MAJOR ENVIRONMENTAL IMPACTS OF DAM AND IRRIGATION PROJECTS

A Case Study of Aisegba Dam and Irrigation Project in Ekiti State.

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APPROVAL COLLUMN

This Project has been read and approved as meeting Post-graduate Diploma (Agric Engineering) requirement of the Department of Agricultural Engineering, Federal University of Technology, Minna, Niger State.

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DEDICATION

The project is dedicated to my late Father, Pa Samson Olawumi Arotiba

&

the support and affection of

my lovely wife, M. F. Arotiba and my Children, Jemimmah, Faith, Joy and Victor.

ACKNOWLEDGMENT

To God be the glory for his mercies through out this programme, may his name be exalted.

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ABSTRACT

Although agricultural projects are usually associated with its positive impacts on human life, irrigation practices may be associated with adverse impacts on the environmental conditions, which may eventually curtail the sustainability of irrigation projects. For this reason, Environmental Impact Assessment has been recognized as an integral part of the early planning studies of irrigation projects in order to identify any expected negative impacts and suggest the necessary actions to curb these impacts. In the process, EIA can demonstrate the positive and negative impacts of different design alternatives for the project as an essential step for better decision making in implementing irrigation projects.

EIA studies evolve primarily from cost- benefit analysis due to the growing necessity of including social and ecological impacts while planning for development projects. In this context, EIA is meant to predict the future changes in environmental quality and to evaluate these changes. Ultimately, this aims at protecting the environment including the human welfare and health from any foreseen negative impacts as well as to elaborate on the positive impacts of the project.

Available EIA techniques for irrigation projects range from simple checklists to sophisticated simulation models. In fact, the accuracy and scope of each technique varies according to the intended purpose as well as the targeted users. A fundamental objective of any method remains; however, to determine all potential positive and negative impacts in a manner that facilitates the comparison between available project alternatives. In addition, it should identify those impacts

that need an evaluation by a specialist. Advanced techniques provide wider scope of objectives that may support the decision making by weighing environmental effects on common basis with economic costs and benefits. Accordingly, targeted users for the different techniques vary to include specialists and non-specialists planners, designers and decision-makers.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 GENERAL

Nigerian efforts since independence in 1960 have been to develop the agricultural sector to overcome increasing food and agricultural raw materials supply short-falls, rising food prices, low agricultural exports, and general poverty of the farming population. These efforts demonstrated by way of a number of agricultural policies, programmes and projects, were intensified in the seventies and early eighties and more vigorously in the last six years owing to worsening performance of the sector.

A significant part of the policies programmes and projects established in the last decade and half are related to the development of irrigated agriculture, particularly in the semi-arid regions. A comprehensive plan for water resources development has been pursued with the objectives of ;

i) Undertaking a comprehensive development of both groundwater and surface water resources for multi-purpose use.

ii) Constructing and maintaining dams, dykes, boreholes, irrigation and drainage systems and other works necessary for food production and human water needs.

iii) Providing water from reservoirs and lakes for irrigation purposes to farmers and

iv)Controlling the pollution of rivers, lakes, reservoirs and other large water bodies in Nigeria, among others. The above indicates the increasing role that water resources development for irrigated agriculture will continue to

play now and in the future in Nigeria much more so as the country strives for increase food and agricultural production in the face of increase threats from drought and desertification.

Environmental issues, though not pursued to any significant extent in the past, have not been overlooked in water resources development for irrigation or reservoirs. The very recent focus on environmental impact of river basin development projects is indeed a welcome departure from the previous practice of neglect which has given rise to serious ecological problems such as water logging, salini zation and human diseases in many of the existing irrigation schemes.

The need to pay due attention to the study of the ecological consequences of river basin development activities to avert costly disasters.

The establishment of new projects must be based on "preventive planning" as a way of avoiding undesired consequences. Preventive planning involves the incorporation into a plan of all foreseeable consequences, environmental, economic and social of a development activity.

1.2 LOCATION

The project area is located very close to the Aisegba town in Gboyin Local Government Area of Ekiti State.

The proposed irrigation project covers an area of about 400 hectares and lies within the flood plains of the river Apariko

The Apariko river a tributary of Ogbesse river has total basin area of about 286km^2

The project covered all the communities in the area and communities in the near by basins which may be directly or indirectly affected by the

project. The communities covered are; Aisegba-Ekiti, Ijan- Ekiti, Kajola, Aba- Omuaran, Arola, Surulere, Ilupeju, Egbe-Ekiti and Ilu-omooba.

1.3 OBJECTIVE

The main objectives of this impact study are:

a) To give a baseline of the existing situation against which to measure the effects of the Dam and irrigation project.

b) To provide adequate information which can inform and reassure the public that everything that is relevant to the area and the people affected has been taken into consideration.

c) Identify the present and potential environmental risks and problems that are associated or are likely to be associated with the Dam and Irrigation Project.

d) To offer suggestions as to how the impacts identified can be modified to maximize the benefits and minimize injuries

1.4 SCOPE OF STUDY

The Environmental Impact Study of Aisegba irrigation covered the following:

a. Agriculture and Soil study

b. Hydrological and Fisheries study

c. Human Health study

d. Socio – Cultural study.

1.5 METHODOLOGY

Several approaches were adopted for the study of the environmental impacts. Among them are:

i) Interview with farmers and rural communities in the area under study using questionnaires.

ii) Discussion with corporate agencies operating in the area.

iii) Direct field investigation of the effects of irrigated land use on the resources of the area including soil, water, animals, plants and people.

iv) Varieties of approach were made to obtain the true price of the impact of the project on the public health

v) Observation of rural settlements and land use pattern in the area and identification of different category of people in the study area.

Interviews with farmers and communities were conducted in selected villages in the upstream and downstream of the proposed dam.

Field investigations included the documentation of land use types and spatial relationships, observations of flooding or waterlogging conditions in fields proximate to the villages visited and elsewhere in selected sample areas. Observation, with sampling, of surface water conditions within areas, investigating salt pollution (e.g. salinilization, sodicity, eutrophication, etc) in soil and surface water arising from

fertilizer and agro-chemical uses; documentation of agrochemical practices in rain-fed and irrigated fields; recording of pest and disease situations of crops plants of phenological growth stages; and recording of the nature and pattern of the occurrence of upland and aquatic weeds in the study areas.

CHAPTER TWO

2.0 DISCUSSION.

2.1 Soil Quality

Soils under irrigation in the tropical regions of the world often develop common problems of salinization and/or alkalinization, water - logging, soil erosion, nutrient losses and nutrient imbalance if not proper managed.

Among the side effects, salinity and alkalinity developments pose the most devastating threat to the performance of irrigated agriculture in the semi-arid to arid tropical regions

Impact of Irrigation on Soil Quality

In the project area, water logging, siltation, incipent salinization, alkalinization and erosion were studied for the side effects of the profit.

2.1.1 **Water logging**

Water logging is a condition that describes the ponding of soils at or above the soil surface to such an extent and for such duration that requires soil drainage for agricultural uses or growing of adopted crops

One or combination of the following factors generally causes water logging:

i) Seepage water from unlined irrigation canals;

ii) Flood water due to rivers over-flowing their banks;

iii) Presence in soils of shallow water table or perched water table;

iv)Presence of restrictive (impermeable) layers in soils such as hardpan, clay-pan, or impermeable clay; and

v) Presence of micro and macro-depressions where rainwater or irrigation water can stagnate.

Waterlogging of the soils or landscape has not produced any serious side effect in the project area. Water logging varies from frequent to irregular in all the areas during the raining season depending on the closeness to the river.

2.1.3 **Erosion**

Erosion of soil is a natural geologic phenomenon that takes place in all landscapes of the world, gradually shaping the land-surface. Under natural conditions, its pace is very slow and almost noticeable unless when accelerated by catastrophic events such as uplift or earthquake. However, in modern times Man's intervention through improper land use and indiscriminate removal of vegetal cover accelerated the erosion process.

The method of irrigation profoundly affects the vulnerability of the land to erosion. Because irrigated land is wetter, it is less able to absorb rainfall and runoff will therefore be higher. Field size, stream size, slope and field layout are all difficult to change and all significantly affect erosion rates.

Only water erosion will affect soil quality in the area. Water erosion will manifests as riverbank erosion, with the banks of the rivers highly dissected randomly.

The project area is the lower reach of the river, the problem of erosion is low because of the landform.

The soils also are generally clayey loam, therefore, are fine and closely attached to each other, making erosion very difficult.

2.1.4 Siltation

Siltation is the process of the deposition of fine sediments mainly fine, inorganic particles on the soil surface or riverbeds. Sometimes fine organic particles may constitute part of the sediments. The sediments are usually carried as load by moving water concentrated and sheet-flow, river, or floodwater, which deposits its load whenever its velocity is drastically reduced or ceases completely.

2.2 Impacts and Consequences (soil)

2.2.1 Water-logging

The effects of water - logging are the creation of anaerobic conditions in soil and the build-up of carbon dioxide in the trapped soils. The landscape affected is converted from terrestrial regime to an aquatic regime resulting not only in land reduction but also in unsuitable conditions for plant growth.

The consequences of waterlogging affect not only agricultural activities in the area but other land use requirements such as pasture for livestock and water management. Reduction in usable area of land, restrictions in the choice of crops and reduced yields are the consequences to agriculture, thus limiting food supply to the inhabitants.

Low quality of wet land grasses, which eventually replace the terrestrial, fine-regenerated nutritious grasses, and reduction in size of grazing land, and livestock diseases harbouring are the consequences to pasture and livestock.

Weight loss in livestock has been reported as the end result of low quality pasture caused by water logging.

2.2.2 **Siltation**

The effects of siltation of all the tributaries draining into the river may choke the drainage ways raising their beds substantially. The result is that flows in the tributaries channels will reduce such that they contribute little water to the flow except during occasional flash floods.

The Apariko River is very shallow in the parts of project area, a phenomenon that increases the over flowing of its banks during occasional flash floods and flooded land is often sealed at the surface with sediments transported by the water. When this occurs, the infiltration of water into the soil is reduced and evaporation is promoted, thus causing the wastage of otherwise utilizable water.

The reduction in the quality of water is also a consequence of siltation, which may hamper the operation of certain irrigation systems.

2.2.3 **Erosion**

The effects of erosion are the loss of vital topsoil, nutrients and water through sheet erosion, and surface scaling of soils through siltation, all amounting to poor soil conditions for good crop growth. Drastic losses in crop yields are the consequences of these effects on agricul

Table 2.1: Salinity (EC) and Alkalinity (Exchangeable Na) investigations in Soil of the Aisegba irrigation project.

SOIL LOCATION	DEPTH (CM)	VALUE OF SOIL PROPERTIES						
		PH		EC	EXCHANGEABLE CATIONS (Meq / 100g)			
		1 : 2 $CaCl_2$	Suspensions H_2O	(Mmhos/cm	Na	K	Mg	Ca
Right Bank of the River	0-20	6.5	7.3	88	1.44	0.27	0.71	6.15
Left Bank of the River	0-20	4.7	6.0	74	1.33	0.33	1.59	4.13
Ogbese Forest Reserved	0-20	4.8	5.7	59	0.70	0.18	0.87	4.12
Bolorunduro plantation area	0-20	6.0	7.0	46	0.89	0.16	0.33	3.25

Salts in soil excert both toxicity and osmotic effects on crops. The toxicity is due to high concentration of sodium chloride or other ions.

In general, Saline, Sodic and Saline-Sodic Soil conditions drastically limit the productivity of the land. In the case of very salty land, productivity is totally eliminated as nothing grows; instead the bare land often develops white crystals (efflorescence) at the surface.

When crops can grow, reduced yields are often the result, which varies depending on the salt tolerance of the crops. Salt tolerance rating has been determined for crops based on the yield reduction on salt affected soils. The salinity classes are described as:

Non - Saline	(EC = 0-2mmhos/cm)
Very Slightly Saline	(EC = 2-4mmhos/cm)
Moderately Saline	(EC = 4 - 8mmhos/cm)
Strongly Saline	(EC = 8-16mmhos/cm) and
Very strongly Saline	(EC =greater than 16mmhos/cm).

