

TITLE PAGE

**ENVIRONMENTAL IMPACT
ASSESSMENT FOR DAMS AND
RESERVOIR OPERATIONS**

(A CASE STUDY OF SOCIOLOGICAL IMPACT OF TUNGAN KAWO DAM & IRRIGATION PROJECT)

By

NDANUSAH, UMAR MUHAMMAD . .

APRIL, 2000

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By

NDANUSAH, UMAR MUHAMMAD.


*A thesis Submitted to the Postgraduate School,
Federal University of Technology Minna. In
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Post Graduate Diploma (PGD) in Environmental
Management.*

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CERTIFICATION

This dissertation titled: **“ENVIRONMENTAL IMPACT ASSESSMENT FOR DAMS AND RESERVOIRS OPERATIONS**

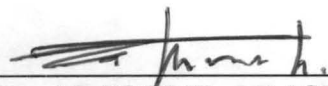
- A case study of Sociological impact of Tungan Kawo Dam and Irrigation Projects” by Ndanusah, Umar Muhammad meets the regulations governing the award of Post Graduate Diploma of the Federal University of Technology Minna, and is approved for its contribution to knowledge and literary presentation.



Dr. A. S. ABUBAKAR
Supervisor




DATE




Dr. UMOH T. UMOH
H. O. D. Geography



DATE



Dr. M. T. USMAN
Course Co-ordinator



DATE

PROF. J. O. ADENIYI
Dean, Post Graduate School

DATE

EXTERNAL EXAMINER

DATE

DEDICATION

This project work is dedicated to My beloved Mother Hajiya Aishetu Gogo (Koko) and my late Father Alhaji Muhammad Ndanusah. (May his soul rest in peace – Ameen)

ACKNOWLEDGEMENT

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ABSTRACT

The construction of dam is usually accompanied by some environmental impacts. These usually calls for pre and post environmental impact studies to quantify/assess the changes that have taken place. Those changes could be physical, chemical, biological and social. The aim of this study is therefore to assess the environmental impact, with emphasis on sociological aspect of Tungan – Kawo dam and irrigation project. The sets of data on hydrological and social aspects were collected, analysed and adopted for the environmental impact studies.

The Environmental Impact Assessment (EIA) process is elaborate and consists of many stages, which take considerable time to accomplish. The purpose of an EIA is to ensure that the development (Project) options under consideration are environmentally sound and sustainable. An EIA complements economic, financial, institutional and technical analyses of projects. Without an EIA, a project, through negative, unforeseen or unmitigated environmental impacts may have negative or reduced utility values on the intended beneficiaries.

The objective of an EIA on this project is to determine the potential environmental, social and health effects of the project, with a view to reducing or mitigating any adverse effects. However, a detailed discussion of the procedures necessary for conducting a proper EIA is beyond the scope of this study, which is limited to the sociological impact.

More than 160 dams of various reservoirs capacities have been constructed in different parts of the country. The principal objectives for building these dams are for water supply, irrigation and

hydropower generation. Secondary benefits include recreation, wildlife conservation, fisheries and flood control.

Tungan Kawo dam and irrigation project was commission in the year 1988. Operation of the scheme started the same year. Field report on the scheme revealed that a large percentage of the command areas could not get water as a result of low head development at farm levels. This has incapacitated the operation of the scheme. The survey also revealed a dilapidated canal structure, broken down control structures, silted canals and badly eroded canal embankments.

This study highlighted on the potentially affected environment (400 hectares of reservoir area, 800 hectares of arable land, communities of Wushishi, Bankogi, Dankuwagi, and Kanko) either affected by inundation, flooding, arable farming, fisheries and other related issues of Socio-economy and health. The impact of water reservoir (lake) behind the dam of 400ha surface area with capacity of 22.0 million cubic meters of water. The observation has shown that both positive and negative impacts occurs consequent on the construction of the dam and irrigation facilities, such as flood control, channel erosion, channel metamorphosis and some changes in the river flow regime, chemistry, siltation and disruption of basin ecology.

The impacts of irrigation activities were assessed with emphasis on excavation and stripping of top soil during land preparation and levelling, labour emigration, dislocation of people, health hazard, land clearing (deforestation) etc. the environmental implications of dams and irrigation projects tend to imply some negative effect as approach preferred by the environmentalist for

whatever reason. However, Nigerian agriculture may never develop beyond a fragile subsistence enterprise if it continue to be subject to the uncertainties of rainfall. It impacts directly also on social and economic life of the people within the communities of the project as a result of availability of perennial water for both domestic, livestock, fisheries and agricultural purposes as against seasonal prior to the dam construction. About 97% of the heads of household interviewed reported that the dam construction has had effect on their occupation and life. Of these, 85% positive, 12% negative and 3% no response. These effects vary from income to accessibility, which include fishing enhancement and improve farming and animal husbandry, labour etc. among other social conflicts

There are cases of water borne diseases as confirmed by the study, due to lack of adequate health care and environmental education/unawareness and personal hygiene.

The study also gave an overview of the nature and uses of dams and reservoir dam safety, problems of existing dams and reservoirs, policy on dam maintenance. It suggested also certain mitigatory measures and recommendations.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BASIC CONCEPT

Environmental Impact Assessment (EIA) is a management tool for officials, managers and policy makers for taking important decisions about major development projects. It has been defined as a process used for predicting the environmental consequences of a proposed major development projects (such as factory, hydroelectric projects, dam and associated irrigation projects e.t.c.) and planning the appropriate measures to reduce the adverse effects of the projects on the environment.

An E.I.A, therefore, focuses on the problems, conflicts, natural resources constraints, effluent discharges, and e.t.c. that can adversely affect the viability of a project. It also examines how the project could cause harm to the people it is meant to serve, its effect on their properties and livelihood or to other nearby projects.

Experience has show that many otherwise viable or laudable major economic development projects have turned out into major disasters because sufficient account was not taken of their relationship with the surrounding environment. Some have proved unsuitable because of unanticipated resources depletion, public opposition, unforeseen cost escalation or damage to natural resources.

After identifying and articulating the potential problems, the EIA proceeds to identify measures that must be incorporated into the project design/planning at an early stage in order to minimise or remove completely the problem identified. This is to be preferred to the alternative situations in which remedial measures are introduced after negative impacts have occurred. In this way, the, an EIA is an economic, engineering and environmental feasibility study. It is now regarded as a sine qua non in the

design and execution of viable and sustainable economic development projects and allows for greater conservation and optimum utilisation of natural resources.

In the industrialised nations, where there is high level of environmental awareness, project developers are kept in check by the local populace, various pressure groups and Non- Governmental Organisations (NGO).

It is instructive to note that the resentment may arise for varied environmental, conservation and aesthetic considerations such as:

- Preservation of a park, greenbelt or water front;
- Preservation of a monument;
- Abatement of noise;
- Resource conservation (e.g. preservation of important agricultural land)
- Preservation of endangered species and fragile ecosystems.

