout environmental impact auditing or monitoring of the project to see how it has affected its immediate environment in the past 20 year of its existence.

3.1.1 Description of the study area

Location: The Tungan kawo dam is built across the flood plain of River Ubandawaki and Bankogi. It is located at 7.5km from Wushishi town in Wushishi Local Government Area of Niger state.

It is located within latitude 7^0N 10^1 and Longitude 6^0E 7^1. The location map is shown as figure 3.1

3.1.2 Climate

Climate: The climate of the project area is the same as that of the middle belt of Nigeria with high temperature and excessive relative humidity during the greater part of the year. The nearest metrological station which has got continuous records for a considerable period is at Minna, some 60km on the eastern side of the project.

Topography

The land surface is fairly elevated and undulating through out the project area. The elevation varies from 83 to 103m above sea level (UNRB, 1985).

Rainfall .

The normal rainfall ranges between 1120mm and 1300mm (Manmansani, 2006).

Temperature

From available record, the temperature varies from $37^0 5^0$C maximum to 18^0C minimum, the hotter period being the month of Feb, March and April every year. (UNRB, 1997).

3.1.3 Hydrology

River Kaduna and Ubandawaki (Gabuko) are the main rivers in the vicinity of the project area. River Ubandawaki on which the project is located has a catchment area of 166sqkm at the dam site (UNRB,85). The River comprises of several minor tributaries which ultimately discharge into River Niagi and it in turn join River Kaduna on the downstream end of the project.

Geology and geomorphology

The project area is situated more or less on the border of the basement complex and Nupe sand stone. The basement complex consists mainly of metamorphic rock with local granite and basic intrusions. While the Nupe sand stone consist of fine sand stone, but sometimes overlain by pliuthite (iron-stone or lateriate).

Drainage

The entire survey area generally drains into River Kaduna. Two small tributaries of River namely, river Bankogi and Ubandawaki flow through the project area.

3.2 Principal feature of the project site

The project site consists of the following main engineering elements which are:

a. Reservoir/dam structure

b. Irrigation, flood and drainage structure

c. Access and service roads

d. Spillway and spillway channel

3.2.1 Reservoir/dam structure

The dam has the following features:

i. A 3.3km length of earth fill dam with a reservoir impoundment of 22cm

ii. A horse-shoe type of reinforced concrete outlet pipe of 1.2m internal diameter with a discharge capacity of $3.34m^3/sec$ at a minimum water level of 107.5m

3.2.2 Irrigation, flood and drainage structure

The main features of the irrigation, flood and drainage structures are as follows:

i. An irrigation system comprising of 0.72km length of lined canal, 10.64km length of unlined secondary and tertiary canal to feed the filed lots.

ii. An escape structure which is located at 0.65km of the main canal which is reinforced concrete box culvert type of dimension 1.4 x0.85 x 7.4m^3 provided with a sliding gate with lifting gear at the upstream end.

iii. A drainage sluice located at the outfall of the main collector drain comprising of 6No. Corrugated steel pipe with flap gates at the down steam end with a capacity of 23.24m^3.

iv. A 6.7cm length flood protection earth embankment against flood water from Ubandawaki River.

v. A drainage system comprising of 7.5km long Bankogi drain to convey flood water from Bankogi river to a 3.2km long main collector drain.

3.2.3 Access and Service Roads

The road work involves the construction of lateritic sub-base and base course and bituminous surfacing of the 11km access road from Wushishi junction to Tunga kawo dam site.

A 14.2m span bridge across river Ubandawaki to link the service road to neighboring Kanko village.

3.2.4 Spillway and Spillway Channel

A gradually varied spill channel which pass through a steep area with an initial bed width of 30m downstream of the stilling basin. The channel has a side slope of $1^1/_2$:1 and finally empties river Ubandawaki with a bed width of 20m and depth of 2.5m.

3.3 Prediction of Impacts

The method adapted for these studies were two folds, the questionnaire schedule and interviews, field visit, observation, sampling and interpretation of available data which mostly fall under checklist method.

Questionnaires were administered in the physical area of health, agronomy, socio cultural and economy.

Information on health include among others the following:

Risk to human health may arise from

Direct exposure to pollutants in the ambient environment via ingestion or respiration.

Change in visibility having effect on traffic safety and road accident.

Changes in sound level causing hearing damage

Changes in micro-organism and vector causing disease.

Indirect effects from reduced human welfare.

3.3.1 Prediction on agronomy (biological/ecological resources)

Development projects can result in the direct removal or disturbance of plant, animal and habitat. It is important to predict number of individual or species effected, the area/type of habitats and the extend of disturbance of biotic communities.

This factor may be predicted as follows

Survey of individuals or habitats through use of aerial photograph, satellite images or field survey may be use to assess loss once a project is in operation or to compare to existing projects to the one proposed.

The use of professional expertise in predicting the effect of disturbance on habitats, possibly through use of complex controlled laboratory experiments.

The empirical close-effect model of the physical effect on plants, animal such as the arrival to region a particular species of bird due to cultivations of rice.

Valuation methods which are used to describe the importance or value of a habitat that will be lost, or to describe its vulnerability to disturbance or the change in value before and after the implementations of the project.

Predictions on effects of explosion to environmental pollutant this can be in terms of increased death rate from specific disease or toxicity, increased incident of disease or damage and change in rate of growth, reproduction, or metabolism

3.3.2 Predicting change in soil quality: Soil quality changes may have both first and second order impact on soil micro-organisms, plants and animals. soil systems are complex and prediction of soil quality's difficult.

The main methods used are:

Mathematical model which simulate the complex soil system and its inputs/outputs.

Empirical model e.g. for nitrogen transport in the soil

Laboratory experiments using column tests and lysimeter to investigate the behavior of substance in soil.

3.3.3 Prediction of soil impact: Soil pollution: The main sources of impacts on soil are: leaching and gas production in landfill sites; there are no formal methods, and predictions are usually done by comparison with existing site operating under comparable condition.

Change in soil structure, erosion and subsidence, variable generally for describing soil structure includes: ground level and slope, soil texture and density, grain and pore size, soil material and soil moisture content

3.3.5 Methods available for predicting soil structure effects include:

Erosions resulting from change in ground cover, management practice, rainfall, runoff wind exposure

Subsidence caused by underground removal of soil

Consolidation settling and shrinkage carried by drainage in specific soil type e.g. peat soil.

All the methods based on mathematical models include:

The universal soil loss equation in which movement of soil from one area is calculated on basis of rainfall, soil type, land slope and management practice.

Korrejans formula for predicting settling.

Several indicators of surface water effects on the environment can be viewed from the following:

Change in surface water hydrology and may be predicted by:

Physical scale modeling where three-dimensional behavior is important e.g. for lake, estuaries, and harbors.

Mathematical model which is based on three dimensional naiver stokes water movement equations

Change in surface water quality including salinity

Mathematical modeling e.g. mixing model which predicts downstream concentration resulting from the mixing of a discharge with a river flow.

Physical scale modeling using three-dimensional models and simulation of pollutions with dyed or hot water

Field experiment involving the release of tracer substance at the proposed point of discharge and monitoring its effect.