Irrigated farming in the project area is unlikely in a foreseeable future to cause appreciable salinity and alkalinity as indicated by the low exchangeable sodium (Na+).

From the soil analysis, the soils in the project area are of low values of exchangeable cations.

The electrical conductivity (EC) of the area is less than 3mmhos/cm (EC<3mmhos/cm), which makes the soil neither alkaline nor saline.

The rainfall in the area is relatively heavy and the total dry number of months is very low. This together with the high soil permeability will have the effect of adequacy and regular desalination of the irrigated soil in the area.

The soil does not present serious salinity or alkalinity problems within the root zones of major crops.

However, the facts that some lower horizons are saline-alkali suggest that salinity may be induced into the root zone by ground water due to inadequate drainage after irrigation.

2.3 CROPS AND AGRICULTURE

2.3.1 Crop Pests and Diseases

Organisms, which attack and injure crop plants or animals, exist in nature at a characteristic level of abundance. How frequently this level of abundance is exceeded depends on how frequently man's activities destabilise the balance of nature. This strive for maximum crop productivity per unit area or per unit area of investment has compelled over simplification of the ecosystem through crop mono-culture, growing carefully selected varieties, suppression of weed competitors, soil fertility and conservation and soil water management.

The incidence of pests and diseases are crop related. Therefore the knowledge of the crops in the project area is a necessary prelude to the discussion of pests and diseases. The main crops grown included

maize, yam, cocoyam and Cassava. Both crops were cultivated on farm of less than one hectare.

Inter-cropping was prevalent in the plantation fields, the crop combinations included Cocoa + Coffee +Oilpalm +Orange + Banana, sometime with cocoyam. In the area, there is no dry season farming yet because the dam, the canals, and the hydraulic structures are not yet in place. Overall approximately 90% of the farmers sampled planted local cocoa and arable crops.

2.3.2 Insect Pests and Diseases

Crops in the fields examined at the different areas were at various phonological growth stages. Table 2.2 lists the insect pests and diseases observed on crops in the surveyed area.

Table 2.2: Common Insects and Diseases Attacking Crops in the Project Area

PESTS	CROP ATTACKED	PLANT PART ATTACKED
Insects		
Miliarpha Separatelia	Rice	Tillers
Sesamia Calamistics	Maize	Stem, Ear
Busseola Fusca	Maize, Sorghum	Stem, Ear
Cicadulina Spp	Maize	Leaves
Poophilus Spp	Maize	Whorl leaf
Zonocerus Variequtus	, Maize All cereal crops	Leaves Root
Termites	All cereal crops	Root
Other Arthropods		
Centipede	Maize, Groundnut	Seedling root & Stem, pod.
Mites	Tomato	Leaves
Vertebrate Pests		
Birds	All cereal crops	Seedlings and grains
Rodents	All cereal crops, groundnut, soya bean, cowpea.	seedlings
Diseases		
Leave spot	Yam, Rice, Cassava	Leaves
Algae spot & frickle	Yam, Cassava	Seedlings
Bunchy top	Banana	seedlings

2.3.3 Use of fertilizer

Most farmers applied fertilizers on their farm lands, and the majority who didn't was fully aware of the value of supplementary soil nutrients but they ...st could not procure fertilizer owing to its scarcity and / or high cost. ...ey data showed inadequacy in fertilizer usage in terms of the ...tities applied. Interviews with the farmers also revealed ...opriate use of fertilizer.

A...ding to farmers, the type of fertilizers applied is dictated by what was available to them, the costs and to some extent, by the individual or collective experience(s) in the previous cropping seasons.

The most frequently used fertilizers were NPK and SSP. Our interviews also revealed that farmers compound fertilizer before use, the combinations included UREA + NPK, UREA + SSP, UREA + NPK +SSP.

Table 2.3: Frequency of use of different types of fertilizer in the Project Area

Fertilizer Type	Frequency of use, %
NPK	40.
UREA	49.3
CAN	4.0
SSP	6.2

Abbreviations:

NPK - Compound Nitrogen N: Phosphorus (P):Potassium (K).

CAN - Calcium Ammonium Nitrate

SSP - Single Super Phosphate

2.3.4 Use of Pesticides:

There was limited use of agrochemicals in all the farms in the project area. Weed growth was suppressed mainly by cultivation and by manual hoe weeding (3-4 times per growing season). Few farmers used herbicides to control weeds. The herbicide used was primagram and was for weed control in maize.

Insect pests on Rice, G/corn, cowpea, maize and groundnut were controlled with insecticides by 10% of the total farmers interviewed.

No farmer protected his crops with chemicals against the attack of disease - causing agents such as Fungi, Bacteria and Nematodes.

Seed treatment chemical (insecticide, fungicide) were used by less than 5% of the farmers interviewed. The crop seeds treated were mainly

Cocoa, Coffee groundnut and cowpea. The chemicals used were Gamaline 20, Fernasan D, Actellic dust or Aldrex T.

2.4 Impacts and Consequences (crops)

Different groups of plants pests are present in the project area. From the studies of another irrigation scheme around the project area, the pests leads to about 20% loss by farmers in irrigated fields.

Soil borne diseases are also common in the area. They destroy seedlings for transplanting of cocoa, coffee,tomato and rice.

Leaf born caused by rice plant hoppers is also common in the irrigated farms, the leaf tips of rice turn brown.

The major pest in the project area is the Grasscutter. They pose a serious treat into harvest of the farmers in the project area. Quantities of agrochemicals dispensed in the area covered in the survey were generally low. Agrochemical effect on the quality of irrigation water could not be ascertained since irrigated farming is not practiced yet in the project area. But the effect will be minimal since the Agrochemical used in area is very low.

w individuals possessed equipment for pesticide applications. Other mers borrowed or hired equipment used or they improvised.

The low level of the use of fertilizer and pesticides in the area explains the minimal effect of these agrochemicals on water quality. The high potential of pesticides to pollute water on the environment with consequent threat to wildlife and aquatic life is of great concern to

planning further irrigation development. The use of herbicides in future to increase the benefits of irrigation will have great impact on surface and underground water quality.

2.5 WEED AND ALGAE ASSESSMENT

Irrigation Project which involves providing water for a land with water–short falls radically changes both the agricultural and natural ecology in the project area. The creation reservoirs and channels provide the possibility of enhanced aquatic habitats. In particular, reservoirs and channels offer the opportunity of pisciculture and aquaculture and favourable habitats for water fowl, both permanent and migrating, but may also offer favourable habitats for disease transmitting insects. Bird sanctuaries and wildlife parks can be created around reservoirs.

The consumption of water for irrigated agriculture and the reduced quality of return flows is likely to adversely impact on downstream ecosystems. Reduced flows, increased salt concentrations, lower oxygen levels, r water temperatures and increased pollution and silt load all tend to gorous, tolerant species of aquatic weeds.

in the study area are grouped into three categories

i) nds weeds,

ii) Wetlands weeds

iii) Aquatic weeds

Weeds were rated by 88% of the wet season farmers as their greatest problem. Weeding represents 40-70% of the labour used for crop production in a season. These weeds existed in complexes in the entire farm visited. In general the dominant weeds found in the project area visited are given below:

Table 2.4: Common Weeds Found in the Study Area

A). Upland Weeds	**(B)Wetland Weeds**	**(C)AquaticWeeds**
Commelina benghalensus	Aschynomene indica	Polygonum Salicifolium
Acanthosperum hispidium	Ludwigia hyssopifolia	Heteranthera Callifolia.
Digitaria horizontalis	Elytrophorus spicatus	
Monechima Ciliatum	Sacciolapis africana	
Trianthema portulacastrum	Echinochloa Cruspavonis	
Alternanasthera pungeris	Hydroles glabra	
Amarathus Spinosus	Echinocholoa obtusifolia	
Tridax procumbens	Panicum maximum	
Vernonia ambigua	Edipta albibum	
Cassia mbtusifolia		
Occidentialis		
Euphorbia heterophylla		
Sida rhobifollia		
...uta		

...ence of blue-green algae was noticed along the river banks.

2.6 WILDLIFE ASSESSMENT.

This section considers the effect of the project as it would affect the forest and wildlife of the area. Also, the section discusses livestock in terms of

the effects of the projects on them, their consequences on the environment and information on forest/game reserves as wildlife sanctuaries.

2.6.1 Wildlife Species, Population, and Dynamics:

Statement by farmers and hunters in the project area indicate little or no wildlife in the project area. According to farmers, there are diversity of rodents like, birds, reptiles, monkeys and herbivores but there are no sanctuaries for them. The pressure of human population density and extensive agricultural activities are driving wildlife into extinction in the area. The best survivors are rodents who are also pests.

It is environmentally important to create the catchment's area above the reservoir into a forest and wildlife sanctuary as essential component of the project. This will have beneficial impact of saving some wildlife species while preserving the original forest. The additional benefit will be to greatly reduce transportation of sediments into the reservoir.

.5: List of Common Wildlife Species in the Project Area

	Rabbits	Ostrich	Kob & Rock Python
ys	Squirrels	Wild cats	Leopard
rat	Alligator	Crocodile	Spotted Hyena
ass cutters	Buffalo	Water buck	Roan antelope

2.6.2 **Livestock Development**

Ekiti State is one of the states with low concentration of wide variety of livestock.

Livestock raised in the project area include cattle, sheep, goats, pigs and poultry. The population varies over the area depending on the intensity of settlement.

Generally, there are two categories of livestock rearer in the areas, the farmers (Villagers) and Fulani nomads (who migrated from the north to the state for greener pasture). The farmer/villagers keep mainly poultry, sheep, goats and to a lesser extent pigs, all of which are confined to homesteads.

Fulani cattle rearers with their stock are dispersed over the entire area More Fulani herdsmen move their animals in the dry season to take advantage of the longer rainy season and water supply.

Confined livestock are fed with crop residues and grasses and leaves harvested by their owners and brought to the homesteads. However, some outdoor grazing is allowed on riverbank grassland in the dry season. On the other hand the fulani nomads graze their animals during the dry season and move towards the north during the rainy season.

2.6.3 Livestock Disease

The harbouring of livestock diseases pathogens such as ticks, hibernating platyhelminthes, cercariae and eggs of cestodes and

nematodes which result in hairlessness, footrot, lockjaw and foaming-at-mouth is rampant in the surveyed area. Livestock weight loss and deaths have resulted from these diseases. The poor growth, a result of insufficient weight gain, was attributed to the poor quality of flood plain grasses compared to nutritious upland grasses that regenerated after burning.

- contagious Bovine Pleuropneumonia (CBPP)
- Foot & Month Disease (FMD)
- Dermatophillosis
- Mastitis
- Helminthiasis
- Abortions
- Bloat & Pest despetite Ruminant (PPR)
- Ectoparasitism
- tick borne disease
- roplasmosis
- osis

ES ASSESSMENT.

reserve in the basin of Apariko river i.e Ogbesse Forest ve serves as a temporary sanctuary for little wildlife due to cover. The substantial part of the forest has been cleared of land used for farming illegally. According to the forest officer, because of the encroaching and other

human activities, animals like the Lion, Leopard and Elephant which are formerly found in the reserves are no longer sighted in the reserves.

Table 2.6: Common Tree Species in the Forest Reserve.

Botanical Name	Local Name
M / excilsa	Iroko
Triplodutun Scoleroxylon	Arere
Cordia	Omo
Afzelia	Apa
Albizzia	Ayere
Khanya grandis	Oganwo
T / Superba	White Afara
Terminalia Ivorensis	Idigbo
Antenis Africana	Oriro
Neso papa ferifera	Danta
Alstonia Congensis	Ahun
Dialluin	*Araba*
Ceiba	Abura
Mitrygna	Orodo
ansonia	
culia	Koko Igbo
	Apado
agina	Ijebo
	Oporoporo
	Eminado
	Kole Agba
	Osun
	Eku
Benthamuamu	Ayan
furtii	Papo

2.8 Impacts and Consequences Agriculture.

The completion of Aisegba Irrigation Project will make the production of some crops possible at economic level. These include the cereal, (rice & maize), the legumes (common beans and soya bean) and vegetables including the exotic ones like Cabbage, Carrot and Lettuce.