For a country like Nigeria where the level of environmental awareness is very low, the government and the Federal Environmental Protection Agency have a duty to ensure the protection of the environment as well as the right of every citizen to a healthy environment.

Observation has shown that both positive and negative effects occur consequent on the construction of dams and reservoir. Such as flood, erosion, channel metamorphosis and some changes in the water chemistry, reservoir siltation and disruption of basin ecology. The regulation of river channels occurs frequently through dam construction and stream diversion. While construction of dams obviously make water available for various useful purposes and helps to solve the problem of seasonal water deficiency in the drier parts of the country, it is known that such dams and reservoir destabilise pre-existing physical and chemical properties of the basins in

which they are constructed, both upstream and downstream. Such destabilisation is not all positive. The magnitude of the negative effect of such hydraulic structures has been so overwhelming that it rises questions on the rational for constructing dams and reservoirs for large scale irrigation when small-scale projects needing no reservoir could be undertaken with same benefits without disadvantages.

The most important physical consequences of the changes in flow characteristics downstream of Sudano-sahelain dams in the considerable amelioration of floods in such locations. It should be stated that flood control, usually considered as a positive environmental impact of dams and also one of the expressed objectives, may be a negative effect if proper care is not taken (i.e. counting the flooding in August 1988 consequent to failure of Bagauda Dam in Kano State, 1988 Alau Dam in Borno State, 1999 flooding of River Niger Basin consequent to over releases from Shiroro and Kainji Dams in Niger State e.t.c.).

Another physical effects of the hydrological changes is channel Metamorphosis occasioning channel erosion, contraction and stabilisation. The lower post dam discharge requires a narrower effective channel to contain the flow. Thus, the pre-dam storm channel, typical of Savannah rivers, is no longer required, and a large part of this storm channel is abandoned to give rise to an emerging over bank zone, especially since the new, narrower effective channel is usually incised into the former storm channel. Downward channel erosion is encouraged because of the flow downstream of the sediment trapping dam is relatively sediment free.

The effect of days upstream, a part of flooding of large tracts of lands in the reservoir basins consequent to impoundment and normal use of reservoir water there is excessive evaporation and enhancement of high water tables in upstream areas. It also encourages the expansion of settlements and associated socio-economic activities in such area. It is also

believed that the chemistry of the reservoir water is different from that of pre-dam river water in the zone. For one thing, excessive evaporation, mentioned earlier, means a higher concentration of dissolved solid, especially during the dry season. They also "import heat".

Luckily, some of the negative effects can be eliminated while others can be contained with appropriate reservoir management that allows controlled, perennial and optimum discharge in the natural channels downstream of the dams, particularly in the savannah area. It may be concluded that when both sides are considered, the positive and negative, the construction of dams and reservoir is more beneficial than destructive to man and his environment in this country and particularly so in the savannah ecological zone.

The nature of the Environmental Impact Assessment study depends on the nature of the project, from where the Terms of Reference (TOR) will be drawn. The EIA Decree No. 86 of 1992 lists 19 major activities/projects for which an EIA study is mandatory. However, the various project types can be categorised into four general groups as:

- i. Agricultural and Rural Development Projects.
- ii. Industrial and Infrastructural Projects.
- iii. Public Utility Projects.
- iv. Transportation Projects.

However, the nature of the project notwithstanding, the terms of reference for an EIA study and the preparation of an EIA study report can be structured along well-defined formats. It could suggest the following and can be modified as required.

Terms of Reference for an EIA study include:

- ☛ Introduction
- ☛ EIA Guidelines
- ☛ Background information.

- ☛ Project description
- ☛ Time limitation.
- ☛ Existing Environment.
- ☛ Project optimums.
- ☛ Environmental Impacts.
- ☛ Mitigatory measures.
- ☛ Conclusion/Recommendation.
- ☛ Report and References.

The EIA process is elaborate and consists of many stages. In Nigeria, recommended procedures are set out in Decree No.86 Environmental Impact Assessment Decree 1992 signed into law on the 10th of December, 1992 by General I. B. Babangida, then President of the Federal Republic of Nigeria. In 64 sections and one schedule, the decree is partitioned into three parts. Part I consist of sections 1 – 13 deals with the GENERAL PRINCIPLES OF ENVIRONMENTAL ASSESSMENT. It defines among others, the

- ◆ goals and objectives of the EIA;
- ◆ restrictions on projects without prior consideration of the environmental effects of the projects;
- ◆ minimum content of the EIA; and
- ◆ Opportunities for experts and other interested parties to comment on an EIA.

Attached to section 13 of the Decree is the schedule listing the activities or projects for which an EIA study is mandatory. Dams and reservoirs construction and operation is among the listed projects.

1.2 GEOGRAPHICAL BACKGROUND OF THE STUDY AREA

Tungan – Kawo Dam and irrigation project is built across the flood plain or Rivers Ubandawaki and Bankogi. It is located at 7.5km from Wushishi town in Wushishi Local Government Area of Niger State. (Location Map and plan refers)

It is one of the multipurpose projects embarked upon by Upper Niger River Basin Development Authority, Minna and was commissioned in the year 1988. The operation of the scheme started the same year. The objectives of the project are to provide irrigation facilities and water management services for approximately 800 hectares of arable land. The controlled release of water would also check the perennial flooding of the valuable agricultural land and the downstream villages. The dam would as well provide domestic water supply to neighbouring towns and villages including fishery activities.

(Technical Brief on Tungan Kawo Dam and Irrigation Project – UNRBDA)

1.2.1 CLIMATE

The climate of the project area is essentially the same as that of the middle belt of Nigeria with high temperature and excessive humidity during the greater part of the year. The nearest meteorological station which has got continuous records for a considerable period is at Minna, some 50km on the Eastern side of the project.

The normal rainfall ranges between 1,200mm and 1,300mm. Form the available records, temperature varies from 37°C maximum to 18°C minimum. The hottest period being the months of March and April of every year.

1.2.2 HYDROLOGY

Rivers Kaduna and Ubandawaki (Gabuko) are the two main streams in the vicinity of the project area. River Ubandawaki, on which the dam is located, has a catchment area of 166 sq. km at the dam site. The river comprises of several minor tributaries which ultimately discharge into River Niagi which in turn joins Kaduna River on the down-stream and of the project area.

1.2.3 GEOLOGY

The project area is situated more or less on the border of the basement complex and Nupe sandstone. The basement complex consists mainly of metamorphic rocks with local granite and basic intrusions, while the Nupe sandstone consists of fine sand stone sometimes overlain by plinthite (iron –stone or laterite).

1.2.4 TOPOGRAPHY

The land surface is fairly elevated and undulating throughout the project area. The elevation varies from 83m to 103m a.m.l.

1.2.5 VEGETATION

The vegetation of the area is typical of that of Northern Guinea Savannah. There are species of legumes in the area in the area, which enhances livestock performance in the area.