Changes in sediment behavior may be predicted by direct measurement and empirical formulae

Physical scale model, which require very extensive data for construction and validation but have been used for many years especially for predicting changes in river bed geometry after channel widening; dredging etc.

Mathematical model for different types of work, body, these are usually complex and require experts to set them up and interpret their result

The use of expert advice.

3.3.6 Prediction of different water impacts

3.3.7 Surface water

Effluents can affect surface water by increasing flow or introduction of substance, heat and or microorganisms to the system. The prediction information needed are:

The rate of flow of the discharge

The substance present in the discharge

Concentration of substance and temperature of discharge

The rate of release of substance in the discharge and

The location and timing of discharge

Predictions method may be done by

Using information about discharge rate concentration of substance

Comparison between the proposed site and project already in operation in similar site

Using discharge factor for specified type of activity (e.g. sewage treatment)

Using special models for prediction of accidental discharge

Runoff may change as a result of project development for example through

Change in land use, land clearing, use of agro-chemical, increase in traffic flow and new roads.

Prediction of runoff is done by runoff model which are usually computerized mathematical models designed to predict runoff from different catchment type and use of expert advice.

CHAPTER FOUR

4.0 Result and Discussion

4.1 Soil analysis

The analytical soil test on various points within the project (about 10 points) in May/June 2001 under my supervision presented in Table 4.1

Table 4.1

Soil parameter	value	comment
pH – H_2O	5.30	Low
pH – KCL	3.9	
Conductivity (Ec)salt Ns/cm at 25^{0c}	200µs/cm	Low salinity hazard
Exchangeable AL^3 H^+	0.80mcm-$1kg^{-1}$	
Exchangeable cation (cmol leg^{-1}soil)		
Ca_2^+	10.5	Normal
Mg^{2+}	3.0	High
K^+	1.26	High
Na^+	0.05	Very low
Cation exchangeable Capacity (ECC) (cmol kg^{-+} soil)	15.61	Normal
Exchangeable sodium Percentage	32%	very low
Sodium adsorption ratio (SAR)	0.28	very low

Source: UNRDA 2007 soil analysis for Tunga Kawo

The result shown that pH level of the soil has a downward trend (soil with strong acidity), this may be due to activities of exchangeable hydrogen and aluminum ions.

The salinity level is low an average of (200µs/cm) probably owing to the low content of soluble salt and sodium. There is corresponding rise in calcium magnesium and potassium; this may be due to effect of fertilizer application.

This finding was also reported in the work of (Mohamed, 2003). The soil type ranges from sandy clay loam to clay loamy soil which have poor infiltration rate therefore are poorly drain. The crop grown is rice which agrees with the type of soil in the project area.

Table 4.1 Soil analysis from ten different parts of the irrigation scheme

Sand	62%	72.5%	53%	32.3	34%	34%	14.4%%	68%	46.7%	64%
Silt	31%	24.4%	16.2%	33.7	26.8	41.3%	45.2%	11.7%	28.1%	17.7%
Texture	7%	5.1%	30.8%	34	39.2	24.7%	24.7%	20.3%	25.2%	18.3%
pH-H_2O (suspension 1:2$^1/_2$)	Sand loan	Land sand	Sandy clay loam (SCL)	Clay loam (CL)	Clay loam (CL)	Loam (L)	Loam (L)	Sand clay loam	Sandy clay loam	Sandy loam
pH-kcl suspension (1:2$^1/_2$)	5.3	5.3	5.0	5.1	5.4	5.7	5.7	5.6	5.2	5.0
Organic carbon	4.9	4.6	4.5	4.6	4.7	4.8	4.8	4.6	4.9	3,8
Organic matter	0.95%	0.56%	0.25%	1.3%	1.11%	1.5%	1.5%	1.57	0.4%	1.78%
Total nitrogen	1.64%	0.81%	0.5%	3.2%	1.91%	2.3%	2.3%	2.72	0.9%	3.10%
Electrical conductivity Ec x 10^6 mhos/cm	0.09%	0.08%N	0.06%N	0.14	0.07%N	0.09%N	0.09%N	0.06%	0.06% N	0.084 %N
Exchangeable meg/100g soil15.7	0.06mhos/cm	0.05mhos/cm	0.03mhos/cm	0.06Mhos/cm	0.07mhos/cm	0.02mhos/cm	0.02mhos/cm	0.03mhos/cm	0.01mhos/cm	0.09mhos/cm
Ca	1.70	4.2	2.2	19.1	1.4	21.70	12.6	27.3	14.3	10.1
Mg	2.3	0.7	0.6	5.4	0.12	8.5	6.8	13.7	5.8	4.5
K	0.14	0.2	0.2	0.13	0.12	0.15	0.2	0.21	0.2	0.27
Na	0.12	0.3	0.1	0.16	0.19	0.19	0.1	0.12	0.2	0.19

Table 4.2 continue

Exchangeable acidity										
H &AC meg/100gsoil	0.76 Soil	1.0	0.6	0.78	0.64	0.44	1.3	1.2	1.0	2.24
Caution exchange capacity (CEC)	5.02meg/s oil	6.4meg/10 0g sol	3.7	25.07meg/ 100g soil	18.05	30.98	21.0meg /100g soil	42.53	21.5	17.3
Base saturation BG	24.9%	844%	83.8%	98.9%	96.4	98.6	93.8%	97.2%	95.4	87.1
Exchangeable sodium percentage ESP (sodicity)	2.40%	4.7%	2.7	0.64	1.1%	61%	0.48%	0.5%	0.93%	1.1%
Available phosphorus	0.7ppm	1.5ppm	3.2	01.42	0.14ppm	0.84ppm	4.10ppm	0.56ppm	0.48	0.7ppm
Lime requirement	Appl lime 1 tone/ha	-	N/A	Apply 1 ton/ha	N/A	NIL	NA	Nil	N/A	1 tone/hr of line
Permeability/infiltration	1.2-1 8cm/hr	1.8-2.5 cm/hr	0.9	0.6-0.8cm	0.6-0.8	0.8-1.2cm	0.6cm/hr	0.9- 1.2cm/hr	0.9-1.2	1.2- 1.8cm/m
Water holding capacity	9-12cm/m	6-10cm/m	12-15cm	11.7-12cm	11.7- 12cm/m	12cm/m	11.7cm/ m	12-15cm/m	12-15cm/m	9- 12cm/m
Drainage class	Moderatel y drain	Well drained	Moderately well drained	Poorly drained	Poorly drained	Poorly drained	Poorly drained	Moderately well drained	Moderately well drained	Poorly drained

Source UNRDBA 2007

4.2 Land use and farming activities

Using checklist method, interview and questionnaire approach, which are summarize on Table 4.2. It was observed that, most land are been put under intensive cultivation. During the early stage of the project, few trees and shrubs were cut down for agricultural purposes. The trees were not only cut down but treated with various mechanisms to disallow regenerations.