The positive impact of the all year round cultivation of cereal, legumes and vegetables manifests in an improved socio-economic well-being of the people of the area.

The negative impact arising from the greater use of fertiliser and pesticides to enhance production could come from luxuriant growth of weeds including algae," blooms" in water and lowering of water quality from chemical pollution, irrigation projects by their very nature create conditions which favour the proliferation of water loving weeds. The weeds grow in and around reservoirs as well as in irrigation canals where they create siltation problems by lowering flow velocities or by trapping sediments. Species tic plants, which commonly infest such aquatic environment, include auriculata. Hydrophytes also beg conditions favourable for disease vectors such as Malaria, Bilharzia and Elephantiasis.

irrigation, there will be exhaustion of land, as it will be ed, which will lead to soil degradation. Continuous irrigation age crop diseases associated with cereals and vegetables. s of rice are borers. There is therefore the tendency for an breeding of these insects over a vast area of land.

CHAPTER THREE

3.0 HYDROLOGY, WATER QUALITY AND FISHERIES.

The purpose of this aspect is to present the finding of the Environmental Impact Assessment with regards to the nature and extent of probable impacts arising from activities associated with the construction and operation of the Aisegba dam and irrigation component of the project. It is usual that an EIA encompasses planning/design, construction and operation phases of a project.

The areas which have been considered and which are discussed in this section are:

(i) Physical and Hydrological aspect.

(ii) Water Quality Aspect.

(iii)Fisheries Aspect.

ater Quality Survey

course of this study, field measurement and laboratory analysis for rs were either taken or performed. Water samples were River Apariko at the specified study blocks. Groundwater collected from wells in and around the project area.

ve of the water quality survey was to characterize the ical parameters in the River Apariko and thereby define guidelines to be maintained in the management of the ation system. It was also to ascertain the extent of

contamination of both surface and underground water due to irrigated agricultural practices.

Field measured parameters included temperature and pH. Water samples for laboratory analysis were collected at midstream and at both banks of the river at shallow depths in each of the specified blocks. Special care was taken to preserve the samples for laboratory determination of parameters that changes with time and labelling done appropriately.

The following parameters were analysed:

- Total solids (TS)
- Total dissolved solids (TDS)
- Biochemical Oxygen Demand (BOD_5)
- Chemical Oxygen Demand (COD)
- Iron (Fe)
- Total hardness
- Phosphate (PO_4^-)
- Ammonia (NH_4^+)
- Manganese (Mn)
- Chloride (Cl)
- Magnesium
- Calcium
- Conductivity
- Copper.
- Sulphate (SO_4^-)
- Alkalinity
- Turbidity
- Colour
- Temperature
- pH
- Suspended solids
- Nitrate
- Silicate
- Fluoride
- Lead
- Dissolved Oxygen

Standard laboratory methods were employed for the analysis of the above parameters. Titration and or Calorimetric methods were

employed. Also standard laboratory quality control procedures were followed for the chemical analysis of the water samples. These included determination of reagent blanks for nitrate analysis, use of fresh standards for chloride and alkalinity analysis and duplicate analysis of the same sample for Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD) and Suspended Solids (SS).

Hydrological Survey

The pre-dam variation in flow was analysed in other to predict the post-dam variation in water discharge. Groundwater level data were obtained and analysed. Sediment transportation and deposition in the reservoir were analysed. The environmental consequences of sedimentation were considered.

Questionnaires were administered to find out the extent of farming and use of synthesized (chemical) products within the study area. In all, 15 ers were interviewed.

it was gathered from literature that the use of inorganic rbicides, pesticides and other agro-chemicals were relatively e agricultural activities in the area for a number of nse from farmers apart from substantiating this would pact of these chemicals on both surface and s when large scale irrigation begins and use of soil g agro-chemicals gather momentum.

Analyses and Discussion of Results

A) Hydrology (Flow Regime)

The primary effect of a dam built across a river is to regulate its flow by storing excess water during the flood flows and releasing part of it during the period of low flows. The results of statistical analysis performed on the rainfall records and records of other hydrometeorologically similar basins shows that about 88% (6.084 Mm^3) of the Mean Annual Flow (MAF) occurs during the wet season (April to October) with a once in five year minimum yield of 5.355Mm^3.

The current flow regime, without a dam, is such that during the wet season, the minimum flow occurs in April (0.518Mm^3) with a maximum of 1.354Mm^3 occurring in September (peak of wet season) depending on the rainfall pattern. From October, the stream flow decreases steadily to December when flow ceases. River flow is sustained between November and December due to augmentation from ground water storage and such flow ases when the water table at the river channel becomes very low as the ll experienced during this period goes into soil moisture deficit. A od of about 84m^3/s is expected during the peak of wet season. magnitude has been known to submerge land along the river even weeks. Flood marks along both banks at the ve shown that the land/flood plain adjacent to the river rs) is submerged every year and restricting movement

B) Groundwater

Groundwater in the Apariko basin occurs in the long and narrow bodies of alluvial aquifer locally forming the banks of the river and the basement formation of granite within the project area.

The alluvial aquifers are recharged by direct percolation of rainfall and wet season river flow, percolation from adjacent hydraulically continuous aquifers and overland surface flows. Yields from groundwater sources vary characteristically from 15 to 40m^3/hr for alluvial aquifers to 10 to 14m^3/hr in the underlying shale depending on the formation from the point of view of recharge and on permeability limitation of the aquifer material. Measurements of water levels in open wells as obtained during the field work (October) show that the water table in settlements close to the river bank is between 3.0 and 5.5m due to recharge from the river while the upland areas are between 7.5 and 13.0m during this period. Fifteen water samples were collected from open wells for laboratory analysis to ascertain the effects of the reservoir and agrochemicals on the groundwater quality.

C) Erosion and Sediment Transport:

Sheet erosion, which is no less significant than gully erosion, affects the project area significantly. The sediment load of a river is carried in three main ways; bed-load, suspended load and solution load. The bed-load determines the behaviour of the riverbed as regards scouring and deposition. The amount of suspended load, which is made up largely of silt with little fine sand, is usually much greater than that of the bed load and this is responsible for the building up of the alluvial valleys and contributing greatly to the rate of reservoir sedimentation.

The estimated sediment yield of Apariko River with an annual water inflow of $7.955Mm^3$ is 1.72×10^4tonnes per year at the proposed dam axis. This is the result of land cultivation within the catchment area whereby the soil structure is loosened by farming activities and easily dislodged and washed by rainfall into the river.

3.2 WATER QUALITY

3.2.1 *WATER QUALITY OBJECTIVES*

In the course of this study, findings have been considered in relation to the current or proposed water quality objectives for designated areas under the United State Federal Protection Agency (USEPA) and The World Health Organization (WHO) standards.

In principle, water quality objectives are quantitative or qualitative standards, required to maintain specified beneficial uses allocated to the designated water control zones, and may be applied either as;

a) Maximum permissible concentration or

b) Limit values which should not be exceeded for more than a specified number of sampling occasions or time periods.

The beneficial uses considered in this study include:

i) Conducive habitat for aquatic life to maintain fish and fisheries resources regardless of their value as an exploitable resource.

ii) Water of adequate quality for both domestic and industrial purposes.

iii) Suitable water for irrigated crops.

The water quality objectives should aim at supplying both domestic and industrial users with good quality portable water and is expected to be suitable for irrigation of crops too.

For the purpose of establishing water quality status, quantitative values for analyzed chemical parameters are compared with USEPA and WHO standards.

Table 3.0 Guidelines For Interpretation of Water Quality for Irrigation.

			Level of Restriction on use		
Potential irrigation problem		Units	None	Slight to Moderate	Severe
Salinity (affects crop and water availability)					
EC		dS/m	<0.7	0.7-3.0	>3.0
TDS		Mg/l	<450	450-2000	>2000
Infiltration (affects infiltration rate of water into the soil, use EC &SAR)					
SAR=0-6	EC		>0.7	0.7-0.2	<0.2
SAR =3-6	EC		>1.2	1.2-0.3	<0.3
SAR=6-12	EC		>1.9	1.9-0.5	<0.5
SAR=12-20	EC		>2.9	2.9-1.3	<1.3
SAR=20-40	EC		>5.0	5.0-2.9	<2.9
Specific IonToxicity (affects sensitive crops).					
Sodium (Na)					
Surface irrigation		SAR	<3	3-9	>9
Sprinkler irrigation		Me/l	<3	>3	
Chloride (Cl)					
Surface irrigation		Me/l	<4	4-10	>10
Sprinkler irrigation		Me/l	<3	>3	
Boron (B)		Mg/l	<0.7	0.7-3.0	>3.0

Miscellaneous Effects (affects susceptible crops)				
Nitrogen (NO3-N)	Mg/l	<5	5-30	>30
Bicarbonate (HCO3) (overhead sprinkling only	Me/l	<1.5	1.5-8.5	>8.5
pH		Normal Range 6.5-8.4		

Source: Ayers and Westcot, 1976.

3.2.2 *RESULTS*

Tables 3.1 and 3.2 summaries the results obtained from sampling events of both river flow and ground water. From Table 3.1, it is observed that there are no significant variations of parameters, especially parameters like pH and temperature along the River Apariko. Table 3.2 shows slight difference in groundwater quality depending on the nearness of the location to the Apariko River and geological formation in the vicinity.

3.2.3 DISCUSSION

In interpreting the results presented, it is emphasized that a spot survey as carried out provides relative values for comparative purposes. The following observations are made on key parameters:

(i) Colour: The greenish colour of the water sample is as a result of algal growth in the stagnant water. This is as a result of decaying organic matter in the water.

(ii) Temperature: The high temperature of the water sample downstream of Aisegba dam is expected to decrease solubility of oxygen in the water and thus increase the oxygen demand for aquatic life.

(iii) Solids: Table 3.1 shows the result of suspended solids, total solids and total dissolved solids (TDS). These three parameters are a measure of

turbidity and general pollution potentials in the river. The result presented show low values of suspended solids, TDS and Total solids in Apariko river as a result of high concentrations of fine particles derived from erosion and the virtually stagnant downstream of Aisegba dam.

(iv) Organic pollution: The level of organic pollution in Apariko river in the dry season was estimated in terms of Bio-chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and 4hr Pr. Both BOD and COD values indicate low level of organic pollution, falling within FEPA's recommended levels.

(v) Wet chemistry

a. *Total Hardness*: The total hardness for the water sample downstream of Aisegba dam is higher than WHO highest desirable level of 100mg/l for domestic use. This is however below the maximum permissible level of 500mg/l

...n: The result shows a high level of ammonia concentration of about ... river Apariko. This indicates a low level of anthropogenic ...values is higher than WHO standard of 0.05mg/l.

...sphate level of 0.5mg/l in Apariko river is indicative of ...against FEPA's standard of 0.1mg/l for flowing waters and ...d reservoir.

...nese level is 0.04mg/l in Apariko river a bit lower than

...oncentrations of 190mg/l in Apariko river is lower than ...00mg/l

f. *Iron*: Iron concentrations are low in Apariko river. In water, iron discolours clothes and cause scaling in plumbing fixtures. Iron is highly objectionable in water because of its bitter sweet astringent taste. It is lower in Egbe reservoir.

Chemicals have become an essential part of agricultural production and the benefits are enormous. However, when misused, the adverse impacts can be extensive.

...oratory Analysis of Water Samples (Surface Water).