1.3 PROBLEM STATEMENT

Dam creates artificially large bodies of water (reservoir) which cause significant changes on the surrounding ecosystem. The dominant ecological factors associated with the operations of dam and reservoir were evaluated

in relation to their sensitivity to project development and associated environmental problems.

The poor sanitation and health situation of the people in the area, as reflected by the evidence of water related diseases, indicates a high potential for the endemicity of vector borne and water – related diseases such as malaria, dysentery, schistosomiasis e.t.c. likely aggravated by dam project and the accompanying irrigation activities. Also, the dilapidated dam and irrigation structures, which could cause flooding unless mitigated, hence the need to institute health education programmes in the affected areas.

1.4 JUSTIFICATION

Reconnaissance survey of the study area revealed a dilapidated canal structure, broken downs control structures, silted canals and badly eroded canal embankment. The observation has shown that both positive and negative effects occur consequently on the construction of the dam and reservoir, such as flood, channel erosion, changes in water chemistry, siltation, disruption of basin, ecology and general environmental metamorphosis.

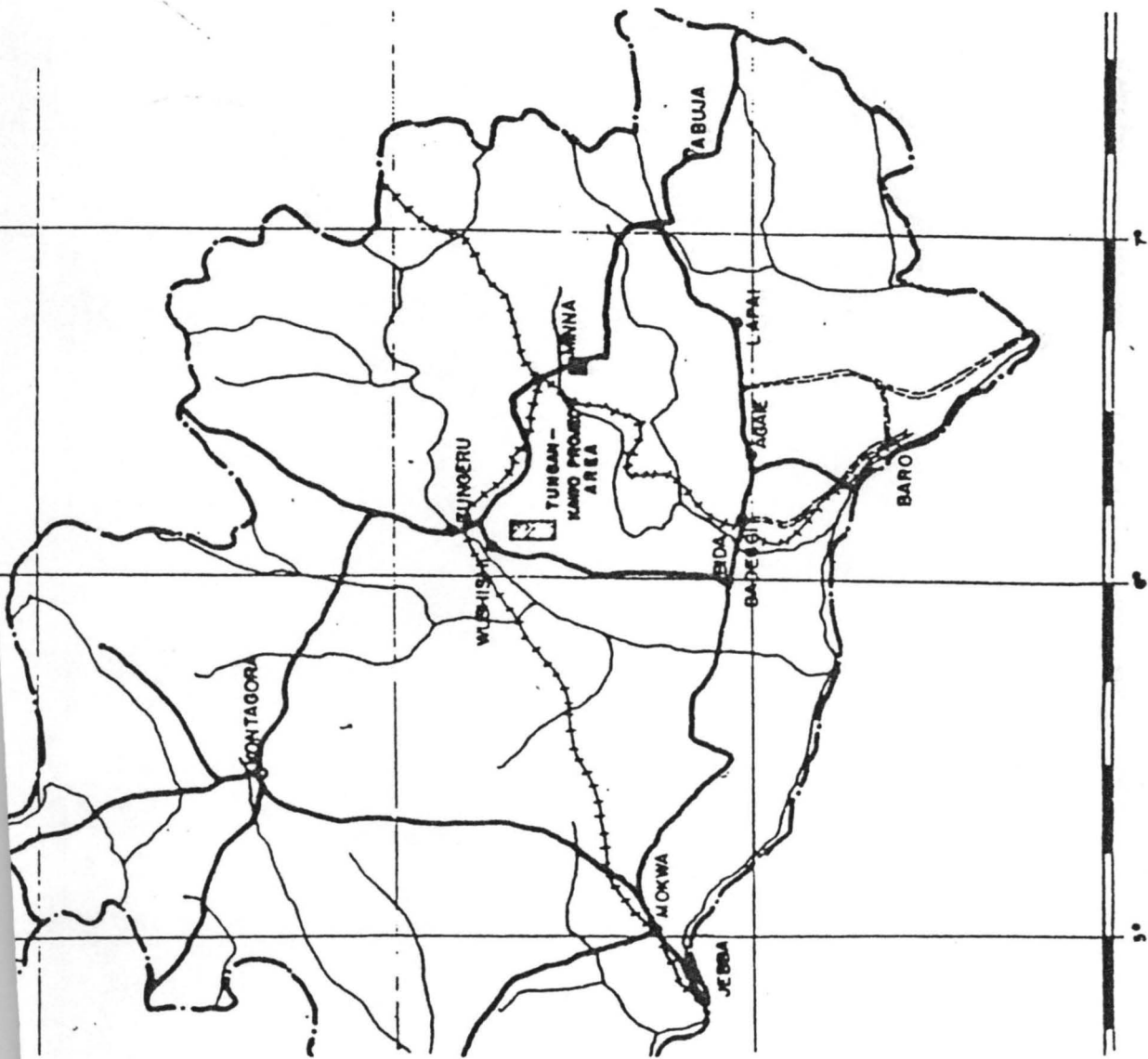
Dam often have profound and abrupt impact on the environment which affect the hydrobiological and physical parameters of the environment as well as the socio-economic welfare of the communities around the project area. The construction of the dam result in the inundation of large expense of land and also result in high biodiversity losses and organic matter loading and anaerobic decomposition within the reservoir. Toxic and hazardous chemicals from pesticide spraying of agricultural lands as well as fertiliser applications within the watershed would adversely impact the water quality, fisheries and wild life.

1.5 SCOPE AND LIMITATIONS OF THE STUDY

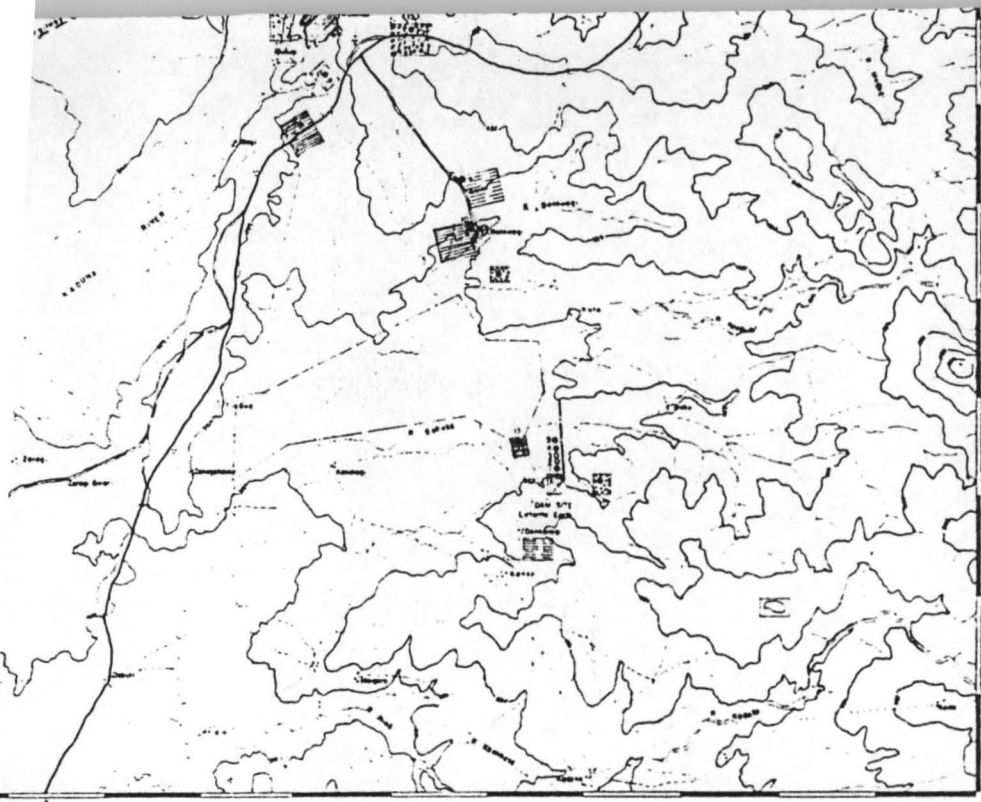
This thesis examine the potential environmental impacts and evolving such recommended mitigation measures that would minimise the adverse environmental problems related to the dam and the associated irrigation facilities. It involved the evaluation of water resources, vegetation and land use, wild life and fishery resources, public health and safety of the dwellers of the project area. Geological and geotechnical considerations though necessary were not included in the scope of this thesis, which aimed at studying the environmental impact assessment of the study area with emphasis on sociological impact.

