SFG2854

Final Report

Environmental and Social Impact Assessment (ESIA) for Emergency Rehabilitation of Eleyele Dam, Oyo State

Submitted to

Ibadan Urban Flood Management Project (IUFMP)
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List of Acronyms

AAS	Atomic Absorption Spectrometer
AIDS	Acquired Immunodeficiency Syndrome
APPI	Area of Potential Project Influence
ASTM	American Society for Testing and Materials
AQ	Air Quality
BAT	Best Available Technology
BOD	Biological Oxygen Demand
CDA	Community Development Association
Cm	Centimetre
cfu/ml	Colony Forming Unit per Milliliter
CO	Carbon (II) Oxide
COD	Chemical Oxygen Demand
COHb	Carboxyhaemoglobin
CSR	Corporate Social Responsibility
dB(A)	A-Weighted Decibel
DISCO	Distribution Company
DO	Dissolved Oxygen
EA	Environmental Audit
EAP	Emergency Action Plan
EC	Electrical Conductance
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMT	Emergency Management Team
EPC	Engineering, Procurement and Construction
EPP	Emergency Preparedness Plan
ER	Electrical Resistance
ESIA	Environmental and Social Impact Asssessment
ERP	Emergency Response Plan
FEPA	Federal Environmental Protection Agency
FMEnv	Federal Ministry of Environment
GC	Gas Chromatograph

GEF	Global Environmental Facility
GIS	Geographical Information System
GPS	Global Positioning System
GW	Ground Water
HCl	Hydrogen Chloride
HIA	Health Impact Assessment
HIV	Human Immunodeficiency Virus
HNO_3	Nitric Acid
HSE	Health, Safety and Environment
HUB	Hydrocarbon Utilizing Bacteria
HUF	Hydrocarbon Utilizing Fungi
IMM	Impact Mitigation Monitoring
ITCZ	Inter-tropical Convergence Zone
IUFMP	Ibadan Urban Flood Management Project
KCl	Potassium Chloride
kV	Kilo Volts
L	Liter
LAT	Lowest Astronomical Tide
LGA	Local Government Area
MEDIVAC	Emergency Medical Evacuation
ml	millilitre
mm	millimetre
MMUSD	Million United States Dollars
m/s	Meter per Second
MPN/100ml	Most Probable Number per 100 milliliter
MSDS	Material Safety and Data Sheet
NGO	Non Governmental Organisation
NIMET	Nigeria Meteorological Agency
NO_x	Nitrogen Oxides
OYSSWMA	Oyo State Solid Waste Management Authority
PCF	Prototype Carbon Fund
PDA	Potato Dextrose Agar
pH	Hydrogen Potential

PIU	Project Implementation Unit
PPE	Personal Protective Equipment
ppm	part per million
QA/QC	Quality Assurance/Quality Control
SEPA	State Environmental Protection Agency
SO_x	Sulphur Oxides
SPM	Suspended Particulate Matter
SRT	Soils Resistivity Test
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
TAB	Total Anaerobic Bacterial
THB	Total Heterotrophic Bacterial
THC	Total Hydrocarbon Content
THF	Total Heterotrophic Fungi
TCF	Trillion Cubic Feet
TDS	Total Dissolved Solids
TDU	Thermal Desorption Units
Tmax	Maximum Temperature
TMin	Minimum Temperature
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TS	Total Solid
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
UN	United Nations
UNEP	United Nations Environment Program
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
^0C	Degree Celsius
Mg/m^3	Microgram Per Cubic Meter
µm	Micrometer
%	Percent

EXECUTIVE SUMMARY

Introduction and Background Information

Given the history of flooding events in the city of Ibadan especially the heavy downpour of 187.5 mm in about 4-5 hours on August 26, 2011, the Oyo State Government recognized the need for an integrated and long term solution to flooding in the city. The Oyo State Government thus requested the World Bank's support to finance a flood management project in Ibadan. This request informed the establishment of the Ibadan Urban Flood Management Project (IUFMP), which aims to develop long term flood resilience in the city—by collaboratively identifying and implementing robust and sustainable solutions for mitigating flood risk, and improving flood preparedness.