Par...				Block II		Block III					
				...a muara	Arola	Suruler e	Ilu-omoba	Egbe	Left bank	Right bank3	Ogbese forest
				47	61	52	53	52	63	53	62
				26	27	27	27	27	27	27	27
				7.2	7.1	7.3	7.3	7.2	7.1	7.2	7.2
			43	53	50	52	55	56	55	53	53
		567	630	620	595	620	615	620	610	615	
	605	610	683	670	647	675	671	675	663	668	
T...	12...	115	134	92	139	125	136	113	124	113	122
Alka...	65	59	63	62	66	63	65	64	62	61	60
Ammonia ...	1.4	1.5	1.6	1.8	2.0	2.1	2.1	2.2	2.2	2.3	2.1
Chloride (mg/l)	160	150	155	180	185	180	190	200	190	195	190
Sulphate (mg/l)	153	140	145	165	155	170	160	165	170	155	160
Phosphate (mg/l)	1.5	1.6	1.6	1.7	1.65	2.0	2.1	2.0	2.2	2.3	2.2
Nitrate (mg/l NO_3)	45	44	43	50	51	53	52	55	56	55	54
Silicate (mg/l)	44	40	42	50	52	55	55	53	55	56	54
Lead (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (mg/l)	0.9	0.8	0.8	1.0	1.1	1.0	1.2	1.2	1.4	1.3	1.4
Copper (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese (mg/l)	0.5	0.5	0.5	0.6	0.8	0.8	0.7	0.9	0.9	0.8	0.9
Iron (mg/l)	0.4	0.3	0.4	0.5	0.5	0.6	0.5	0.6	0.6	0.7	0.6
Calcium (mg/l)	120	110	115	130	135	140	145	150	148	149	145
Magnesium (mg/l)	40	38	39	50	49	52	50	55	54	53	54
Conductivity (μS/cm)	980	952	940	1052	1090	1143	1164	1153	1168	1175	1169
BOD_5 (mg/l)	150	140	145	160	170	165	163	172	175	170	165
COD (mg/l)	340	330	320	362	385	370	366	372	390	382	376
D O (mg/l)	7.5	6.3	6.9	7.9	7.6	8.2	8.3	8.2	8.4	8.5	8.3

Table 3.2: Results of Field Measurements and Laboratory Analysis of Water Samples (Ground Water).

	Block I					Block II		Block III			
Parameters	Aisegba	Ijan	Kajola	Aba omuara	Arola	Surulere	Ilu-omoba	Egbe	Left bank	Right bank3	Ogbese forest
Colour (TCU)	19	25	30	26	16	36	42	20	25	22	25
Temperature (0c)	26	26	26	25	26	25	25	26	26	26	26
pH	6.8	7.0	6.9	6.9	7.0	7.0	6.8	7.1	7.0	7.0	7.1
Suspended Solids (mg/l)	18	27	26	20	15	30	32	17	19	16	18
Total Dissolves Solids (mg/l)	260	270	298	301	250	311	295	250	271	243	264
Total Solids (mg/l)	278	297	319	321	265	341	327	267	290	259	282
Total hardness as $CaCo_3$ (mg/l)	98	120	129	115	92	132	89	99	118	142	110
Alkalinity (mg/l)	35	55	62	45	37	68	72	33	48	52	61
Ammonia (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloride (mg/l)	120	110	103	132	98	122	86	99	128	139	115
Sulphate (mg/l)	34	46	39	48	52	55	49	52	58	51	49
Phosphate (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silicate (mg/l)	36	29	42	40	33	26	24	46	40	35	27
Lead (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (mg/l)	0.7	0.9	1	0.8	0.6	0.8	0.9	1.0	1.1	0.8	0.7
Copper (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese (mg/l)	0.4	0.3	0.4	0.5	0.6	0.4	0.3	0.4	0.2	0.5	0.6
Iron (mg/l)	0.2	0.1	0.3	0.4	0.3	0.2	0.1	0.40	0.5	0.2	0.3
Calcium (mg/l)	105	121	114	100	96	131	119	122	130	109	99
Magnesium (mg/l)	58	68	66	50	46	73	62	49	70	53	44
Conductivity (μS/cm)	420	455	502	540	463	430	402	450	506	436	398

3.3 FISHERIES AND ALGAL STUDIES

Fishing activities are not pronounced within Apariko basin and fishing is done on a part time basis by indigent fishermen along the river course (in all the Blocks).

During the field survey, twenty-eight species of fish belonging to 19 families were recorded from the Apariko and other Basins Most of the fishermen operated between 4 to 6 hours either at a stretch or in two phases of early mornings and evenings. Also all the 22 species encountered in this survey are considered to be of commercial importance.

The presence of a few blue green (single celled and filamentous) algae (phytoplankton) was noticed on the upper layers of the water in some sections of Aparoko River due to the existence of nutrients such as Phosphate and Nitrates.

Conclusions

From this study, we concluded as follows:

i) The basin is rich in fish resources relative to most local rivers in Northern Nigeria.

ii) Variable gears and methods are in use by the local fishermen depending on the seasons and fish habits.

iii) Fishing by local fishermen is easier in the dry season and quite a number of the people are engaged in fishing (full and part time), but the greater percentage being subsistent farmers.

iv)The catch over the years has fluctuated and fish resources in the basin are not yet being over exploited.

Table3.3: Fish Species in the Apariko Basin

Fish Species	Family	Authority
Gnathonemus abadii	Mormyridae	Boulenger Lali
Mormyrous hasselquist	Mormyridae	Luvier & Valenciennes
Hepstus Odoe	Characidae	(Bloch)
Ichthyoborus besse	Citharinideal Icthyoboridae	(Joannis)
Tilapia (Saroteradou)	Cichlidae	-
Tilapia nilotica	Cichlidae	(L)
Tilapia aurea	Cichlidae	
Tilapia zilli	Cichlidae	Gervais
Tilapia melanopleura	Cichlidae	Dumeril
Clarias spp	Claridae	
Lates niloticus	Centropomidae	(L)
Barqus docmac	Bargidae	Dagnet
Barqus bayad	Bargidae	Pfaff
Gymanchus niloticus	Gynachidae	Cuvier
Mormyrous sp	Mormyriche	-
Barqus sp	Bargidae	-
Citharinus citharinus	Citharinidae	(Geoffroyst Hilaire)
Labeo sp	Cypriidae	-
Synodontis nigrita	Mochocidae	-
Schilbe mystus	Schilbidae	(L)
Auchenoglanis accidentalis	Bargidae	-
Hyperopisus sp	Mormyridae	-
Ophiocephalus sp	Ophiocephalidae	-
Hydrocynus sp	Characidae	-
Clupisudis niloticus	Oskoglossidae	-
Alestes nurse	Characidae	Rupeli
Alestes nurse	Characidae	(Joannis)
Synodontis schalls	Mochocidae	(Bloch & Scneider)

Problems

The following problems were diagnosed during the study:

a) Fishermen:

i) High flood and occasional storms impede their fishing operations

ii) Inadequate fund to procure appropriate fishing gears to fully exploit the resources

iii) Divided attention between farming and fishing does not allow most of the settlers to obtain optimal benefits from fishing.

b) Villagers

i) Both their farms and homes are occasionally threatened from unusual flooding in certain years

ii) They suffer sufficiently from lack of social infrastructures like drinking water, electricity, roads, health care etc.

3.4 Impact of Dam and Reservoir on the Environment

A) Hydrological Impacts

The storage of water in the Aisegba reservoir will bring about both beneficial and detrimental changes in the hydrology of the area. This in turn will have an influence on water availability for multipurpose uses.

(i): Flow Regime

The dam and reservoir provide adequate guarantee to significantly reduce the adverse effect of low flow regimes by providing more water during the drought period. This situation is expected to be improved upon when the dam is operational because the flow regime will be effectively controlled in terms of quantity and timing of river flow and

water releases. Dry land will receive adequate water through releases from the reservoir for cultivation, domestic water supply and livestock as watering and drinking spot. Similarly, a reduction of the flood discharge at the peak of wet season will occur and ensuring a sustained flow in the river all year round.

The availability of water on an all-year-round basis will result in changes in the ecology and land use in the flood plain especially in the lower Apariko basin. For instance, areas that are largely sparsely vegetated by drought resistant species will, with continuous wetness, be taken over by aquatic species. An all-year-round farming will equally result in a production area that is about twice the area cultivated on an annual basis.

Another impact of the project will be felt on recession farming. The floodplain which was formerly cultivated during the dry season when soil moisture was adequate for plant growth and development will give way to all year round farming. The release of water from the dam ensures that the period of dryness of the floodplain is significantly reduced and enabling the cultivation of different types of crops in the lower Apariko floodplain

(ii): Sediment Transport

The trapping of the sediments within the reservoir, however, reduces the load available for transportation and deposition downstream. The water released from the spillway will contain less sediment, with the potential for active erosion downstream of the dam. The water with low

sediment load emerging from the spillway might erode the downstream portion of the dam hence encourage erosion of the river bed and banks which needs to be adequately protected.

Since most of the sediment has been deposited in the reservoir, the water flowing in the canals contains less sediment; hence the canal efficiency will be maintained, as sediment deposition will be minimal.

Sediment accumulation in irrigation canals reduces the conveyance capacity of the canals and results in higher rate of discharge if pumping remains constant. It could also lead to the delivery of water that is less than the irrigation requirement of the crops. In both cases, irrigation efficiency is reduced. Sedimentation in water supply canals also attracts additional cost in terms of the extra treatment to make it clear and safe for use, particularly for domestic purposes.

(iii): Groundwater

The communities around the River Apariko use groundwater resources for drinking purposes. Upstream of the dam, the water table will be raised when the reservoir becomes fully operational with the presence of a permanent water body.

At the downstream, groundwater levels are expected to be constant because of continual recharge of the aquifer by rain, the bed of the reservoir and the prolonged river flow, even during the dry periods due to continual releases from the reservoir through the spillway, canals and drains. Similarly, excess water applied to crops seeps to the ground to augment ground water flow.

Changes in the quality of water in the reservoir may also have some impact on the quality of groundwater due to seepage into the ground. It is also to be noted that leachates from irrigated water can easily get to the high water table thereby contaminating the groundwater. The application of chemical fertilisers, herbicides and pesticides results in the residual chemicals contaminating the groundwater as highlighted in the water quality impact.

3.5 WATER QUALITY IMPACTS

The effect of a dam and irrigation project is mostly pronounced in the changes in the water quality parameters due mainly to the application of agro-chemicals to enhance agricultural production. Aisegba Irrigation project is not an exception. Even USA and Europe, with developed agricultural systems, have rivers which contain excessive nutrient levels sourced from industrial and agricultural activities. Such rivers usually have major problems including the promotion of algal bloom and a lowering of oxygen levels in the water caused by decaying algal material. In arid and semi-arid zones like in the project area, dam and irrigation project is not only attractive but it is equally the only guarantee for a viable agriculture. To realise the potentials of the soils of the area through crop production, the provision of water in adequate quantity and quality must be complemented by improved soil fertility. To do this, it is usual to add either organic or inorganic fertiliser. The former is usually considered when the latter is not available. Pesticides and herbicides are also used to enhance agricultural production.

Such inorganic fertilizers are washed down by rain into stagnant pools and ponds of water on the plains and also into storage reservoirs. The sudden increase in nutrients in the water generates excessive growth of phytoplankton. Such blooms could be advantageous or disadvantageous to the fishery, in the sense that if the water contains fish that feed on algae (e.g. tilapia, labeo etc.) the algae will be exploited to the benefit of fishery. Excessive blooms of algae, however, lead to high biological oxygen demands thus resulting in aquatic pollution as a result of drastic oxygen depletion of the water, causing much stress to the greater majority of the fish species, which gradually die off. Fish species like Clarias and Tilapia can tolerate such polluted waters and therefore become overpopulated, with Clarias feeding on tilapia fingerlings and tilapia feeding on the algal bloom.

In the surface waters of Aisegba Reservoir, the greatest impact is on dissolved oxygen (DO), which is likely to be increased by phyto-plankton production during the dry season. Although the concentration of nitrate and phosphate is similar in all the blocks, the dam will trap the organic matter brought down the Apariko River and this will supply additional nutrients as the decomposing nutrients may also be leached from the flooded soils. The implication of such is the progressive concentration of nutrients, which may in turn favour growth of phyto-plankton. Average value of DO in the river ranges between 6.3 and 8.5mg/l near the surface. When the reservoir becomes operational, the expected DO at the surface should not to be too far off from that of the flowing stream. At greater depths, considering the sediment load and

siltation, many species of fish would find it difficult to obtain needed oxygen and may experience extremely low DO especially during the dry season.