From the interpretation of ground assessment of the project site, over 900Ha of land were cleared for the purpose of cultivations, which have subjected the land to soil erosion due to removal of vegetation. The farm area had being in operation since 1988, there was serious need for fertilizer application years to improve yield. The indiscriminate and improper use of this chemical have brought about over usage of the chemical, which do not necessary translated to improved yield. (Mohammed, 2003).

It was both reported in Mohammed, 2003 and UNRB, 2001 that the soil require nutrient supplement in form of fertilizer, yet the high level of calcium , and potassium element was also reported. This simply mean that the chemical were over applied and at the wrong time.

The average numbers of participating farmers are over 300. But questionnaires administered to fifteen of them showed that the average farm holding capacity ranged from 2 ha to 25 ha (Table 4.3)

Most of their inputs including fertilizers are obtained from the open market. They have not in recent time received any financial aid from government or its agent. They borrow money from friend and money lender to carry out their operations.

Market and road are generally agreed to be available and in good condition.

Table 4.3 Agronomy Interview

No of farmers interview	**Hectare**	**No of farmers**	**Fertilizer / herbicide usage**	**Gov. loan & financial support**	**Source of labour family**	**Hired labour**	**Source of fertilizer**	**Effect of fertilizer and herbicide**	**factor Affecting crop production**	**Factor Affecting yield**	**Project & service road & material**
15	>5	2	15	14 from leading	1	14 out of	15 from	5 out of 15	Erratic water	Weed/pest	Good 7
	5-10	5	15	1 self financial		15	market	say no effect	supply 4	11	Fair 7
	10-15	1	15	independence				10 is	Drought and	Weed/field	No
	15-20	6	15	No government				indifferent	floor 10	lost 4	response 1
	20-25	1	15	support					Erosion 1		
	Above 25	none	-								

4.2.1 Herding

This is another major source of vegetal cover lost. The cattle rearers usually go to the farm land shortly after harvesting is completed with intensive verocity and the stalk and other remnant of farm produce are consumed by the cattle. This activity exposes the farmland to agent of erosion and the fertility of the soil is steadily lost.

There is another usual practice by the animal herder in the project area that is very deleterious for vegetal regeneration especially the trees and shrubs, this is done by setting farm land on fire, with the believe that it will improve subsequent year grass cover for their cattle. But most vegetable grass covers that have the ability to protect the soil never recover from the effect of the fire. These culminate in extinction of some species within the project area.

4.3 Health and Hygiene

The settlement around the project area comprises of Wushishi, Bankogi, Kasankogi, Dankwagi, Maitor Kanko and Tunga Kawo village.

The only rural health centre is located at Wushishi. People from other villages are expected to travel to Wushishi for their medical problems. These villagers are predominantly farmers with poor living condition. The environments are dirty and drainage systems are non existence. The few traces

The table below show the detail of the 2 years record as obtained from Rural Hospital Wushishi. The plate no shows some villager washing and taking water from the Bankogi arm of the secondary channel.

Health and sanitation summary sheet

Table 4.4

	2004	2005	2006	2007	2008
Water borne diseases	3	1	1	9	2
Cholera	11	21	12	29	13
dysentery	26	26	24	26	23
Typhois	32	32	35	33	40
Amobiasis					
Other					
Water washed					
Ascariasis	2	-	5	6	3
Other					
Water based					
schristemiasis	54	39	47	53	58
Dracunchasis					
Other					
Insect vector	-				
Borne disease	-				
Yellow fever	-				
Rift fever	-				
Lass a fever	-				
Encephalilis	-				
Encephalomyelitis	-				
Laishmaniasis	-				
Loaiosis	-				
Onchocerciasis	-				
Other	-				
Facial disposal	-				
Diseases	-				
Ancilotatomiasis	-				
Other	-				

Source: General Hospital Wushishi

PLATE C:- Women taking water from a secondary canal.

PLATE D:- Fisher men fishing in the lake. And acquatic weeds also in the lake

4.4 Dam Embankment and reservoir

4.4.1 Reservoir

The construction of the dam has resulted in the impoundment of the water flow in river Ubandawaki and Bankogi, creating reservoir of water of about 222mm^3 over an area of 400Ha. The impoundment of water will enable farmer to grow crop throughout the year, therefore keeping farmer within the project busy thought-out the year.

However, failure from a storage reservoir of such magnitude can be disastrous to people down stream of the reservoir. These failure can be access in terms of seepage from the dam, inflow into the dam after the attainment of full reservoir supply level, and the rainfall characteristic within the reservoirs area. All these can be classified as hydraulic failure.

4.4.2 Failure due to seepage

There are overa/bout nine number of piezometric well behind the dam to monitor seepage from the dam. The present situation indicate that the pizometric wells are all blocked with stone by cattle rears, these have made them inoperatable. This is a dangerous signal which needs to be quickly attended to. Every earth dam seeps, functionality of device to monitor such seepage is important as failure of earth dam could result from excessive seepage (piping).

A plate vandalized Piezometer is presented as plate no E.

4.4.3 Failure due to inflow into the dam

The reservoir is provided with a 37m length of Ogee shape spillway and spill channel which take water from the reservoirs to safe distance away from the embankment area. Thus is functional, therefore failure due to inflow not exceeding 1000m^2/sec which the spillway is design to carry is not likely to occur.

4.4.4 Rainfall characteristic

Flood or excessive inflows are generated from rainfall. Therefore the 11 years data of rainfall available are analysis, for annual trend, and the average monthly trend.

Two years moving average is analyzed to show any significant trend. The annual rainfall varies from 1055mm to 1300mm. The peak rainfall occurring in the month of August or September each year. These months of high rainfall are considered the months of highest flood.