1.6 AIMS AND OBJECTIVES

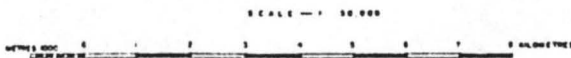
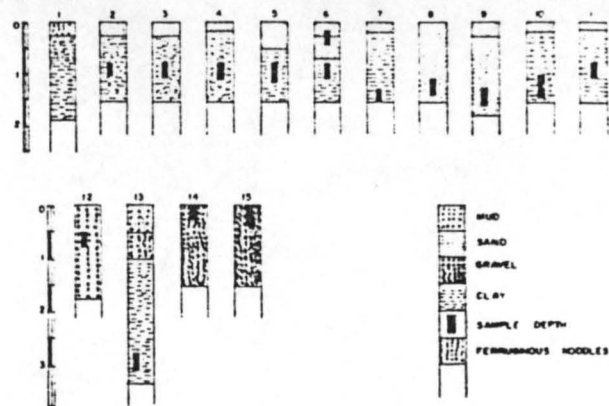
- ✓ To assess the environmental impact with emphasis on sociological aspects of the project.
- ✓ To determine the potential environmental, social and health effects of the project.
- ✓ To highlight the need for legislation to guide dam owners/operators.
- To evaluate site specific conditions by quantitative data of components of the environment in relation to their degree of sensitivity to project development.
- ✓ Recommend environmentally sound operational techniques and appropriate mitigative measures that would minimise project related adverse impacts.



TUNGAN KAWO IRRIGATION PROJECT
LOCATION PLAN



TEST PIT LOGS OF T/KAWO DAM SITE



NOTE — REPRODUCED FROM TOPOGRAPHICAL SHEET N° 163 SW OF FEDERAL SURVEYS, NIGERIA

Engineers & Consultants Limited					
NO. 1, P.M.E. SAKI, IBADAN					
DATE					
REF No.					
ISSUED	REVISIONS	CHECKED	APPROVED		

TUNGAN — KAWO IRRIGATION PROJECT

APPROVED:	SCALE: 1:50,000	DATE: 1968

PRINCIPAL PROJECT DATA**General**

Name of the Parent River	- River Ubandawaki (Gabuko)
Catchment Area	- 166sq.km.
Purpose	- Irrigation
Other Uses	- Flood and drainage control and water supply
Net Irrigation Area	- 800 hectares.

Dam.

Type of dams	- Earthfill
Dam Crest Elevation	115.5m
Highest Flood Level	- 114.0m
Normal Water Level	- 113.0m
Low Water Level	- 107.0m
Maximum Height of Dam	- 11.75m
Dam Crest Length	3.30km
Dam Bund Top Width	6.00m
Reservoir Surface Area at N.W.L.	- 400 ha.
Reservoir Capacity at N.W.L.	- 22.0 million cu.m
Live Storage	- 21.0 million cu.m.
Dead Storage	- 1.0 million cu.m.

Spillway

Type of Spillway	- Uncontrolled overflow
Spillway Crest Level	- 113.0m
Spillway Crest Length	- 39.0m
Spillway Discharge Capacity	- 85m ³ /sec.
Maximum Free Board Allowed	- 1.5m.

Irrigation Structures

Main canals	- 0.72km (lined)
Secondary and Tertiary canals	10.64km

Flood and Drainage Structures

Length of Flood Protection	- 6.7km.
Length of Drainage System	- 7.5km
Length of Main collector-Drain	- 3.24km.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 E. I. A.(DAMS & RESERVOIR)

Reservoir impoundment caused by damming impact directly environmental associated problems, with effect on the hydrological and physical parameters of the environment as well as the socio-economic welfare of the communities around the projects area. It results in the inundation of large areas of land and biodiversity losses and health hazard among others. EIA will therefore, provide necessary information for the assessment of the fate of infrastructure, lives and properties and recommend strategies to be adopted for implementation of inundation mapping, emergency preparedness and planning. It also pay interest to dam safety because dam failure incidences endangers lives and properties.

The main objectives are therefore:

- 👉 to understand the likely environmental consequences of the impoundment;
- 👉 to visualise the consequences of the dam failure/break;
- 👉 identify measures by which such impacts can be mitigated;
- 👉 present the results in such a way that they can provide valuable input into decision-making.

The lists of severe environmental hazards and disasters associated with Dams and Reservoir is well known, amongst them is misnomer for storm surges and river floods which often cause over-spilling and or overtopping of dam consequently lead to break. Also degradation of channel as a result of changes in hydraulic regimes, including non-equilibrium of rivers are the various effects. But protective and evasive action is possible

where advance knowledge permits. It will be fool hardy if we don't take the opportunity to arm ourselves with information about the hazard it might caused.

Where do such things occur?

When can they be expected?

Can warning system be made effective?

What are the mitigate measures?

What should we do when disaster threatens?

Broadly speaking, such information comes under environmental impact assessment and protection.

Nigeria lacks well-developed hydrological and hydrogeological network, hence, there is no reliable data for project planning and implementation. There is also no water legislation to guide those building dams or any water impounding structure on how much water to release at a particular time to downstream. If sufficient care is not taken, reservoir created may dry-up the flood plains downstream with very serious consequences. There is therefore a need for a definite policy guide.