The low DO concentration may reduce fisheries potential of the reservoir with reduction in the diversity of invertebrates. If however the phyto-plankton population increases during this season, due probably to the presence of nutrient from fertilisers and animal droppings, oxygenation in the reservoir might compensate for the depletion of oxygen at or near surface water. Deeper sections of the water body are expected to remain largely anaerobic in decomposing accumulated and settled materials.

In the Aisegba reservoir, no appreciable variation is expected in the water body temperature during the rainy season. There is, however, the possibility of a pronounced stratification by temperature during the dry season. The main negative effect of this will be on the circulation of nutrients and dissolved oxygen (DO) in the reservoir. If the vertical mixing is reduced, this will result in very low DO concentration in the deeper part of the reservoir. Decomposition of organic matter at greater depths (at the bottom) will result in an anaerobic phase that induces production of hydrogen sulphide and carbon-dioxide gases as well as increases in the acidity of the water, phosphate concentrations and in iron and manganese concentrations due to their release from bed sediments.

As stated earlier quality conclusion, concentrations of inorganic constituents like sulphate, chloride, silicate, fluoride, calcium and

magnesium are not too far off the tolerable limits. These constituents are not expected to pose any serious problem as regards water quality in the reservoir.

At the downstream portion, the quality of water in the river is expected to deteriorate due to the application of chemical fertilisers, herbicides and pesticides that are washed into the river and groundwater. From the Tables, it can be seen that careless use of agrochemical may result in environmental degradation. The availability of 3.03×10^3kg of assorted agrochemical constituents as excess in the soil system from a year's crop cultivation may yield various negative impacts. These include degradation of the quality of surface and groundwater sources, health hazard to man and aquatic lives (e.g. algal bloom), modification of the vegetation and biotic lives, among others.

Turbidity is another potential source of water quality impact. Due to the nature of River Apariko, sediment load in the river is high. When the reservoir comes into operation, the solid content of the inflowing river water is expected to reduce the reservoir capacity due to settlement and a storage loss of $0.552Mm^3$ would result in about 50 years of operation.

This deterioration of water quality will effect fisheries production. Observed large quantities of animal droppings (mainly cattle, goat and sheep) along the riverbanks, poses great environmental health hazards to the local people using the water for drinking.

Irrigation projects by their very nature create conditions, which favour the proliferation of water loving weeds. The weeds grow in and around

reservoirs as well as in irrigation canals where they create siltation problems by lowering flow velocities or by trapping sediments. They may also invade the irrigated fields and constitute serious menace to farmers. The weed problem has been found to be particularly worrisome in some of the existing projects such as Kadawa and Bakolori in Kano and Sokoto States of Nigeria, respectively (NEST, 1991). Hydrophytes also lead to conditions favourable for breeding of disease vectors such as Bilharzia and elephantiasis. Species of aquatic plants, which commonly infest such aquatic environments, include Salivinia auriculata.

The following sensitive receptors highlighting the effects of the water quality impacts are summarized as follows;

A) Domestic water supply: Treatment and distribution of water from a reservoir with low quality water to the surrounding villages will require an additional treatment procedure, which increases the cost of water supply.

B) Aquatic life: The most important among them will be fish production, which can be greatly hampered by deterioration in water quality of the river.

C) Public Health Interest: Increase in organic load in the reservoir or downstream will affect the health of the villagers at the edges of the reservoir and riverbanks downstream as long as they depend on the water for their domestic needs.

3.6 FISHERIES IMPACT

The greatest impact of Aisegba dam and reservoir is the creation of a permanent water body where fishing activities will take place all year round as fishing is done on leisure and part time basis by children and young adults at the moment. This affords the part time fishermen the opportunity to go into full time fishing as the reservoir can be stocked with the most viable fish species that will yield the best economic returns.

Similarly, Migrant fishermen will move to the reservoir and various fishing technologies and equipment will be introduced in the project site. The nutritional level of the people in and around the reservoir will be enhanced, as they will have access to fish protein and other nutrients derived from fish.

With the reservoir in place, there is the possibility of waterweed and algal growth occurring within the reservoir due to the availability of nutrients. In this case fishing activities might be hampered, as the fishes tend to hide beneath the growth making them difficult to find and catch.

CHAPTER FOUR

4.0 PUBLIC HEALTH. AND SOCIO-CULTURAL

Water and sanitation play a very important role on the health of a farmer in his rural setting. The situation aggravates when waters are impounded and communities gather together in large numbers for agricultural operations and economic gains. Over 30 types of diseases are known to be transmitted through water as a medium. Any alteration in the existing pattern of water development and usage may effect the disease pattern. The various diseases transmitted through water and excreta commonly found in Nigeria are shown in Table 4.1. Besides these biological agents, a variety of agro-chemicals may also enter water sources and foods and cause disease.

Malaria

In Nigeria, malaria is considered as number one parasitic disease affecting a large number of populations. The causative organisms most widely occurring area: Plasmodium falciparum (80% of all the infections), malariae (15%) and P. Ovale (<5%).

Table 4.1: Diseases Transmitted Through Water and Excreta Commonly Reported in Nigeria

DISEASE	PATHOGEN/VECTOR	MODE OF TRANSMISSION
Malaria	Plasmodium sp. (anopheles mosquito)	Mosquito bite
Schistosomiasis	Schitosoma sp. (snail host)	Wading through water infested with snail host
Onchocerciasis	Onchocera volvuvus (Simulium or Black fly)	Simulium bites
Trypanosomiasis	Trypanosoma sp. (Tse-tse fly or Glossina sp)	Tse-tse fly bites
Yellow fever	Arbovirus (Aedes mosquito)	Mosquito bite
Filariasis	Wuchereria bancrofti (Culex and Mansonia mosquitoes)	Mosquito bite
Dracunculiasis	Dracunculus medinensis or Guineaworm (Cyclops sp. or water flea)	Drinking water containing flea
Paragonimiasis	Paragonimus westermani or lung fluke (Fresh water snail, crab or Cray fish)	By eating crab or Cray fish
Leptospirosis	Leptospira sp. or spiro chaete bactrium	Contract with rodent urine
Diarrhoea/ Dysentry	Amoebic (Entamoeba histo lytica), Bacillary(Shigella sp.), other types (Escherichia coli, Campylobacter sp., Rota virus, etc. Giardia sp.)	Drinking polluted water or eating contaminated food; through flies and fingers
Cholera	Vibrio cholerae	as above
Gastro- enteritis	Miscellaneous bacteria or viruses	as above
Typhoid/ Paratyphoid	Salmonella typhi; S paratyphi	as above
Infectious hepatitis	Hepatitis virus A	as above
Ascariasis Ancyclo-stomiasis, trichuriasis, Strongyloidiasis	Helminths	as above

Vector names are in parenthesis.

Usually transmission takes place indoors. It may also occur out-doors especially when people sleep or spend the evening hours outside their houses.

Mosquito larvae require water for their development. Major factors that determine habitat preference are shade or sun exposure, quiet or flowing water, temperature, salt content, surface vegetation and floatage, and organic pollution. The common vector species in Nigeria are Anopheles gambiae (Sensu Stricto), A. arabiensis, A. Funestus and occasionally A. melus.

Schistosomiasis

Schistosomiasis, commonly known as Bilharziasis is endemic in 74 developing countries affecting over 200 million people. Children get heavy infections which may result in disability or death. It is also a risk for about 600 million people as they perform daily activities related to swimming, fishing, farming, washing and bathing in water canals or streams. According to an estimate by Food and Agricultural Organization in 1975, about 92 million hectares of irrigated land is available in developing countries.

Onchocerciasis

Onchocerciasis is an infection with a filarial nematode Onchocerca volvulus) causing a chronic disease which may lead to blindness. It is transmitted by Simulium damnsosum usually lays its eggs in fast flowing and well-aerated streams. African vectors mainly bite on the

legs, and microfilariae are most numerous in the skin of the buttocks and the outer and dorsal surfaces of the calf and ankle. It is manifested by nodules, severe itching and appearance like lizard skin or depigmentation.

Dracunculiasis

It is popularly known as Guineaworm disease and is caused by Dracunculus medinensis. It is transmitted through a water flea, cyclops which inhabits ponds and stagnant fresh water bodies. It is acquired by drinking such water without any treatment. It is found almost in every State. At present about 2.5 million Nigerians are affected every year of which 1 million are farmers and school children. The infected persons are temporarily incapacitated for periods of 1-3 months but an estimated 12,000 suffer irreversible disablement annually. Guineaworm is noted as the leading constraint to rice production in Anambra, Benue, Cross River and Imo States (Anon, 1987).

Trypanosomiasis

It is a vector borne disease transmitted through Tse-tse fly, Glossina palpalis and G. Techynoides. These flies breed near water sources under bushes. Bush clearance near water courses 200m away from settlements is good for effective control. They do not travel far from the breeding places. The causative agent is Trypanosoma Sp, a parasitic protozoan.

Miscellaneous disease

Other miscellaneous disease which might affect farming populations are helminthiases, yellow fever, viral infections and fish borne infections. In addition, chemicals such as nitrate, nitrites, and pesticides or herbicides may pose a serious threat to the health of the workers. They may cause a variety of diseases and show up with a variety of symptoms (Table 4.2).

Table 4.2: Commonly used Fertilizers, Herbicides and Pesticides in the Farming Area.

Chemical	Technical Name	Effect on Human Health
Fertilizer		
CAN UPK Urea SSP BSP	Calcium Nitrate - - - -	Indirect effect through algal blooms in waters affecting the tastes and odours; nitrates in water cause methaemoglinaemia; certain types of cancers.
Herbicides		
Basgran PL2	Benthazone (Dithiocarbamate)	Depending on the type: cancer, birth defects, necrotizing pulmonary fibrosis, neurotoxic, CNS stimulus in fish, mammals, birds, stored in fat tissues.
Tamarice	O,S -Dimethyl Phosphoramidothioate	
Grammazone	Paraquat (dichloride) Dipyridillium derivative)	
Gammalin 20	Lindane (organochlorine)	
Bentazone	Carbamate	
Ronster	Oxadiazone	
Pesticides		
Cymbush	Cypoermethrine (Synthetic - Pyrethroids)	Burning sensation swollen face by evening and disappearing by morning
Primextra	Atrazine + Metal ochlor	Nausea, dizziness, headache, anorexia, fatigue, convulsions.
Karate	S. Pyrethroid	
Vetox 45	Carbamate	

Perennial irrigation provides year-round breeding site for the anopheles mosquito, as well as increase the risk of Schistosomiasis and Filariasis (Lipton and deKadt, 1988). Examples of increased prevalence of Schistosomiasis resulting from water source development projects (PEEM, 1992) are given in Table4.3.

Table 4.3: Increased Prevalence of Schistosomiasis for Water Impoundments.

Country	Project	% Prevalence Pre-Project	Post Project	Schistosoma sp.
Egypt	Aswan Dam (1906)	6	60	Haematobium Mansoni
Sudan	Gezira Scheme (1925)	0	30 - 60	Haematobium Mansoni
Tanzania	Arusha Chini(1973)	Low	53-86	Mansoni
Zambia & Zimbabwe	Lake Kariba	0	16 adults & 69 children	Haematobium Mansoni
Ghana	Volta Lake (1966)	Low	90	Haematobium
Iran	Dez Pilot Irrigation project (1965)	15	27	Haematobium
Nigeria	Lake Kainji (1969)	Low	31 - 45	Haematobium

Irrigated rice cultivation with its characteristic surface flooding and soil saturation provides an ideal environment for the snail vectors. The density of Anopheles was up to 125 larvae/litre. Under intermittent irrigation, they varied from 0 to 15. When the flow of water was swift and weed growth was minimal, no larvae were observed (Anon, 1985). Obeng (1977) reported an increase from 2% to 75% of morbidity due to Schistosomiasis after the introduction of irrigation projects in many countries where it is endemic. The snail intermediate host proliferates in irrigation drains, ditches and seepage pools. Frequent use of

irrigation canals for defecation increases the transmission of Schistosomiasis (Betterton and Fryer, 1987; Udonsi, 1990).

4.1 Existing Health Information

Information was obtained from hospitals and clinics in the area and the state ministry of health, the communities, through the use of structured questionnaires and by observation of the surroundings.