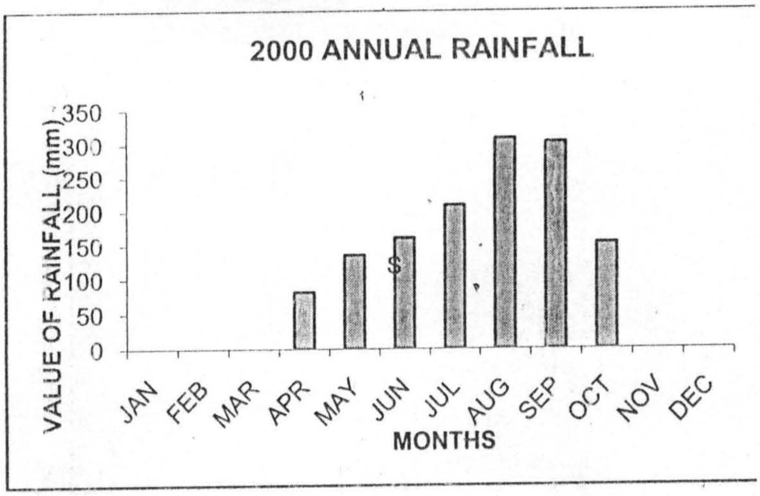

Fig 4.4: 2000 Annual Rainfall

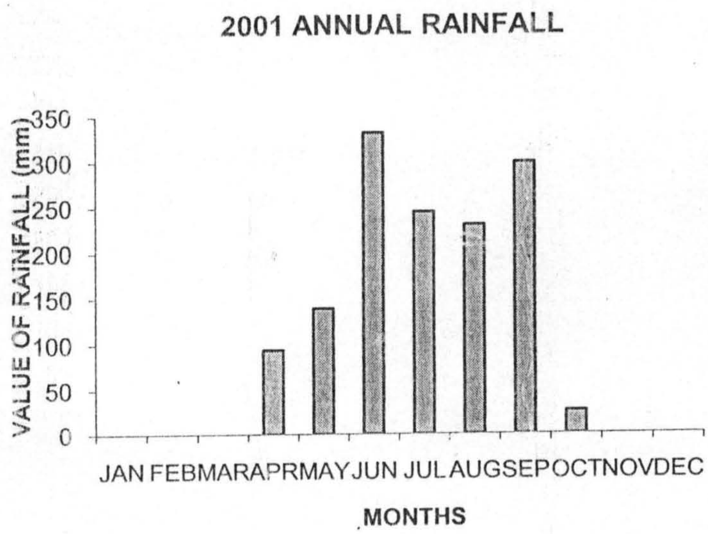

Fig 4.5: 2001 Annual Rainfall

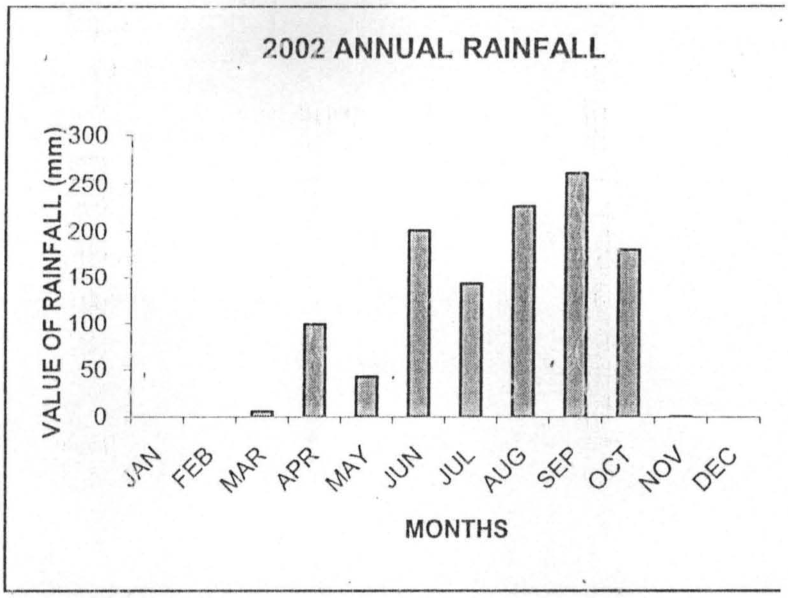

Fig 4.6: 2002 Annual Rainfall

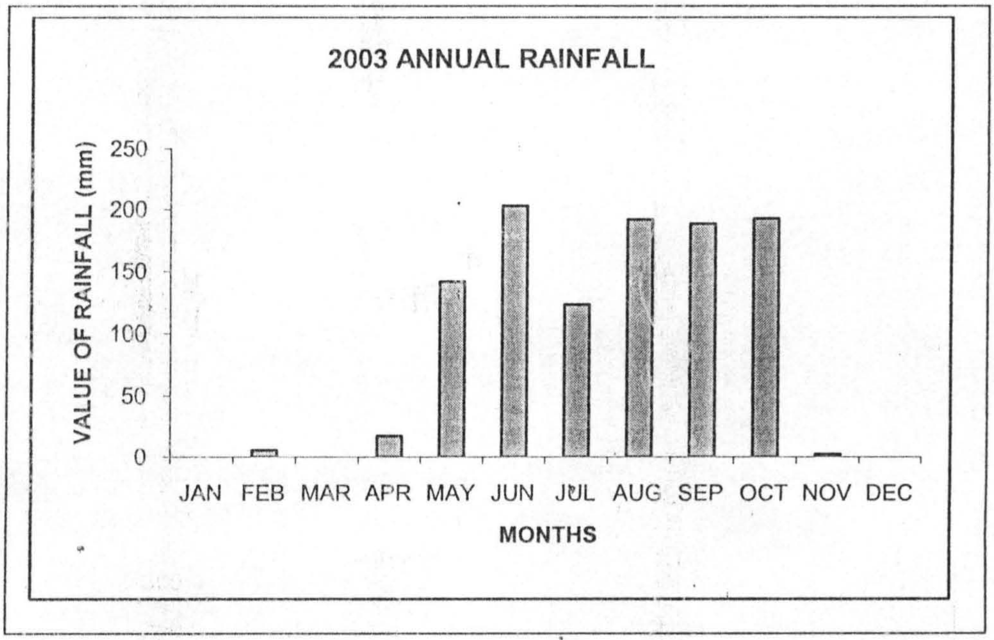

Fig 4.7: 2003 Annual Rainfall

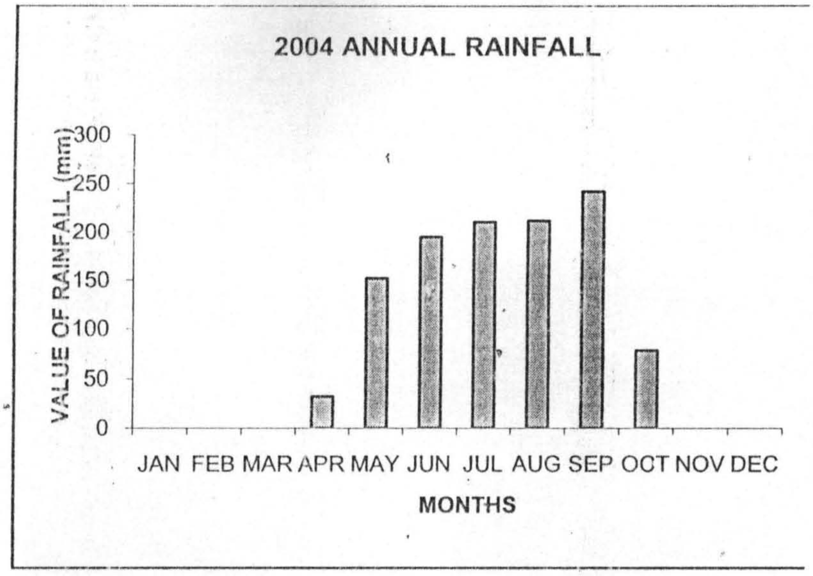

Fig 4.8: 2004 Annual Rainfall

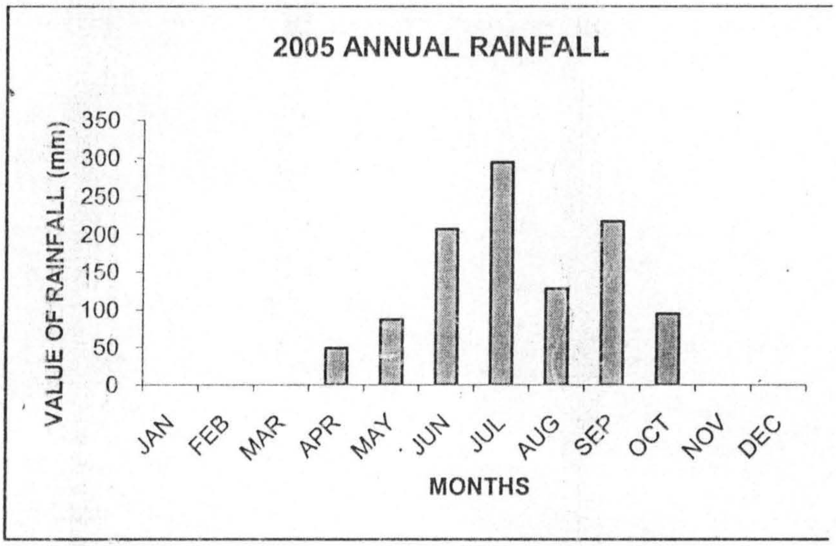

Fig 4.9: 2005 Annual Rainfall

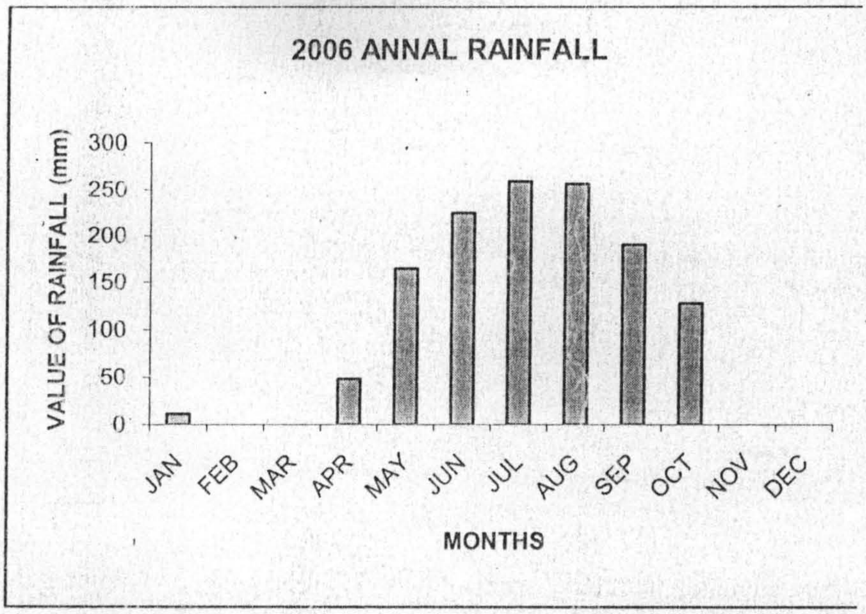

Fig 10: 2006 Annual Rainfall

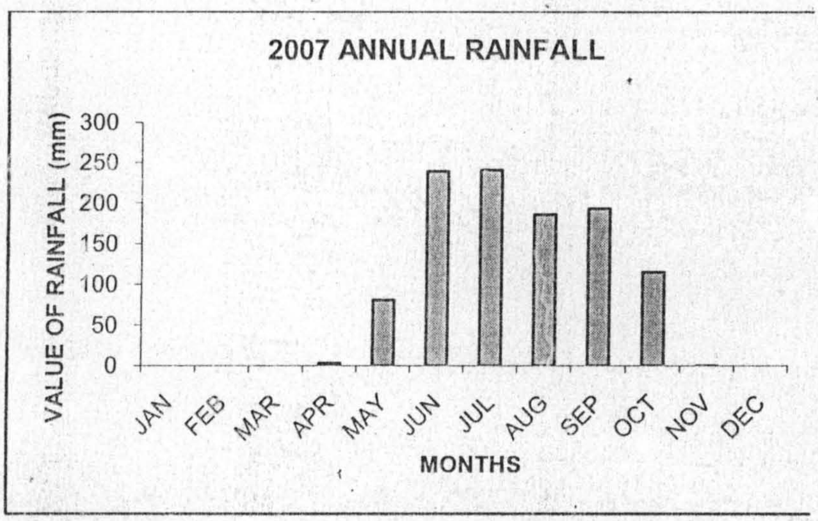

Fig 4.11: 2007 Annual Rainfall