The race to industrialise and increase water supply and agricultural production through provision of Dams and Reservoir due to mounting population pressure has generated severe environmental problems. The purpose/objective of an EIA is to ensure that the project (Dams & Reservoir) options under consideration are environmentally sound and sustainable. The EIA for dams and reservoirs will complements economic, political and technical analysis of the project. Without an EIA, a project through negative, unforeseen or unmitigated environmental impacts may have negative or reduced utility values on the intended beneficiaries.

2.2 E. I. A. PROJECT REVIEWED

In the course of this work, some EIA reports on certain projects were reviewed particularly the ones on Owena Multipurpose Dam and Kagara Dam.

The Environmental Impact Assessment (EIA) Report of Owena Multipurpose Dam, and Environmental Impact Statement (EIS) emanating from it containing a condensed summary of the observed environmental impacts, the recommended mitigation measures as well as the recommendations on projects implementation/project alternatives were issued. The dominant ecological factors of the project area were evaluated in relation to their sensitivity to project development and associated potential environmental problems. The study was aimed at evolving such recommendations as would minimise adverse construction and improvement related impacts. It involved the evaluation of water and soil resources, vegetation and land use, wildlife and fishery resources, hydrology, public health and safety of the dwellers of the project area. Geological and geotechnical investigations, though considered necessary, were not included in the scope of the EIA.

The results of the field baseline ecological surveys carried out in both the dry and wet seasons indicate significant adverse potential impacts of the proposed project on the environment. The impacts, endangered by the existing conditions of the project area, will be aggravated by changes caused by the alteration of water flow pattern and water impoundment and flooding of land to form the reservoir. The impacts were predicted on the existing ecological conditions, sensitivity of the environment and extrapolations from studies of similar features of other existing dams and reservoirs mostly in the geographical region.

On the EIA reports of Kagara Dam, the study has followed strictly the guidelines specified by the Environment Impact Assessment Decree (No. 86 of 1992, section 4). The report is organised into two major sections – The Technical and the Non-Technical Report. The methods of analysis of field work and example questionnaires were all included. Apart from the earth dam construction, the package involves the construction of spillway, water supply intake, draw – off works, office and residential accommodation among others. These are activities with real potential consequences on the natural habitat. It was observed that the impacts of the dam on the environment were not considered during the project design. It was also discovered the there were no plans for the resettlement of the people displaced by the project and neither were there any contingency plans in case of downstream flooding nor plans for the migrants who will be attracted to the site as a result of new opportunities. The impacts of the dam at the construction stages were studied. The findings, conclusions and recommendations are thus presented based on the followings: -

- Hydrogeology and Dam safety;
- Fish ad fisheries;
- Ecology
- Soils;
- Forestry;
- Farming practices;
- Livestock;
- Socio-economic and Environmental Health.

2.3 NATURE AND USES OF DAMS AND RESERVOIR

Dam is a barrier built of concrete or earth materials (embankment) across a river/stream to hold backwater and raise its level to form a reservoir.

Dams are categorised in large, medium or small. Large dams are classified in accordance with definitions of International Commission on Large Dams (ICOLD) which is a global association effectively used in dam development activities and in which Nigeria is a financier and active member. But medium and small dams follows the definitions adopted by the Nigerian Sub – Committee on Dams (NSCD). See fig. 1.

More than 160 dams of various reservoir capacities have been constructed in various part of the country. The principal objective for building these dams are for water supply- (domestic and industrial uses), irrigation and hydropower generation. Secondary benefits include recreation, fisheries, flood control, and wildlife conservation.

Since man can raise or lower the floodgate on the dam, he can smooth the irregularities of the flood – draught cycle, accumulating water during high flow and releasing it during low flow. Government through Federal Ministry of Water Resources, River Basin Development Authorities, and Water Board/Agencies/Corporations is intensifying opening new frontiers in the development of Water resources of the country in the field of dam technology.

From statistical records available, only about 5% of the impounded water meant for irrigation are utilised while only 10% of the impounded water meant for water supply is utilised. There are number of reasons that have lead to this dismal situation. The Federal Government has put most of these structures and due to lack of adequate funds, cannot construct and develop the downstream irrigation facilities. In many of these dams, the impounded water is released only when there is eminent danger of over

topping the dam and/or when there is spilling from the spillway due to excess inflow. Therefore, the needs to only safeguard the dam from collapse when unexpected high flood occur rather than sole concern for downstream damages. While this denies the downstream users from their riparian rights for the use of the water from the impounded rivers, sudden and excessive release of these water cause serious flooding of the downstream areas resulting in lost of lives and properties. The major social and economic benefits of the impounded reservoirs are thus lost.

2.4 DAM SAFETY

The last three decades witnessed the construction of a number of dams in Nigeria. It has therefore become necessary to pay interest to dam safety. A few dam failure incidences including Ikpoba in Edo state, Bagauda in Kano state and Alau in Borno state were recorded, consequently endangered lives and properties in the areas in which they are situated. The danger could have been averted if routine inspection were enforced.

The huge investment in dam projects coupled with the high risk to population as well as developments downstream and socio-economic benefits of dams justify the necessity to ensure prevention and control of dam failures. It is essential that dam owners in Nigeria should understand the importance of giving priority attention to safety aspects of their dams. In the light of these, there is need for a formulated programme of visual dam safety inspection in Nigeria in accordance with the procedure recommended by the International Commission on Large Dams and adopted by the Nigerian National Sub – Committee of Dams which give guidelines on what to inspect on the various components of a dam system (embankment, spillway, outlet works, reservoirs e.t.c.).

During examination and inspection, concentration should be given to the following:

- i. The upstream face of the dam such as slope protection and erosion.
- ii. Downstream face to include movement of body, seepage or wet areas.
- iii. Seepage on abutment, cracks, and joints.
- iv. Crest of the dam, especially surface cracking.
- v. Performance of instrument such as piezometers, reservoir level gauges, cross – arm device e.t.c.
- vi. Approach channel, control structures such as aprons, crest, wells, gates, stilling basins e.t.c.
- vii. Inlet and outlet works, emergency control facility and reservoir capacity.
- viii. Also examine and advise on the emergency preparedness planning with regards to communications, operating procedures, access roads and safety features on the dam.
- ix. Identify the high hazard potentials.
- x. Identify dams requiring rehabilitation or maintenance and instrumentation works.

The main objectives of dam inspection include:

- a. To prevent dam failure and this reduce risk to life and properties.
- b. To enhance the longevity of dam infrastructure.

The visual inspection will therefore provide the necessary information for the assessment of the present state of the dam, infrastructure. For deserving cases, the Inspection Report will recommend strategies to be adopted for implementation of Inundation Mapping, emergency preparedness and planning.