4.2 Data Analysis

The data was analysed and presented in table of results.

RESULTS

The result of the field work and the prevalence of diseases as obtained from the several relevant bodies is given herewith.

Disease Pattern in the project areas

The common diseases in the area are Malaria, Diarrhoea, Filariasis, Typhoid, Schistosomiasis and until recently Guineaworm. There are no definite trend over a period. These results also suffer from limitations as all the health centres did not send the results promptly to the Health Ministry and in any case, most villages in the area have no health facility at all. Where they exist, records are not kept.

Year 2001

Table 4.4 Incidence of Some Water Related Diseases Reported at General Hospital Ado-Ekiti

S/no	Disease	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1	Malaria	439	449	461	473	486	492	505	550	585	542	502	477
2	Bloody Urine	55	44	40	37	34	26	29	31	33	49	55	51
3	Filaria	37	40	49	45	46	51	54	57	60	51	49	43
4	Typhoid	161	154	162	130	159	175	179	183	187	172	170	165
5	Diarrhoea	275	186	133	108	88	93	96	121	148	162	194	216
6	River Blindness	3	2	1	1	-	5	3	1	2	-	2	1
7	Dysentry	10	7	3	4	5	3	11	11	15	10	12	11

Table 4.5: Incidence of Some Water Related Diseases Reported at Aisegba Dispensary

S/No.	DISEASE	2001							
		Mar	Apr	May	Jun	Jul	Aug	Total	(%)
1	Malaria	22	21	22	22	27	31	145	63.3
2	Typhoid	2	2	1	3	2	3	13	5.6
3	Yellow Fever	1		-	-	1		2	0.8
4	Body Itching	3		4	1	1	3	12	5.2
5	Bloody Urine	1	2	2	1	1		7	3.0
6	Diarrhoea	5	7	8	8	11	11	50	21.8

4.3 Data from Communities

The data obtained from various communities through the administration of questionnaire and personal observations are summarized in this section. The data centred around disease pattern, the vector habitat and breeding sites in the areas and behavioural practices of the farmers which may cause or prevent the water related diseases.

The results (Table 4.4 and 4.5) indicate that Malaria, Schistosomiasis, Diarrhoea, and Stomach pain were observed among those interviewed. Mosquito infestation is high and the snail population is small.

Table 4.6: Disease Pattern Among Communities in the Project Area. (*n = 60*)

S/No	Diseases	% Affected (Aug '2000 - Aug '2001)
1.	Malaria No of attack in 6 months	100.0 Once (13.7%) Twice (15.7%) Thrice (13.7%) 4x (21.6)
2.	Yellow fever etc.	33.6
3.	Schistosomiasis	53.7
4.	Oncho nodules	17.1
5.	Itching	43.9
6.	Dracunculiasis	3.9
7.	Diarrhoea/Dysentery	48.8
8.	Stomach pain	60.9
9.	Back ache	95.1
10.	Prolonged Hospitalization	7.3

Table 4.7: Perception of the Presence of Vectors in the Area (*n = 60*).

S/No	VECTOR	% ACKNOWLEDGED
1.	Mosquitoes (Low infestation)	100.0
2.	Snail Population	60.9
3.	Simulium fly	60.9
4.	Tse-tse fly	95.1
5.	House fly	100.0
6.	Rats/Mice	100.0
7.	Snakes/Scorpions	100.0

Table 4.8: Behavioural Practices and the Feeling of the People in the Area

S/No.	PRACTICE/FEELING	%
1.	***Water source***	
	River	12.8
	Well/borehole	79.8
	Stream	7.4
	Tap	-
2.	Use of Pit toilet	Nil
3.	Washing Hand Before Eating	100.0
4.	Contact with water (Bath or Swim)	100.0
5.	Exposure to Mosquito bites	100.0
6.	***Protection Against Mosquito Bites***:	
	Bednets	Nil
	Coil	26.8
	Pia-Pia (Local insecticide)	Nil
	Commercial insecticides	Nil
	Local herbs	46.3
7.	***Use of***:	
	Fertilizers (3 to 30 bags per year)	51
	Pesticides (2 to 50 litres per year)	43.9
8.	***Expected Benefit from Dam***:	
	Economic gains	92.7
	Source of drinking water	12.2
9.	***Bad effect of Dam expected***	
	Floods/Farm loss & damage	43.9
	Health	39.0

4.4 Comparison of Various Areas

The features of the disease pattern in the studied areas shows the following:

(a) Malaria is everywhere, but the level of Mosquito infestation is not directly related to the occurrence of Malaria. Even during the dry season, with little or no stagnant water, malaria is the most prominent disease of all the people.

(b) Incidence of Schistosomiasis is relatively high in the area, but no disease is at an epidemic level.

4.5 SOCIO – CULTURAL ASSESSMENT.

The major purpose of irrigated agriculture is to increase agricultural production and consequently improve the economic and social well-being of the area of the project. Although irrigation schemes usually achieve this objective, they could often have been more successful in developing countries if more attention had been paid to the social and economic structure of the project area.

4.5.1 Population Change

Irrigation projects tend to encourage population densities to increase either because they are part of a resettlement project or because the increased prosperity of the area attracts incomers. Major changes should be anticipated and provided for at the project planning stage.

4.5.2 Human Migration

Human migration and displacement are commensurate with a breakdown in community infrastructure which results in a degree of social unrest and may contribute to malnutrition and an increased incidence of disease. Large, new irrigation schemes attract temporary populations both during construction and during peak periods of agricultural labour demands and provision for their accommodation needs to be anticipated. The problems of displacement during project construction or rehabilitation can usually be solved by providing short-term support.

4.5.3 Resettlement

Often the most significant social issue arising from irrigation development is resettlement of people displaced by the flooding of land and homes or other works This can be particularly disruptive to communities and, in the past, insensitive project development has caused unnecessary problems by a lack of consultation at the planning stage and inadequate compensation of the affected population.

4.5.4 Minority group

Minority group or tribal minorities can benefit from the increased economic development of a new irrigation area. However, they are often disadvantage by irrigation development as they are excluded from the scheme because of uncertain land rights and may be pastoralist rather than farmers.

4.5.5 Sites of value

New irrigation schemes should avoid destroying or downgrading sites of value whether that value be aesthetic, historical, religious, mineral, palaeotological or recreational. A change in water table associated with well-established schemes, can threaten buildings.

4.5.6 Women's Role

Changing land patterns and work loads resulting from the introduction or formalizing of irrigation are likely to affect men and women, ethnic groups

and social classes unequally. Groups that use common land to make their living or fulfill their household duties, eg for charcoal making, hunting, grazing, collecting fuel wood, growing vegetables etc. may be disadvantaged if that same land is taken over for irrigated agriculture or for building irrigation infrastructure. Historically, it has been men from the more settled and powerful groups that have had greatest access to the benefits and increased income from irrigated agriculture. Women, migrant groups and poorer social classes have often lost access to resources and gained increased work loads. Conversely, the increased income and improved nutrition from irrigated agriculture benefit women and children in particular.

e) Regional effects

Anew project will both place demands on the region (marketing, migration, physical infrastructure) and contribute to regional development. For irrigation schemes to be economically viable, they need to complement other activities in the region and the EIA should consider the effects of any other development, such as agro-industries or new roads. Industrial and urban development may adversely affect irrigation schemes by competing for water and reducing the quality of water available.

CHAPTER FIVE

5.0 RESULTS (IMPACTS MITIGATION MEASURES)

5.1 SOIL QUALITY

Comprehensive Soil studies are essential to the successful management of irrigated farm areas.

Arable land is continuously going out of production at approximately 5 to 7 million hectares per year due to soil degradation. Careful management can reduce the rate of salinity build up and minimize the effects on crops. Management strategies include: leaching; altering irrigation methods and schedules; installing sub-surface drainage; changing tillage techniques; adjusting crop patterns; and incorporating soil ameliorates.

Periodic soil test, (every 4 – 5 years) needs be undertaken to confirm what is available in the soil in terms of nutrients and what is required as supplement to meet the nutrition requirements of specific crops. This approach ensures that residual nutrient after plant up-take is □ertilize with an equal reduction in concentration that eventually contaminates the environment.

It is important to evaluate the irrigation water quality together with the soil to be irrigated because low quality irrigation waters might be hazardous on heavy, clayey soils, while the same water could be used satisfactorily on sandy and / or permeable soils.

Gypsum in the irrigation water or mixed into the soil before irrigation is a practice that is used to reduce the sodium content of sodic soils.

An increase in the salinity of the groundwater is often associated with waterlogging, an appropriate and well-maintained drainage network will mitigate against such effects.

Groundwater drains, either pipe drains or deep ditches, carry out the dual task of controlling the water table and through leaching, counteracting the build up of salts in the soil profile. Normally water is applied in excess of the crop water requirement and soluble salts are carried away in the drainage water although in some areas leaching can be achieved during the rainy season.

Therefore, adequate drainage to a depth between 100 and 150cm will remove the harmful effects of soluble salts within the root zones of major crops grown in the flood plain.

Careful design can avoid the occurrence of erosion problems. Agricultural practices affect soil structure and therefore the soil's erosivity, or the ease with which particles are dislodged. In general land-forming for irrigation, such as land-levelling and the construction of bunds, tends to reduce erosion.

Irrigation infrastructure needs to be designed to ensure that localized erosion, eg gully formation, does not occurs. Construction activities generally expose soil to erosion. After the completion of construction work, vegetation should be established around structures so that bare soil is not exposed to erosive forces.

5.2 AGRICULTURE

The present fertility status is not appropriate alright for the proposed irrigation scheme therefore, Fertilization will be necessary to correct deficiencies especially in the clayey soil of the project area.

The ecological impact identified in the Aisegba Irrigation Project are flooding and Water logging, erosion, Salinity and or Alkalinity development, drainage, siltation, and crop pests. While the impact is currently very low in the area, they in the long run can be advanced by the future irrigation development on an extensive scale.

These detrimental effects and drainage problem accruing from irrigation farming have been known in other parts of the world to lower crop yields and thus offset agricultural production expectations from investment in irrigation.

A strategy for combating the ecological problems has implementation and monitoring elements. The implementation element involves the identification and establishment of control programmes Monitoring involves the periodic assessment of the processes of detrimental effects as well as to the progress and effectiveness of the control programme, which includes the following: adequate training /enlightenment, through field demonstrations, for farmers in fertilizer use and handling with particular emphasis on the environmental consequence of over-application. These entire control and monitoring programmes assume greater importance when the irrigation project becomes fully operational.

5.3 HYDROLOGY

(i) Flow Regime

From all indication, the dam/reservoir has a positive impact on the flow regime, as the quantity and timing of flow will be controlled. In other to meet the purpose of the dam/reservoir, the following measures should be undertaken:

(a) To be able to predict flow regimes, regular measurements of hydrometeorological events should be institutionalized. Measurements of rainfall, evaporation, river stage and discharge, groundwater level, physical and chemical properties of river and groundwater, etc. should be embarked upon. Some functional stations should be, as a matter of urgency, be established along the Ajebie River in particular and within

the basin in general. All hydro meteorological stations already established within and around the Apariko basin as well as other major rivers like Owena Should be made functional.

(b) Experience has shown that proper operation of dam-reservoir system is crucial to the accomplishment of design objectives. Such operation needs to be based on sound and adequate information from the hydro meteorological stations. Trained and experienced personnel should be stationed at dam sites for this purpose.

© To avoid turbulent flow, reduced delivery capacity and weed growth in the canals, the use of appropriate design slopes will be required to permit easy transportation of suspended solids without settling.

(d) To prevent permanent water logging of the floodplains, subsurface and surface drainage should be put in place while due attention should be given to efficient water use and suiting irrigation system/type to soil type and topography.

(ii) Erosion and Sediment

(a) To prevent drastic reduction in the storage capacity of the dam and increase life span of dam, sediment must be removed through mechanical flushing, sediment traps or dredging occasionally when the design life of the dam is to be extended. This might be at a great cost but must be weighed against the expected benefits.