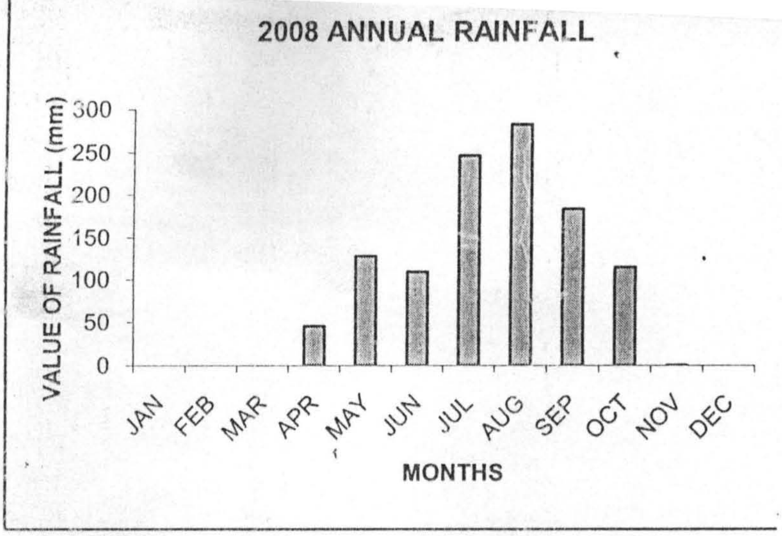

Fig 12: 2008 Annual Rainfall

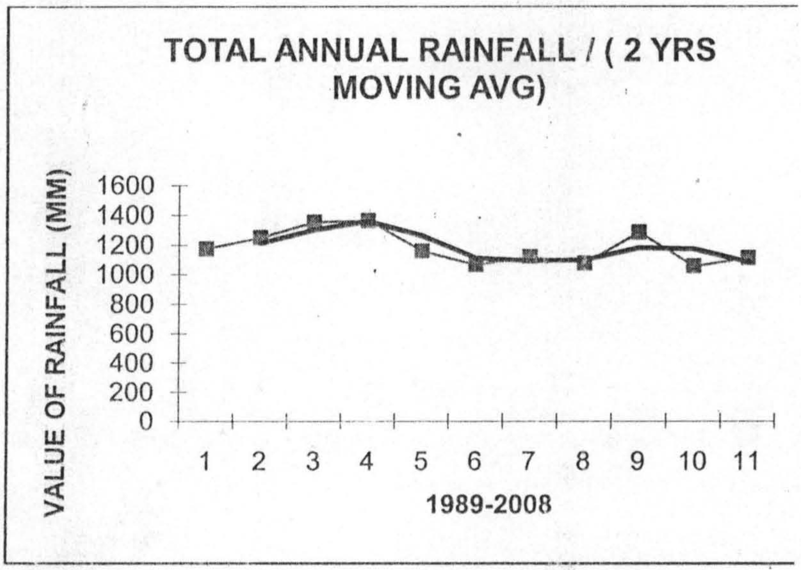

Fig 13: Total Annual Rainfall from (1989 - 2008)

4.4.3 Aquatic Ecology

Silt Rooted trees and shrub were the dominant aquatic vegetation in the reservoir. No sign of algal coloration was observed. There is evidence of siltation taking place. This is true as the reservoir almost dry off in the year 2004/2005. The volume of silt material deposited in the reservoir was not accessed, but it was estimated that above 20-30% of the reservoir volume would have been lost to siltation.