2.5 PROBLEMS OF EXISTING DAMS AND RESERVOIRS

The major problems affecting existing dams and reservoirs are as follows:

- (a) Insufficient Reservoir Inflow against Active Reservoir Capacity: Some large irrigation dams in the northern region are constructed with large active reservoir capacity as compared with reservoir inflow. Thus, over a long period the reservoirs of these dams cannot meet the planned irrigation water demand for the service area. This is one of the problems affecting the Tungan – Kawo Dam. Thus these dams, the reservoir water use plan must be reviewed by Reservoir Operation Study. Otherwise, the irrigation area set up in the original plan will always suffer water shortage problem during irrigation season owing to insufficient reservoir water.
- (b) High Evaporation Loss from Reservoir Surface Area: Due to high evaporation loss in some reservoirs, it is necessary to review the available reservoir water for irrigation and water supply demand in dry season taking into consideration the evaporation losses. Hence data collection to evaluate these losses must be done annually.
- (c) Inadequate Reservoir Water Release to Downstream Users for River Ecology: Irrespective of the use the water in a reservoir is designed for, it is mandatory that water should be released for downstream users and for river ecology.
- (d) Unknown Available Reservoir Water: Due to lack of study during planning and design of some of the dams, available reservoir water which are necessary for reservoir operation are not known.

(e) Small Reservoir Water Use: Presently, the water use for irrigation is about 10% and for water supply it is about 20%. The reasons for these are:

- i. Incomplete irrigation system and water supply facility in service areas;
- ii. Lack of hydrological information due to non installation of gauging stations and no continuous observation at the stations;
- iii. No Reservoir Operation Study, as a result no rule of reservoir operation and unknown available reservoir water;
- iv. No information for charging irrigation water demand irrigation period due to lack of close co – ordination of Operation and Maintenance Staff between dam an service area.

Hence, it is necessary to solve above small water use problems urgently in order to obtain benefit from service area.

(f) Decreasing Active Reservoir Capacity by Sediment Transport:

Some existing dams designed with small dead storage capacity have active reservoir capacity reduced due to siltation from sediment transport and have lost part of their reservoir function. It is therefore necessary in dam maintenance to survey decreasing active reservoir capacity by sediment transport and to review available reservoir water for the designed demand in service areas.

(g) Insufficient Spillway Flood Capacity: Spillways (structures built for excess water release) at some existing dams are inadequate because they are designed with small flood capacity and could no spill flood effectively and safety during normal or high flood

period. Some of these spillways have to be rehabilitated and their functional capability reassessed.

(h) Seepage Through Dam Foundation: Some existing dams suffer from seepage problems through their foundations, for example Goronyo dam. When large seepage water appears, the dam structure is threatened and piping failure could result. Excessive seepage results in loss of reservoir storage. Monitoring work of dam maintenance for seepage water should be carefully and periodically carried out by:-

- Monitoring the performance of dam instruments and relief wells as well as downstream slope and toe;
- Drawing the seepage line on the dam cross section drawings in accordance with monitoring result;
- Measurement of seepage quantity of the dam downstream toe and its colour;
- Analysis of seepage line and quantity for abnormal as compared with the design criteria;
- Reporting monitoring results.

(i) Rehabilitation of Dams and Reservoir : some dams, Some dams, apart from problems mentioned above, need to be physically rehabilitated because of the following additional problems:

- ☛ Gully erosion on the downstream dam slope and dense vegetation and shrub on the upstream dam slope;
- ☛ Sweeping out of riprap material on the upstream dam slope by wave energy of reservoir water;

- ☛ Scouring t the downstream basin of the outlet and spillway;
- ☛ Defective portion of concrete structure at the outlet and spillway as well as mechanical parts such as gates and valves;

Some of these problems can be addressed by: -

- ◆ Removal of dense vegetation and shrub on dam slope and at times closing gates and valves;
- ◆ Protection for seepage through dam foundation by additional toe embankment with drainage facility;
- ◆ Expansion of crest length of spillway with insufficient flood capacity.

We have so many of our dams with the above existing problems and they should be rehabilitated in time, from viewpoint of dam safety and recovery of dam function.

2.6 PROBLEMS MILITATING AGAINST PROPER OPERATION AND MAINTENANCE OF DAMS AND RESERVOIRS

Many dam owners have faced the following problems and difficulties in the operation and maintenance of these hydraulic structures:

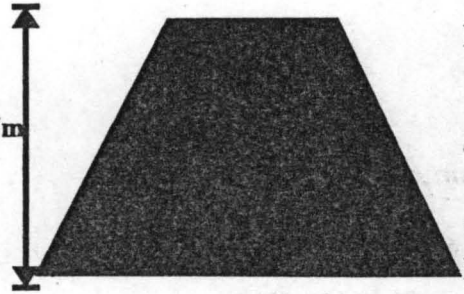
- a. Lack of Hydrological Station and Data at Dam Sites;
- b. Non preparation of Reservoir Operation Rule and Proper Maintenance Rule;
- c. Insufficient Operation and Maintenance Facilities and Equipment;
- d. Lack of Adequate Training for Operation and Maintenance Staff;
- e. Lack of Adequate Funds.

Proper Operation and Maintenance for Dams and Reservoirs cannot be effectively carried out unless above problems are solved.

FIGURE 1

Large

$H \geq 15\text{m}$



For Height of Dam: a) $10 \leq H < 15$;
b) $10 > H$ and

Either

* $L \geq 500\text{m}$ (Length of Dam Crest)

or

* $V_R \geq 1\text{mcm}$ (Volume of Reservoir)

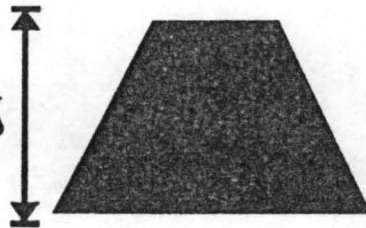
or

* $\text{spdf} \geq 2000 \text{ m}^3/\text{s}$ (Spillway Design Flood)

or

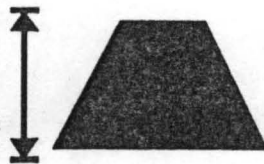
Medium

$8\text{m} < H < 15$



Small

$H \leq 8$
and
 $V_R \leq 5\text{mcm}$



CHAPTER THREE

3.0 DATA AND METHODOLOGY

3.1 DESCRIPTION OF DATA SET

S/No.	Data Set	Duration
1.	Socio – cultural	1988 – 1999
2.	Economy – Fishing & Farming	1988 – 1999
3.	Water Reservoir and Irrigation facilities	1988 – 1999
4.	Public Health	1986 - 1999

3.2 METHODOLOGY

3.2.1 Reconnaissance

Reconnaissance survey of the area was carried out with the assistance of the project staff. During the survey, the four communities were visited and entire project area including the river channel downstream. Few measurements and quantification were also carried out.

3.2.2 Administration of questionnaires

About sixty (60) questionnaires were distributed to the staff, participating farmers and Heads of household in Wushishi, Kanko, Dankwagi and Bankogi. Fifty-five (55) responded. Among which forty (40), which contained detailed responses, were selected and analysed. Of these eighty five percent (85%) reported positive effect, twelve percent (12%) negative on general aspects which vary from income to accessibility which include fishing enhancement and improved farming, labour and public health. In the questionnaire, detailed were asked on certain aspects based on the objectives of the study. (See appendix on the questionnaire).