(b) Effective bed and bank protection measures should be undertaken immediately downstream of the dam like;

(1) The spill tail and stilling basin/energy disipator must be properly designed and constructed;

(2) Boulders and rocks of various sizes must be placed at strategic locations downstream of the dam to protect the bed and banks;

(3) A short but effective river training/dredging works must be undertaken downstream of the dam.

5.3.1 Fish and Fisheries

To fully realize the potentials of the Aisegba dam in fish and fisheries, certain measures must be adopted. These include:

a) Sustained research on the best way to maximize the use of the valuable fish stocks in the basin should continue.

b) There is need for accurate study of the principal or commercial abundant fish species when the dam becomes fully operational.

c) There is need for accurate statistics of daily and seasonal catches and a continuous monitoring of the physical and chemical components of the aquatic environment of the basin.

d) The local fishermen will require assistance and education in terms of organisation into co-operative groups, subsidy on fishing gear procurement, preservation of fish catch and selective harvesting of fish stock.

5.3.2 Water Quality

The emphasis now placed on the EIA as an important component of all development-oriented projects underscore the need to develop both short and long-term strategies for the adverse effects of the Aisegba dam and irrigation project. The following recommendations are important for an enhanced and improved water quality both in the Aisegba reservoir and in Apariko River in general:

a) Pursuance of monitoring programmes for physical, chemical and bacteriological parameters, and data logging and analysis to guide appropriate decision-making.

b) The quality of the discharged water must be constantly monitored for the benefits of downstream users.

c) Siltation and sedimentation in the reservoir must be controlled for an enhanced water quality by use of sediment traps at the upstream portion immediately before the reservoir.

d) Excessive application of fertilizer to irrigated land should be discouraged through good and effective extension advice.

e) Improved water management, agricultural practices and control of chemical fertilizer inputs will reduce the level of deterioration of river water quality downstream of the irrigation project.

f) Periodic soil test (every 4-5 years) needs be undertaken to confirm what is available in the soil in terms of nutrients and what is required as supplement to meet the nutrition requirements of specific crops. This

approach ensures that residual nutrient after plant up-take is fertilized with an equal reduction in concentration that eventually contaminates the environment.

g) Adequate training/enlightenment of farmers, through field demonstrations, in fertilizer use and handling with particular emphasis on the environmental consequence of over-application is required. This assumes greater importance when the irrigation component of the Aisegba Project becomes operational and more land is brought under improved system of cultivation.

h) One of the ways to avoid health related illness caused by unclean water is for the villagers to make use of dug wells and boreholes equipped with hand pumps. Adequate arrangements for clean water should be made for domestic use.

5.4 PUBLIC HEALTH

a. The shortage of potable water in the area is to a large extent responsible for the high incidence of Typhoid, Diarrhoea etc. The use of Aisegba Dam for water supply will greatly reduce this. As for Malaria, there is need to improve on the control of transmission mediums of the malaria parasite. To some extent, the Aisegba Dam reservoir is away from most of the larger settlements.

b. Health facilities in the area is insufficient and will have to be included in an integrated agricultural development system of the area. The local governments must improve upon record keeping also. This will allow the monitoring of diseases before they attain epidemic proportions.

c. The use of chemicals in the area is not widespread. However, with organized irrigated farming, proper extension services are needed to teach the farmers on the use of these chemicals.

5.5 SOCIO-CULTURAL

a) Changing land –use patterns are common cause of problems. Small plots, communal land – use rights and conflicting traditional and legal land rights all create difficulties when land is converted to irrigated agriculture. Land tenure / ownership patterns are almost certain to be disrupted by major rehabilitation work as well as a new irrigation project.

b) User participation at the planning and design stages of both new schemes and rehabilitation of existing schemes, as well as the provision of extension, marketing and credit service can minimize negative impacts and maximize positive ones.

c) Impacts resulting from changes to the demographic / ethnic composition should also be considered.

d) Insensitive project development has caused unnecessary problem by lack of consultation at the planning stage and inadequate compensation of the affected population. EIA should consider the impacts on minority groups and after consultation, appropriate rehabilitation or compensation measures should be allowed for in the project design.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

When considering impacts of irrigation and dam projects two perspectives must be taken into consideration, hey are;

a) the impact of project on the environment, and

b) external factors on the project.

Different types of irrigation will have different impacts and it should not be assumed that modern methods will have fewer impacts; the modern method may significantly increase energy consumption and lead to social problems due to reduced employment in agriculture. Impacts will also vary according to the stage of implementation. For example, during the construction period there may be specific health and other social risks due to an influx of migrant workers living in temporary and unsanitary accommodation. Later, once the project has been operating for several years, cumulative impacts may begin to present serious environmental constraints to project sustainability.

Soil, Agriculture and Wildlife

The soil in the project area is unsaline based. The exchangeable sodium is low. As for the quality of water for irrigation use, water sample obtained from the downstream of the dam is found to be suitable for irrigation, just like that of Egbe dam.

There is currently no dry season farming. The commonest crop is cocoa. This is mixed with kolanut, palm kernel and plantain. The incidence of

There is currently no dry season farming. The commonest crop is cocoa. This is mixed with kolanut, palm kernel and plantain. The incidence of crop pest and diseases is not in the extreme and the use of chemical is not extensive. This is partly due to the non availability of the chemicals and the prohibitive cost. While most of the farmers will like to use fertilizers, this is not available.

There is a lot of shaded areas in the project location due to the presence of cocoa plantation, thus weeds, especially upland ones have not prospered. This is coupled with the non availability of water for growth during the dry season. The presence of aquatic weeds in the reservoir is not very pronounced. Only wetland weeds were observed in the reservoir area. Algae was observed at some stagnant pool of water downstream of the dam and at a pond serving the domestic purpose of the Ilupeju community.

the project location is already under cultivation, there is little or no wildlife present. The commonest occurrence is the presence of bird and rodents. Their presence in the area is because of what they get on the farms. Domestic breeding of livestock is restricted to homesteads and wandering animals will destroy farms and create hostilities. There are no forest reserves in the project area, but the Ogbesse forest reserve bothers it.

This used to be a wildlife sanctuary, but in recent times, Saw Millers have been allowed to commence cutting of trees in the area.

HYDROLOGY, WATER QUALITY AND FISHERIES.

Because the dam is yet to be completed, water that gets to the reservoir simply flows freely to the downstream through the existing sluice. The reservoir is currently empty. The ground water resources in the area is used for domestic purpose and not irrigation. The dynamic water level in the project area varies from 6m to 9m depending on location and distance from the Apariko river. The static water level will be determined during the wet season. There is no sediment transport during the dry season for lack of flow. However, some fine material depositions were noticed at one or two locations downstream.

Fishing has not commenced since there is no reservoir. There are no fishermen in the area. However, a visit to the little Osse dam in the nearby basin shows that there are migrant fishermen in the reservoir. Interest in fishing may be improved when the reservoir is in place. Tilapia is about the commonest species, but fingerlings of other species of fish might be introduced into the reservoir and they will prosper as is been done at Egbe dam reservoir.

Apart form water from wells which are used for domestic purpose, surface water in pools and ponds were tested. The quality of these waters is not

very good, but the people apply some form of treatment: addition of alum and filtration. Solids in the samples are a little bit on the high side. This is partly due to human activity as all sorts of cans are used in the ponds and wells. In the ponds, a substantial percentage of the suspended solid is algae.

PUBLIC HEALTH

The diseases studied include Malaria, Schistosomiasis, Onchocerciasis, Trypanosomiasis, Yellowfever, Filariasis, Drancunculiasis, Dysentry/Diarrhoea, Cholera, and Typoid/Paratyphoid fever. Of these, malaria is the commonest during the dry season. This is followed by diarrhoea. However, while Malaria cuts across all ages, diarrhoea was more prevalent in children of five years and below. Stomach ache was also recorded in more women than men. No disease was at an epidemic level.

Chemical use in the area has not affected the health of the people. The use of the chemical is not extensive and in fact has more impact on the soil because of previous repeated use than on the ground or surface water. There is serious water shortage in the area for domestic use, thus people have resorted to ponds and open pools. These places are community protected against contamination. Waste disposal practices is through pit latrines and on the open farm but not near water sources. Disease vectors are also common in the area, though infestation is generally low.

SOCIO-ECONOMIC AND CULTURE.

Family size in the project area is large because these are basically farming communities. Average size is 10 and most have formal education up to primary schools level. There are no infrastructure and most farmers are migrants. Use of farm input is low and there are no access to credit loans. Most inhabitants engage in self medication.

Most farmers are not well disposed to the project as currently planned.

They are afraid they might lose their land and crops and are therefore not willing to participate. Compensation has been paid to farmers whose farm will be affected by the reservoir but not to the people whose farm falls within the irrigation area.

In any case, they do not see any reason for abandoning cocoa for some other crops. They prefer that the dam be used for water supply and/or the irrigation part be shifted to another area outside their farmlands.

All the farmers in the area want more land for farming, and this has made the issue of land allocation and sharing very touchy. In fact, the Ilu-Omoba community is currently at loggerheads with Aisegba Ekiti and the matter is said to be in court.

This however does not have much to do with the project. There are no shrines or sacred location (e. g cemetery) within the project area.

The inhabitants welcome the project provided water supply will be included and they will be able to keep their farmlands while government look for land

somewhere else for the irrigation. They believe the project will bring more infrastructures to the area, but will not want anything to disrupt their cocoa farm business.

The intensification of agriculture can lead to ground water pollution related to the increased use of pesticides and fertilizers. Improved efficiency may significantly reduce return flows which are often utilized downstream by other irrigation schemes or wildlife habitats. Similarly, upstream developments are likely to impact on an irrigation scheme either in the form of reduced water availability (surface or groundwater) or reduced water quality.

The most common problems of and threats to irrigation schemes are listed in Table 6.1 together with potential mitigating measures.

Table 6.1 Common Problems and threats to Irrigation and Drainage Schemes and appropriate mitigation measures.

Problem	**Mitigation Measures**
Agriculture: Degradation of irrigated land	Improve I & D operation to match demand both how much & when
Salinization	Provide drainage including disposal of water to evaporation ponds or the sea if quality of river flow adversely affected by drainage water
Alkalization	Maintain channels to prevent seepage, and reduce inefficiencies resulting from siltation and weeds. Allow for access to channels for Maintenance in design
Waterlogging	Provide water for leaching as a specific operation
Soil Acidification	Set-up or adjust irrigation management infrastructure to ensure sufficient income to maintain both the irrigation and drainage systems. Analyse soil and monitor changes so that potential problems can be managed.
Human Health	Manage I & D to prevent disease spread.
Increased incidence of water related disease	Educate about causes of disease

Increased inequity	Improve health facilities
Socio-Cultural Condition	
Weaker community infrastructure	Allow sufficient time and money for extensive public participation to ensure that plans are optimal, that all sections of affected society are considered and that local institutions are in place to sustain irrigated agriculture, particularly in respect of land and water rights. Consider markets, financial service and agricultural extension in conjunction with proposed irrigation and drainage changes
Weaker community infrastructure	Ensure that agricultural intensification does not preclude other economic or subsistence activity, such as household vegetables, fodder or growing trees for firewood Provide short – term support and/ or skills for an alternative livelihood if irrigation removes existing livelihood.
Poor water quality	Define and enforce return water quality levels (including monitoring).
Reduction in irrigation water quality	Control industrial development
Water quality problems for downstream users Caused by irrigation return flow quality	Designate land for saline water disposal; build separate disposal channels Educate for pesticide or sewage contamination dangers Monitor irrigation water quality
Ecological degradation	Define ecological requirements
Reduced big-diversity in project area	Operate dams to suit downstream requirements and encourage wildlife around reservoirs.
Damage to downstream ecosystems due to reduced water quantity and quality.	Designate land for flood plain; wetlands; watersheds; drainage water disposal; river corridors
Ground water depletion	Define and enforce abstraction regulations
Dry drinking & irrigation wells	Monitor ground water levels
Saline intrusion at coasts	Adjust abstraction charges

The strategy for combating the generated ecological problem associated with dam and irrigation project has implementation and monitoring element. Control programmes includes measures for design and installation of improved technologies for combating flood and water logging, drainage, irrigation water management, crop and pest management, wildlife and range management and livestock management. The monitoring strategy focuses on the periodic assessment of the processes of soil, erosion, siltation, salinity / alkalinity, waterlogging pollution and pest incidence. Manager of integrated pest management programmes should attempt to include vectors in their monitoring activities and liaise with health authorities on early warning mechanisms for disease outbreaks.,

The monitoring of salinity / alkalinity should be on annual basis, usually in the dry season to remove the effects of rainy season salt dilution.