Fishing activities are generally high. Plate D shows some fishing activities taking place in the reservoir. The major species of fish in the reservoir are the tilapia and cat fish.

4.5 Rainfall Data (MM)

Year	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Total
1998	Nil	Nil	Nil	82.5	121.2	221.0	78.8	243.0	194.7	212.6	Nil	Nil	1173.8
1999	Nil	7.9	Nil	35.7	102.8	164.2	243.9	245.7	237.1	212.2	Nil	Nil	1249.5
2000	Nil	Nil	Nil	81.2	135.9	161.0	208.8	308.5	303	153.4	Nil	Nil	1351.8
2001	Nil	Nil	Nil	93.9	139.0	331.7	244.6	230.2	298.8	25.7	Nil	Nil	1363.9
2002	Nil	Nil	5.7	98.8	42.6	201.0	143.2	226.5	260.6	180.3	0.3	Nil	1159
2003	Nil	5.7	Nil	17.4	141.6	2.3	123.0	291.6	188.2	192.4	2.3	Nil	1065.2
2004	Nil	Nil	Nil	32.2	151.9	194.9	210.3	211.4	241.5	77.6	Nil	Nil	1119.8
2005	Nil	Nil	Nil	49.1	87.0	207.0	294.2	127.8	216.6	94.8	Nil	Nil	1076.5
2006	11.2	Nil	Nil	48.6	164.7	225.0	259.7	257.0	191.1	127.9	Nil	Nil	1285.2
2007	Nil	Nil	Nil	3.6	80.6	238.4	240.0	185.4	192.7	115.0	0.2	Nil	1055.9
		Nil		45.5	127.9	109.2	246.9	983.0	183.7	115.0	Nil	Nil	

Source: UNRB. ADA Wushishi 2006

4.4.6 Dam embankment

The dam embankment is about 3.3km long and has a slope of 1.3 upstream and 1:2.5 downstream. This is considered stable. Since the commissioning of the dam in 1988, there was no sign of slope failure; the designed upstream and downstream slope is therefore considered okay.

The dam service with manomantric level which is related to the part of spillway structure. The idea is to monitor the settlement of the embankment. No sign of vertical crack which is a characteristic of failure due to settlement is notice. However horizontal crack on five different spots along the culture length of the embankment was observed.

Sources from river basin shows that the initial width of the dam was improved to 6m from 4m this later increase could have created line of weakness which is evidence now in the horizontal crack on plate A & B

The rip-rap placed on the upstream of the Embarkment also show sign of stability. But the grassing of the downstream was poorly down. This is couple with bush burning which affected the downstream of the dam annually. This can encourage serious wash down of the downstream of the embarkment (erosion).

4.4.7 Water quality analysis

The table attached shown studies done in **2001and 2007** by River Basin Authorty.

The table comment on the suitability of water for irrigations. The water at pH value of 6.4 is nether acidic or salty.

The highest single parameter for good irrigation water is its amount of dissolved solid, this was found to be less than 160ppm against the allowable level of 400ppm.

Other parameters, such as Hardness, Bicarbonate calcium and magnesium are as attached in the report with various comment as it affect water quality.

Water sample at Tunger Kaawo

Date of collection 24/4/2001

Date of analysis 4/5/2001

Table 4.6 Sample Analysis for Tunga Kawo

Water constituent		Comment
Temperature	30^0c	Within range
Ph	7.4	Normal (mildly alkaline)
(N/cm) at 2500	100N/cm	Low salinity
Total dissolve	10mg/c	Very low
Suspended solid	4.mg/k	Extremely low
Nitrogen/nitrate (N-No3)	220mg/c	Normal
Nitrate (No_3)	96.80mg/c	Normal
Sodium (Na^+)	0.71ppm	Low sodium content
Calcium (Ca^+)	36.0mg/c	Normal
Magnesium mg^{2+}	96mg/c	Low
Hardness $CaCO_3$	89.89mg/c	Normal alkalinity
$MgCO_3$	39.51mgk	Low alkalinity
Chloride (CL^-)	0.043mgk	Very low
SAR (sodium adsorption ratio)	0.184mgeqk	Very low
% sodium	6.71	Very low

Table 4.7 Water analysis report of Tunga Kawo, June 2007

Water constitutes pH at 2501	Value 64	Comment water not acidic or salty
Total dissolved solids	159.8ppm	Less than 400ppm therefore water safe for irrigation
Hardness/alkalinity	52.5mg/L	Very low hardness
Bi-carbonate (Hco_3)	40.5mg/L	Quite low therefore less Na^+ risk
Sodium	2.0mg/L	Low sodium water class
Potassium	2.1 mg/L	High, but good for irrigation and crop production
Calaum	14.2ppm	Less than 50ppm. High precipitation of Ca^{2+} at 6.4pH likely
Magnesium	8.65ppm	Less than 50ppm, high risk of mg^{2+} precipitation at 6.4 pH but not a problem under flood irrigation system
Sodium adsorption ratio (SAR)	0.13	Less low SDR. Therefore no satisfactory
Chloride CL	2.6 mg/L	Less than 25mg/L very low and satisfactory
Sulphate	10.5 mg/L	Very low, less than 200 mg/L therefore desirable

CHAPTER FIVE

5.1 Conclusion and Recommendation

5.1 Conclusion

This study examined the environmental auditing of Tunga kawo. The following conclusion can be drawn from the study.

a. There is environmental degradation at Tunga kawo based on information contained in plate A,B,D,E and the findings on soil analysis

b. The entire project land is low-lying positioned and relatively flat, this account for over 88% of the total available land (800 Ha) out of a total of 900 Ha. There are packets of depression featuring in this part of the field. This shallow depression could prevent even distribution of irrigation water if left unleveled causing breeding place for mosquitoes.

c. The field drainage system was bad. The drainage canal had been blocked in some place to return used water for addition hectare under irrigation.

This arrangement results from poor irrigation infrastructure which is presently allowing for excess water in the field that could create salinity problem in the nearest future.

d. Longitudinal crack are observed at several point along the embankment about one-third of the entire length of 3.3km embankment is affected.

e. The piezomenter well located behind the dam which are about five in numbers are out of operation.

f. There is evidence of sedimentation due to observed aquatic weed in the reservoir.

g. The water quality meet FAO acceptable limit for irrigation purpose.

h. The water has high sediment, colour and odors problem therefore require treatment before it can be consumed.

i. The soil is generally low in nutrient content therefore require soil supplement for improved crop yield.