3.2.3 Personal interview

Personal interview was also carried out to acquire some remote and in-depth information from the local inhabitants within the communities of the project area. This made them to freely divulge certain information.

CHAPTER FOUR

4.0 ANALYSIS/FINDINGS

4.1 POTENTIALLY AFFECTED ENVIRONMENT

The project is located across the flood plain of Rivers Ubandawaki and Bankogi 7.5km from Wushishi town (See fig 1 & 2). The rivers comprises of several minor tributaries such as River Gabuko and Dankuwagi which ultimately discharge in to River Niagi which in turn joins River Kaduna on the downstream end. The affected area/community includes; 400hectares of reservoir area, 800 hectares of arable land, communities of Wushishi, Bankogi, Dankuwagi, Kanko and Maito. They are either affected by inundation, flooding, arable farming. Fishing and other sociological aspects consequent to the construction of the project.

4.2 SOCIO – CULTURAL IMPACT

The construction of the project has attracted many people of different cultural background to settle in the area, thereby increasing the population of the communities and encourage the expansion of settlements.

A lot of socio-cultural changes were observed because of cultural diffusion of different cultures of the inhabitants. Two dominant tribes of Nupe (the original natives) and Hausa (the settlers and the age long representatives of traditional administration from Kontagora Emirate). There were traces of Dakarkaris whose grand parents came as aids to the traditional representatives from Kontagora Emirate. There are also Gwaris who moved to the area for farming and labour. There are also Fulani herdsmen who has settled down because of availability of water from the dam and all year round grazing fields in the area.

These different people inter marry with consequent exchange of cultural activities and believes. In the area of social conflicts such projects

has led to the dispossession of peasants of their land, unsatisfactory resettlement schemes and/or inadequate and delayed compensation, all of which resulted into serious resentment, lack of co-operation or outright revolt on the part of the peasantry against the authority. There is a gross inequality in land (plot) allocation for irrigation. There is unequal access to land and input, finance and other means of production. The original natives were displaced to make way for the project with their land literally confiscated, their fishing ground destroyed and social and economic lives completely dislocated. Yet when it comes to redistribution of the developed land, the rich and influential and politically well – connected individuals from the cities and other parts outside the communities end up getting the bulk of the land, as absentee farmers/landlords, leaving the peasant who originally owed the lands as onlookers or labourers. This practice sometime causes communal clash and social conflict between the original land owners or the communities and the settlers of other communities that were attracted to the area as a result of the project. Also between farmers and cattle herdsman or pastoralists who drift their livestock into the area during the dry season for grazing.

The lost of Fadama land by peasants at far downstream of the irrigated area has forced them to change their mode of farming and some forced to migrate. The problem of labour immigration arise partly from the resettlement of the dam area population and partly from influx of labourers from other parts to avoid the idle time during the dry season because of the availability of irrigation water and fishery.

4.3 ECONOMIC IMPACT – Fishing/Irrigation

The major effect of the project is the economic impact on the life of the people within the communities of the project. The availability of perennial water for both domestic, livestock, fisheries and agricultural purposes as

against the seasonal. About 97% of the Heads of the household interviewed reported that the dam construction has had effects on their occupation. Of these, 85% reported positive effects, 12% negative and 3% no response. These effects vary from income to accessibility, which include fishing enhancement and improved farming and animal husbandry, labour e.t.c.

About 60% of the respondents claimed that they were adequately informed and are being carried along by the project implementers (UNRBDA).

From the result of the study, 20% of the community are full time fishermen, while 20% combined fishing with farming. The fish catch are being sold in local Wushishi and Zungeru markets in three forms viz, fresh, smoked and salt-dried. A part from the usual market day there is a day (Wednesday) for fish market. Another positive effect are the increase in agricultural production, increased in farmers income, desirable transformation of certain reaches of the affected areas, some checks against process of desertification and improved availability of water supply for cultivation of various crops. At the end of each farming season, the Authority prepares the land and reallocate where necessary and charge the farmers for land preparation and irrigation water rate. It also procures and distribute farming inputs to its beneficiaries.

The dam has destabilised the pre-existing physical and chemical properties of the basins both upstream and downstream. The controlled release of water would check the perennial flooding of valuable agricultural land. The dam provide domestic water supply to neighbouring villages and fishery activities. It should be state that flood control usually considered a positive environmental impact of dams also one of the expressed objective may be a negative effect if proper care is not taken since the spillway is uncontrolled type (counting on the flooding in August, 1988 consequent to failure of Bagauda Dam in Kano State, Alau Dam in Borno State, 1999

flooding of Niger Basin consequent to over release from Shiroro, Kainji and Jebba Dams in Niger State.

However, the project has inevitably improved the economic activities in the area. Workers spend their income in the communities thus raising the per capita income of the area, food items are bought and accommodation are provided to the workers by the villagers all these improve the income of the inhabitants.

4.4 IMPACT OF WATER RESERVOIR & IRRIGATION FACILITIES

The Tungan – Kawo project was designed to provide irrigation facilities and water management services for approximately 800 hectares of arable land. The irrigation water is supplied to the farm from the reservoir (22mcm capacity) through a water distribution network comprising of a main canal, two secondary canals, the water finally get to the irrigation fields through a network of field channels (number up to 63). The project under the management of Upper Niger River Basin Development Authority is able to command and prepared about half of the area (400 ha) for irrigation and rainfed farming. This land (divided into plots) were allocated to interested farmers within and outside the communities.

4.5 EFFECT ON PUBLIC HEALTH

Dams cause physical transformation of the environment, inundation of settlements and destruction of habitats, possibly increase seismic tendencies and often leading to explosive aquatic weed growth and the spread of schistosomiasis and other communicable water related diseases. Health hazards are well known to be associated with dams.

During the study of the area and from questionnaires (see Appendix for questionnaire). Heads of household were asked of the cases of different diseases ever recorded in the area after construction of the dam or since they moved to the area. It showed that malaria, cholera, guinea worm, dysentery, diarrhoea, typhoid fever, skin diseases and schistosomiasis are the commonest diseases in the area. These could escalate due to lack of adequate health care system and environmental education in the area. The irrigation scheme might have rendered the area more vulnerable to diseases. Irrigation water can serve as transfer medium and a habitat for vectors.

The following cases were recorded in the field through questionnaires and interview with Heads of households on different cases of diseases recorded in their household since the time of their residence in the project area.