The monitoring of the progress and effectiveness of the control programmes should be based on such factor as water quality, siol, crop performance and yields, and quality of wildlife habitat.

Siltation and sedimentation in the reservoir must be controlled for an enhanced good water quality.

Excessive application of fertilizer to irrigated land should be discouraged through good and effective extension advice and by proper pricing to control and limit contamination of the river body.

Improved water management, agricultural practices and control of chemical fertilizers inputs will curb deterioration of river water quality downstream of the irrigation project.

There is need for detailed study of the principal or commercial abundant of fish species. There is need for accurate statistics of daily and seasonal catches and a continuous monitoring of the physical and chemical components of the aquatic environment of the basin. The local fishermen require assistance and education in term of organization into cooperative groups and subsidy on fishing gear procurement and selective harvesting of fish stock.

The provision of drinking water supply and sanitation is the single largest health promotional component that should be pursued in any irrigation project. As more water becomes available at the household level, the incidence of water washed diseases will be reduced. Safe water supply, preferably in combination with adequate sanitary facilities, will reduce the risk of water – borne diseases dramatically.

The quality of the discharged water must be constantly monitored for the benefits of downstream users.

Strengthening of national health services, in particular primary health care capacity in the project area should ensure that the health risks associated with the demographic change are dealt with effectively.

Health centre must be established in the area covered by the project to take care of the health hazard associated with the project. Malaria is the commonest which

cut across all ages while diarrhea was more prevalent in children of five years and below. Portable water supply in the area must be improved.

Continuing increase in socio-economic activities that have sustainable development as the ultimate goal world-wide must be a necessity.

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FEDERAL UNIVERSITY OF TECHNOLOGY
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
AGRICULTURAL ENGINEERING

AGRICULTURAL ASPECT

EVALUTION OF THE EFFECT OF AGROCHEMICALS ON SURFACE AND GROUNDWATER IN THE PROPOSED AISEGBA DAM AND IRRIGATION PROJECT AREA.

1) Date.....2) Farm size(ha).....
3) Location.....4. Type of farm.....
5) Crops grown.....
6) Do you use fertilizer ? Yes ( ) , No ( )
7) If yes, what type? Organic ( ) , Inorganic ( )
8) Specify: Organic (Amount) ....., Inorganic (Amount) .....
9) Do you use any other agrochemical like herbicide and pesticide?
Yes ( ), No ( )
10) If yes, specify type and amount. Type .....Amount.....
11) If you use these agrochemicals please state amount and time of application. Amount.....,
Time of application .....
12) Do you use enough for your farm. Yes ( ), No ( )
13) If No, why?.....
.....
.....
14) Would you use more if available?. Yes ( ), No ( )

EVALUATION OF THE EFFECT OF DAM AND IRRIGATION PROJECT ON WILDLIFE:

1) Location .....2) Date.....
3) Sex.....4) Age.....
5) Occupation.....
6) Any forest reserves in your locality?. Yes ( ), No ( )
7) If yes, specify.....
.....
.....
8) Wildlife species in your area.
(a) Before Dam construction.....
.....
9) Population of wildlife after construction of Dam. Increase ( ), Decrease ( )
10) Will the project caused migration of wildlife?. Yes ( ), No ( )
11) Do you keep livestock at home? Yes ( ), No ( )
12) If yes, specify .....
.....
.....
13) Livestock's grazing habits:
(a) Migrating pattern, (b) Home fattening, (c) Water-hole utilization.
14) Any prevalent livestock diseases in your area?. Yes ( ), No ( )
15) If yes, specify.....
.....
.....
16) Is the project affecting your life?. Yes ( ), No ( )
17) If yes, specify.....
.....
.....

EVALUATION OF CROP PESTS AND DISEASES, WEEDS, SALINISATION IN THE PROPOSED AISEGBA DAM AND IRRIGATION PROJECT AREA.

1) Date.....2) Farm Size (ha).....
3) Location .....4) Type of farm.....
5) Crops grown:.....
.....
6) Do you experience pests on your farm. Yes ( ), No ( )
7) If yes, specify .....
.....
8) Type of control measures .....
.....
.....
9) Cost of control .....
10) What are the prevailing crop diseases in your farm;.....
.....
.....
11) Type of control measures.....
.....
.....
12) Cost of control .....
13) Prevalent weeds: (a) Upland weeds, (b) Wetland weeds, (c) Aquatic weeds.
14) List of common weeds identified.....
.....
.....
.....
15) Weeds control measure: (a) Hoe, (b) Oxen, (c) Chemical.
16) Do you control your weeds by hoe?. Yes ( ), No ( )
17) If yes how many time per season .....
18) Do you experience any weeds with livestocks disease on the farm?. Yes ( ), No ( )
19) If yes, list them. .....
.....
.....
20) The type of diseases caused on the livestocks. .....
.....
.....

EVALUATION OF THE EFFECT OF AISEGBA DAM AND IRRIGATION PROJECT ON PUBLIC HEALTH.

1. Name of village: .....2. Date: .....
3. LGA: .....4. Sex: .....5. Age: .....
6. Name of the household interviewed:.....
7. Occupation: .....8. Education: .....
9. Numbers of members in the family:
   a) Adults: *Male* ( ), *Female* ( ) ; (b) Children : *Male* ( ), *Female* ( )
10. The type of house they own:
    Roof material:.....Number of rooms: .....Type of walls:.....
11. Water source at the house: Well / stream / pond / piped borne water
12. Water source on the farm: Stream / Open well.
13. Do you use the river source for these: Drinking / Farming / Livestock / Fish culture.
14. The distance of water source from the farm: .....
15. How long have you been farming? .....
16. Use of river water: All year / dry period only.
17. If you drink that, do you filter / treat it ? .....
18. Do you eat fish?. .....19. How often?.....
20. Do you catch from this area? Yes ( ), No ( )
21. Do you eat it in raw form?. Yes ( ), No ( )
22. Hospitalisation for a long time (with reason).....
    .....
    .....
29. Do you swim or bathe in water near farm?. Yes ( ), No ( )
30. Do you allow your children to swim?. Yes ( ), No ( )
31. Do you spend more time in water on your farm?
    (i) All year round ( ), (ii) Only during wet season ( )
32. Do you relax outside your house in the evening?. Yes ( ), No ( )
33. How many hours do you stay out? .....
34. Do you remove your clothes while relaxing?. Yes ( ), No ( )
35. Do you wear any of these at work?
    (i) Gloves, (ii) Long boots:
36. Do you eat on the farm?. Yes ( ), No ( )
37. Do you wash your hands?. Yes ( ), No ( )
39. Give your experiences on the River near you: (include improvement of health, or deterioration of health, insect bites, monetary gains, ability to buy drugs, to engage labour on the farm etc., overleaf)
40. Observational checklist
    Mosquitoes: None/Adult/Larvae/Anopheles/culex/Aedes
    Snails: None/Bullinus/Biomphalaria
    Black flies: None/yes
    Tsetse fly: None/yes
    House fly: None/Heavy/Moderate/Low
    Stagnant water/Pools/Puddles/pits
    Vegetation in canals
    Velocity of flow (approximate) .....
    Refuse dumps/waste food around/dirty pit latrines/Faeces/Dung
    Algae ponds None/yes

EVALUATION OF THE EFFECT OF PROPOSED AISEGBA DAM AND IRRIGATION PROJECT ON FISHERIES.

1. Date: .....
2a. Are you a full time fisherman? Yes ( ), No ( ) (2b). Where do you fish.....
3. If you both fish and farm, Yes ( ), No ( )
   When do you do each (season)?. .....
4. From your experience, is there a time when fishing pays more than farming?
   Yes ( ), No ( ).
5. If yes, when and why? .....
   .....
6. What type of fishing gears do you use?
   Dugout canoe ( ), Powered boat ( ), Net ( ), Traps ( ), Darts ( ), Poisoned darts ( ), Hooks ( ), Poison ( ).
7. If poison or poison darts, what type? .....
   .....
8. How efficient are your fishing gears? .....
9. How does powered boats compare with the local boats in fish catching?. .....
   .....
10. Using modern fishing equipment, do you think you can catch more fish? Yes ( ), No ( ).
11 .If yes, how and why? .....
   .....
12. Give the names of the fishes that you have seen or caught in the River: .....
   .....
   .....
13. What are the most dominant fish species in the area?
   .....
   .....
14. What period (time) of the day do you fish and why? .....
   .....
   .....
15. When do you have your best catch (season) and time of the day?
   .....
16. Over the years, is the catch: Increasing ( ), Decreasing ( ), Constant ( ).
19. Does the fish diversity vary over the years (i.e. has any species disappeared)?
   Yes ( ), No ( ).
20.If yes, what species? .....
21. How do you want the government to help you? .....

SOCIO - ECONOMIC ASPECT

QUESTIONNAIRE SURVEY OF INHABITANTS IN THE PROJECT AREA.

1. Settlement: .....2. Sex: .....
3. Age: 18 ( ), 19-49 ( ), 50-64 ( ), 65+ ( ).
4. Marital status: Married ( ), Widowed ( ), Single ( ).
5. Family size:
No of wives .....No of male children .....
No of female children .....No of dependants .....
6.Residential status: Indigene ( ), Migrant ( ), Foreigner ( )
7. (a) Dwelling type: Hut ( ), Family compound ( ), Modern house ( ),
(b)Building materials: Mud house ( ), Mud + plaster ( ), Cement blocks ( ).
(c) Roofing materials: Thatch ( ), Iron sheets ( ), Asbestos ( ).
(d) Decoration: Not painted ( ), Painted ( ), Floor tiles ( ).
(e) Facilities available within the house: Electricity ( ), Pipe borne water ( ), Well ( ), Borehole ( )

PRE-PROJECT CONDITIONS.

1. Former occupation:
Main: .....
Secondary activities: .....
2. Land ownership:
Individual ( ), Tenant ( ), Family ( ),
Leasehold ( ), Communal ( ).
3. Farmland:

No.	Farm size (indicate unit of measurement)

4. Crops grown now:
Main crop (s) .....
Other crop (s) .....
5. Estimate of crop output (indicate unit of measurement)

Crop	Quantity

6. Use of inputs:

Input	Quantity / Rate	Cost
Tractor Hiring		
Fertilizer		
Seeds/Seedlings		

7. (a) Did you have access to credit loans? Yes ( ), No ( )

(b) If yes, how many times did you receive loans? .....

(c) Indicate amount of loans .....

8. Membership of co-operative societies: Yes ( ), No ( )

9. Indicate problems of farming then:

Late rain ( ), Irregular rainfall ( ), Poor soils ( ), Soil erosion ( ),
Pests ( ), Labour shortage ( ), Poor/lack of roads ( ),
Conflicts with pastoralists ( ),
Others (specify) .....
.....
.....

10. List common diseases in the community now:

Malaria ( ), Typhoid ( ), Cholera ( ), Polio ( ), Guineaworm ( ),
Bilharzia ( ), River Blindness ( ),
Other (specify) .....
.....

11. State curative measures:

Self medication ( ), Traditional healer ( ), Modern clinic/dispensary ( ).

QUESTIONNAIRE SURVEY ON RESETTLED INHABITANTS

1. What did you loose as a result of resettlement?----------
---

2. Did you receive compensation from the government? Yes( ), No( )

3.Are you satisfied with what you received? Yes( ), No( )

4. Did you receive any from of assistance from the government to relocate? Yes( ), No( )

5. What is your present occupation now?----------
--

6.Are you aware of the Dam and Irrigation Projects? Yes( ), No( )

7. Would you like to participate? Yes( ), No( )

8. Do you still farm on your former fadama land? Yes( ), No( )

9. In what way do you think the project will affect you?

Loss	Quantity	Remarks
Farmland		