The economic benefit of the farmers in the project are high. A farmer makes as much as ₦360,000 per Ha against an investment of about ₦70,000 per Hectare. Over Three hundred farmers and their dependent are self employed. Also more than 1,000 people who are employed as labour benefit indirectly from the project.

5.2 Recommendation

a. Land level is required in some area to improved irrigation water distribution and to avoid water stagnation.

b. Project rehabilitation should be carried out to address, the following:

a. Drainage system
b. Sinking alternative piezo meter well to monitor seepage
c. The cutting or opening up and control compaction in all observed cracks along the dam should addressed.
d. Fertilizer supplement should be added to the soil to improve crop yield. The fertilizer requirement for a crop like rice should be 250kg or 5bags of NPK 15-15-15 per hectare, and 200kg or 4bags of CAN per hectare Calcium Ammonium Nitrate (CAN) Fertilizer per hectare. This could help raise the level of calcium observed to be generally low.
e. Surrounding communities should be discourage from using the water from the cannal and reservior for their drinking and domestic use as it does not meet WHO standard for drinking water.

REFERENCES

Aerls, ABU Zaria (1982). Quality of Irrigation Water as affecting Crops and Soil (irrigation advisers Handbook) Extension Bulletin No. 12 Irrigation Bulletion Series No. 1.

FUT Min Venture Limited (2008) The Environmental Impact Assessment of the Kontagora (Auna) Dam and Irrigation Project edited by FUT Minna Consult.

Nwafor J.C (2006) A Test Book on Environmental impact Assessment for sustainable Development, the Nigeria in Perspective. Publish by EDPCA No. 56 Ekwulumili Street City Layout P.O Box 22986 Enugu Nigeria.

Mammensami A.U (2004) Flood Assessment of River Kaduna at downstream of Shiroro Dam, project work presented to Department of Civil Eng. FUT Minna for award of Master Degree Programmme on Water Resources and Environmental Engineering.

O.D Jimoh, M.A Ayodeji and B. Mohammed (2003) effect of Agrochemicals on surface Water and ground Water in the Tunga Kawo (Nigeria) Irrigation Scheme Hydrological Science Journal Dec. 2003.

Tel D.AA (1984), Principle, Application and Methodology of Soil and Water Analysis (lecture notes in soil and plant analysis) IITA, Ibadan Nigeria.

WHO (1998) Guideline for Drinking Water Quality vol 1, Recommendation. World Health Organization, Geneva Switzerland.

Cottenie, A (1980), Soil and Planting Testing as a basis for Fertilizer Recommendation, FAO Bill No. 36

Report on Fertility Soil Survey of Tunga-Kawo Irrigation project, Dec 1995 edited by Soil Management Unit UNRBRDA Minna.

Report on Agricultural Soil Survey of Tunga-Kawo Irrigation Project 2006 edited by soil Management Unit UNRBRDA Minna.

Atoyebi, O. 2000, Overview of Environmental Problem in Nigeria, National Centre for Economic Management and Administration (NCEMA) Paper Presented at the Conference on Environmental and Sustainability Development Ibadan, 17-19 August.

Food and Agricultural or Gravitator (FAO), 2001 Soil Fertility Management in Support of Food Security in Sub-Saharan Africa FAO, Rome.

Jimoh O,D (2003), Seasonal Variation in the Level of Nitrate, Phosphate and Dissolved Oxygen in the water of Tunga Kawo (Niger State) Irrigation Scheme, J. Sustain Tropical Agricultural Resources Nigeria 6, 74-79.

APPENDIX ONE

AGRONOMIC QUESTIONNAIRE

Name of project: Tunga Kawo irrigation project

Implementing: Upper Niger River Basin Authority

Location

a. Village
b. District
c. Local Government Area
d. State

1. Project location

a. Village
b. District
c. Local Government Area
d. State

2.a. Method of farming

- ✓ Rain fed (Yes/No)
- ✓ Irrigation (Yes/No)

b. Method of irrigation

3. Total area (ha) under cultivation in the last 5 years

	2007	2006	2005	2004	2003
Irrigation (ha)					
Rained (ha)					

4. For how long has the land been cultivated under this (year)?

5. Have you receive any institutional loan/credits from (pleases tick)

Source	Yes	No
MANR		
ADP		
Co-operative		
Bank		
FSP		
FEAP		
LEEMP		
Traditional (adashi)		
Relatives		
Friends		
Money lender		
Combination		
None available		
Not needed		

6. What type of fertilizers have you been using?

i. Compound
ii. Ammonium sulphate
iii. CAN (Calcium ammonium nitrate)
iv. Urea
v. TSP (Triple super sulphate)
vi. Combination
vii. Others (specify)
viii. None

7. How do you get your fertilizer?

i. Bought from ADP/FSC
ii. Bought from MANR store

iii. Bought from market

iv. Dealer/agent

v. Combination

vi. Others (specify)

8. Which of the following, items do you use on your farm?

i. Fungicide

ii. Insecticide

iii. Herbicide

iv. Seed dressing

v. None

9. How often do you use the above agro-chemical?

i. Always

ii. Frequently

iii. Occasionally

iv. Never

10. Do you think applied agro-chemical have endangered your crops or environment? If yes, give a short description.

11. Sources of planting materials

i. Own farm

ii. Research institution

iii. Ministry of agriculture/ADP

iv. Open market

v. Any other source

12. What labour do you use to cultivate farm?

i. Head of household only

ii. Head of household and wives

iii. Head of household and children

iv. Wives and children

v. Wives

vi. Children

vii. Head of household, wives and children

viii. Relative/dependent

ix. Any other combination

x. Other (specify)

13. Do you use hired labour on your farm?

i. Yes

ii. No, not needed

iii. No, available

iv. No, too expensive

14. Rank the following as they affect crop production (1-highest)

i. Drought

ii. Erratic water supply

iii. Erosion

iv. Floods

v. Desertification

vi. Any other(s)

15. Rank the following as they affect crop yields

i. Weeds

ii. Field crop loss

iii. Post harvest loss

iv. Pest/diseases

v. Any other(s)

16. Indicate the type of facility for processing and storage of crops

Crop	Mode of processing	Storage
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

17. How do you maintain the fertility of your soils/crops? (e.g poultry, manure, cow, dung, etc). How have these methods helped or degraded you soil?

18. Do you have infrastructure (roads, market, transport etc) adequate to support evacuation of farm products? If yes, list

Road	Mileage/distance to market	Road situation (bad, good, seasonal, all year)
1.		
2.		
3.		
4.		
5.		

Market location	Market days	Intervals	Estimated pop	Transport to market	
				Regular	Irregular
1.					
2.					
3.					
4.					
5.					
5.					
7.					