DISEASE	RESPONSE	FREQUENCY	PERCENTAGE
Dracunculiasis (Guinea worm)	Yes	45	76.27
	No	14	23.73
Dysentery	Yes	42	71.19
	No	17	28.81
Schistosomiasis	Yes	35	59.32
	No	24	40.68
Malaria	Yes	59	100
	No	0	0
Cholera	Yes	10	16.95
	No	49	83.05
Filariasis	Yes	6	10.17
	No	53	89.83

CHAPTER FIVE

5.0 MITIGATION/RECOMMENDATION AND CONCLUSION

5.1 MITIGATION/RECOMMENDATION







the phenomena of environmental degradation associated with dams and reservoir operations with respect to fisheries and irrigation activities and the flooding with respect to hydro-electric dams operation has reached an alarming proportion in the last few years and have become a subject of national discourse in the recent times. The situation has become more compounded by the numerous large dams whose operators had to make emergency releases of floodwater. Consequently, lives and properties are being lost to the floods. It is therefore imperative for appropriate measures to be taken to control these increasing trends.

The Federal Ministry of Water Resources should liase with the Federal Ministry of Environment, Federal Ministry of Mines and Power and other relevant agencies with a view to setting up of a committee of experts to study in details the issues of flooding within Nigeria hydrological areas and recommend measures to mitigate the effects of such floods.

There should be permanent relocation of settlements within the immediate flood plains downstream of these dams and the payment of appropriate compensation by the dam owners.

Other suggested mitigation measures includes:

- 👍 Dam owners and operators should collect, collate and maintain a comprehensive hydrometeorological data to enable them predict flood occurrences and arrange early emergency plans.
- 👍 Dam operators should adhere strictly to the operational guidelines.
- 👍 Dam owners should carry out dam break studies.

- ①  There should be legislation to prevent human developments and habitation within the high-risk flood areas.
- 6  Construction of buffer dams to surcharge floodwaters.
- 5  Proper watershed management to minimise siltation of reservoirs.
- 2  Mitigation measures relevant to the preservation and protection of aquatic resources and water quality and those relating to vegetation clearing in the catchment area and control use of pesticides and chemical fertilisers in the irrigation fields.
-  A well co-ordinated environmental and hydrological monitoring network in the basin.
- ②  Create and maintain awareness among all water users in order to mitigate against all water related problems.

Water release from many dams are based on the need to safeguard the dam from collapse when unexpectedly high floods occur rather than sole concern for downstream damages. While this deprives the downstream users from their riparian rights. The major social and economic benefits of the impounded water are thus lost as a result of lost of lives and properties.

The dam and the irrigation structures should be rehabilitated as some are already dilapidated and the problem of water distribution and flow into the irrigation fields which has bedevilled the scheme since inception should be addressed immediately. Also environmental education programmes are highly recommended for all the communities within and around the area to improve their sustainable interactions with the project and the environment particularly in the area of health and pollution through the use of hazardous substances including pesticides and chemicals in farming. There is therefore, need for strict medical control to avoid the infection and transmission of endemic diseases.

5.2 CONCLUSION

It is generally conceded that Dams and Reservoirs help to solve the problems of seasonal water deficits particularly in the Savannah ecological zones. However, their products of hydrological and hydraulic engineering exert known adverse physical effects on the environment of all ecological zones both down and up streams of the structure. Luckily, some of the negative effects can be eliminated while others can be contained with appropriate resources management. It may be concluded that when both sides (positive and negative) are considered, the construction of dams and reservoirs is more beneficial than destructive/harmful to man and his environment in this country, particularly in the Savannah ecological zone.

The design and planning should include an environmental safety assessment for the entire reservoir and its immediate surroundings and for the river basin downstream of the dam. The assessment should include, but not limited to, such items as reservoir clearing, preservation of water quality, health hazard, fishing and safety of infrastructures. Specific flood warnings system should be provided in the design.

In view of the facts presented for a continuation of development of water resources potentials in the areas of irrigation, water supply, fisheries, hydro – electricity e.t.c. There should be a great care for environment. In this regard, recent government law requiring EIAs for such projects is commendable. There is an urgent need to quantify the environmental status of the existing dam projects with a view to arresting any unwanted trends. There is need also to develop consistent River Basin Management Policies and organise farmer into User-groups that will make them appreciate the benefits of the projects and care for them.

From inception of Tungan – Kawo Dam and Irrigation Project, the whole designed command area of the scheme had never been commanded due to certain problems highlighted earlier. The status of the scheme presently is that all irrigation infrastructures had completely collapsed, silt deposition had take over the canal waterways.

The impounded water in the reservoir and the irrigation fields is posing adverse environmental impact. Human and aquatic lives are been threatened, vegetation and soil has been degraded.

**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
OF TUNGAN KAWO DAM PROJECT
(SOCIOLOGICAL IMPACT SURVEY QUESTIONNAIRE)**

Dear Respondent,

1. This is a research in partial fulfillment of the requirement for award of post Graduate Diploma in Environmental management by the Federal University of Technology, Minna.
2. The questionnaire is designed to gather reliable information for effective Sociological Impact Assessment of Tungan Kawo Dam Project.
3. Be assured that your response will be duly treated with utmost confidentiality.
4. Thank you for promptly returning the completed questionnaire.

U.M. Ndanusah
10th January, 2000

FILL IN OR TICK AS APPROPRIATE

1. Name of village/ward/settlement:.....
2. How many families are staying in this settlement?
3. How many people live in your house?.....
4. What is the major occupation of your house hold?
 Farming public service Trading Others
 (specify).....
5. Are you aware of Tungan Kawo Dam Project? Yes No
- 6a. Does the Dam Project have any effect on your occupation? Yes No
- 6b. If yes, in what form? Positive Negative
- 7a. Has your income been affected as a result? Yes No
- 7b. If yes, in what form? Positive Negative
8. Was your house/farm affected by the project? Yes No
- 9a. If your property was affected, were you compensated? Yes No
- 9b. If yes, in what form? Cash Reritted Others (Specify)-----
- 9c. Were you satisfied? Very satisfied Barely satisfied, Not satisfied

- 9d. If not satisfied, what is your complaint:.....
- 9e. Have you lodge your complaint with the Authority? Yes No
- 9f. If No, what is the problem?
- 9g. If yes, what is the response?
- 10a. Do you use the water from the dam? Yes No
- 10b. If yes, what for? Domestic Farming Livestock
- 11a. What type of human disease do you think is new in this area or is too common which can be associated with the dam project?
- 11b. Has any of your household member had a case of above?
 Yes No (specify how many).....
- 12a. Do you think there is going to be new positive or negative benefits from the dam?
 positive Negative
- 12b. State them
- 13a. Were measures necessary to protect the environment and health incorporated in the design and construction of the dam? Yes No
- 13b. If yes, state.....
- 14a. Is there any plan for resettlement? Yes No
- 14b. How many were officially relocated?.....
- 14c. Were the necessary infrastructures provided at resettlement areas? Yes No
- 14d. What type of infrastructures?
 School, Hospital, Roads, Drinkable water Others
 (state):.....
15. How many families benefit from the associated irrigation schemes?.....
- 16a. Are there any contingency plan in case of downstream flooding? Yes No
- 16b. If yes, what plan?.....
- 17a. Are there any plan for migrants who will be attracted to this area as a result of new opportunities derivable from the dam project? Yes No
- 17b. If yes, what plans?.....

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