APPENDIX TWO

EIA study of Tunga Kawo Dam and irrigation project irrigation, drainage and flood control questionnaire

1. Location

2. Dam - Type

   Salient features

   Maximum yield/capacity

3a. Estimated seasonal crop requirement/peak

b. irrigation scheduling

4a. Crop types

b. area of coverage of each crop type

c. cropping pattern

d. Zinc of planting (irrigated & rain fed)

5a. Area of command under irrigation

b. Area to be drained

c. Slope gradient of the area

6a. Canal types: lined or unlined

b. Seepage through canals

7. Estimated canal length (km)

a. Main

b. Secondary

c. Tertiary

d. Field

8a. Types of grossing bridges/culverts

b. No of bridges/culverts

9a. Drainage facility provision

b. Reuse of drainage water

c. Routine pisa for drainage facilities maintenance

10. Description of

a. River embankment length (km)

b. Cut-off dram length (km)

c. River training length (km)

11. Flood mitigation

a. area under protection

b. Any drain/undrained borrow pit

c. Can it serve as temporary/permanent water bodies

12. Provision for fish ladders/nesting/springs if any

13a. Any operational measures for a habitat enhancement

b. Habitat fragmentation, as landscape degrádation

14a. Soil type (down the profile)

b. Soil control measures

c. Monitoring status

d. Soil nutrient mining

15. Ground water level monitoring

16. Surface and groundwater contamination by the use of pesticides and fertilizers

17. Leading requirement

18. Type of irrigation methods/systems

19a. No of farmers involvement

b. Average holding (size) of farm

c. Average revenue from farm produce

20a. Water changes via WUA (water users association)

b. Cooperation of WUA

c. Benefit-cost ratio of irrigation project

APPENDIX THREE

Water resources assessment component

Name of project: Tunga-Kawo irrigation scheme

Implementing agency: Upper Niger River basin dev. Auth.

1. Location

   a. Geographical co-ordinates
   b. Village
   c. District
   d. Local government area

1. Catchments areas of rivers at closest point to the project.................km^2

2. Describe the form of rating curve and weir of other structure (append rating curve information if available)

3. Describe procedure used to compile rating curve and hoe frequently rating curve are updated

4. Is there any historical evidence of sedimentation of the upstream side of the gauging weir? if so give date

Mean monthly discharge in m^3/s or interpolated for project area

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												
(5)												
(6)												
(7)												

7. Minimum monthly discharge in m^3/s or interpolated for project area (based on yearly total)

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												

8. Maximum monthly discharge in m^3/s or interpolated for project area (based on yearly total)

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												
(5)												
(6)												

Highest recorded flood peaks at the gauging station(s)

Name……………………Period…………………Catchments…………...km²

10. Mean monthly abstraction rate in m^3/s or interpolated for project area:

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												

11. Maximum monthly abstraction rate in m^3/s or interpolated for project area (base on yearly total).

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												

12. Downstream compensation flow requirements (m^3s^{-1})

Station No	Jan.	Feb.	Mar.	April.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
(1)												
(2)												
(3)												
(4)												

13. Describe any significant uses of the river downstream of the project for municipal industrial water, irrigation, livestock, hydropower, fishing, aquaculture, recreation, navigation, or gravel and sand abstraction, washing.

14. Does the project own catchments area that of any river considered ab0ove drain into terminal takes and what are the effects of the project on water level, surface area, shorelines, and salt concretion etc of the lakes?

15. Geological information in which the groundwater aquifer us found

16. Recharge area of the groundwater system (km^2)

17. Estimate rate of recharge ($mmyr^{-1}$)

18. Describe the catchments land-use and foreseeable changes

19. Details of all wells within the project area.

	A	B	C
1. Types of well/abreaction			
a Spring			
b Borehole			
c Hand dug well			
2. Location			
3. Yields (1/mm)			
4. Water level			
5. Depth of well/borehole			
6. Drawdown (m)			
7. SWL (m)			
8. Type of pump (no)			
a Hand			
b Mechanical			
c Without pump			
9. Observation period (from -to)			

20. Abstraction from the groundwater system for project and other existing uses (m^3 $month^{-1}$)

Station no	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
Phase 1												
Phase 2												
Phase 3												
Other uses												

21. Existing uses of the groundwater apart from the project (list by surface cathment)

	Location (river cathmnet)	Uses	Number	Method of abstraction
Well < 3m deep (shallow aquifer)				
Wells/boreholes > 3m (deep aquifer)				

22. Describe any important springs, surface water or wetlands fed by the groundwater system

23. Estimate the leaching fraction if irrigation is used (%)

24. What area of the project is covered by shallow perched aquifers supporting fadama?

25. Mean monthly rainfall in mm or interpolated for project area (m?)

26. Mean monthly rainfall in mm or interpolated for projected area

Station no	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
(1)												
(2)												
(3)												

27. Minimum monthly rainfall in mm or interpolated for project area (based on yearly)

Station no	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
(1)												
(2)												
(3)												

28. Maximum monthly rainfall in mm or interpolated for project area (based on yearly)

Station no	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
(1)												
(2)												
(3)												

29. Mean monthly evaporation in mm for project area.

Station no	A	B	C
(1)			
(2)			
(3)			

Station no	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
(1)												
(2)												
(3)												

(30) Annual total evaporation for project area.

APPENDIX FOUR

To be completed by a health and sanitation

i. Name of settlement ....

L.G.A District ....

ii. Name of office..

iii. Name of establishment for which you are

Responsible ....

iv. Office position..

v. Type of medical facility (Hospital, clinical dispensary etc) ....

vi. Average distance to the nearest health facility.......................................km

vii. Give information about water-related diseases to the area

Diseases	No of recorded cases last year	Approx. % of pop. Believed to have been affected last year
Water-borne:		
Cholera		
Bacterial dysentery		
Typhoid		
Amobiasis		
Others		
Water-washed		
Schistosomiasis		
Others		
Insect vector borne		
Yellow fever		
Dengue fever		
Rift valley fever		
Lassa fever		
Encephalitis		
Encephalomyclis		
Leishmaniasis		
Loaiosis		
Onchocerciasis		
Others		
Faecal disposal		
Aneylostomiasis		
Others		

(viii). Give details of existing or planned programmed for of the above diseases.

Disease	Method of control	Year control began/planned	Who is responsible?	Remarks on effectiveness

(ix) Describe existing programme of regular Health education, birth control, vaccination and treatment in village within the project area.

(x) How many people are employed in 9 above?

(xi) Will any proposed new villages in the project area be included in 9 above?

(xii) Will villages outside/downstream of the project area be included in 9 above?

(xiii) Will extra staff and money be available for this work (9 above)?

(xiv) List the disease in 8 above which you consider most serious in the project area (Schistosomiasis)

Name of disease	Reason for the seriousness (e.g number of cases, disability caused/deaths carried out, etc, give number of cases)	Has the disease become more prevalent in recent years?
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

(xv) List the vectors or reserviour host human or animal disease which are prevalent in the area.

Name of vector or host	Name of disease

(xvi) What is the main method of refuse/sewage disposal in project?

(a) main sewer

(b) septic tank

(c) pit latrine

(d) bush

(e) other (specify)

(xvii) Can you remember the common diseases that afflicted the people in this area?

Please tick as many as you know.

(a) malaria (b) typhoid (c) meningitis (d) cholera (e) small pox (f) polio

(g) river blindness (h) bilazia (i) chicken pox (j) guinea worm (k) yellow fever (l) sleeping sickness

(xviii) state curative measures usually applied by the people

(a) self medication

(b) traditional healer

(c) modern clinic/dispensary