In view of this, the Oyo State Government proposes to rehabilitate the Eleyele dam on Ona River to enhance the dam's capability to support potable water production and forestall future dam failure. One of the IUFMP's tools for attaining these laudable goals is this Environmental and Social Impact Assessment (ESIA) study, which identifies potential environmental impacts of the rehabilitation project and recommends mitigation measures where necessary during the construction and operating phases of this project.

The Eleyele Dam is situated upstream on River Ona, in the city of Ibadan within Geographical Coordinates: Latitude 7°20' - 7°25'N, and Longitude 3°51' - 3°56' E. It falls within the Ido LGA of Oyo State. Eleyele waterworks is located at the close end of Waterworks road which is accessed through Eleyele roundabout on Sango-Eleiyele Road, just downstream of the confluence of River Ona and River Alapata. The Ona River on which the dam is built traverses many locations within Ibadan Metropolis and goes as far as Apata and Omi-Adio. The reservoir is surrounded by a variable margin of woodland beyond which is urban development on all sides of the reservoir.

The proposed Emergency Rehabilitation works on the Eleyele dam include:

a. Rehabilitation of the weir wall, where a section of base slab is missing at the toe.
b. Remedial works at the spillway trough and downstream channels repair of the base slab within the trough section and also the spillway channel down to the confluence with the scour channel.
c. Removal of debris and vegetation including trees within the spillway and spillway channels where these are currently impeding the design capacity of the spillway.
d. Repairs of the access road drainage and as a matter of priority reinstatement of the backfill to the retaining walls downstream of the footbridge would be carried out.
e. Full and detailed assessment of the operating and guard valves and there operating mechanisms.
f. Repair of all defects on the embankment.
g. Repair of the Scour tunnel
h. Rehabilitation of intake tower

Baseline Conditions

The field baseline survey was carried out in March 24-26, 2016. The objective of the field data acquisition was to establish the existing biophysical status of the study area.

The baseline air quality of the project area as it relates to the measured air pollutants (VOC, CO, SO_2, NO_2, NH_3, TSP, and H_2S) is pristine (not polluted) and does not reflect any significant level of anthropogenic alterations. The vegetation is typically of lowland rainforest, made up of mixtures of trees, shrubs, herbs and grasses. Terrestrial wildlife fauna of the region consist of mammals, birds,

herpetofauna and invertebrates. Examples of the mammals include; grass cutter, squirrel, monkey, porcupine etc. The reptiles are spitting cobra, Lizard, Chameleon etc. Some of the birds observed were trhe red neck dove, little egret, kinfisher and the black kite. Soil characteristics of the study area both in term of physiochemistry and microbiology revealed no significant anthropogenic alteration. Heavy metals in surface water recorded values that fell within regulatory limits of the Federal Ministry of Environment.

Socio economics study

The project area is a semi-urban setting within the vicinity of Ibadan capital city development area. The population of host communities range from 500-1000. The area has no much ongoing developments with respect to urbanization. Public services and infrastructures are virtually absent. Common economic activities in the communities were trading, cassava processing, pepper selling, vegetable selling, maize farming, fishing, lumbering, small and medium scale enterprises and working in the civil service.

Consultation and Public Participation

The stakeholder communities include Ojo Busa, Oke Alape, and Ologuneru. The rehabilitation of the dam was generally considered by all respondents as long overdue as it would contribute to flood control in the area. They promised to provide all necessrary support to ensure successful project implementation.

Project Impacts and Mitigation

There are a number of positive impacts that are attendant to this project. However, the primary positive impact of the proposed project is flood control that has hitherto been one of the major environmental challenges in the project area.. In addition, the project is expected to provide employment, from local labour to specialized experienced services. In effect, it will lead to improved economy, both for small business owners who would be patronised by construction workers.

Most of the negative impacts would occur during the construction/rehabilitation phase. Some of the negative impacts include: loss of vegetation during site clearing, shortage of water for riparian use as a result of dredging, construction of embankment, spillway etc, ambient air deterioration due to gaseous emissions and dusts from construction activities (vehicles especially during mobilization of equipment and materials to site and machines). Other potential negative impacts are; potential traffic congestion especially along adjoining roads, change in population due to influx of migrant workers, pressure on very limited infrastructure in host communities, potential increase in cost of accommodation as a result of pressure from migrant workers, potential increase in road accidents and increase in noise emission from construction vehicles and machines in the present relatively quiet project environment. Most of the potential negative impacts are expected to range from minor to negligible in terms of magnitude and duration. The potential impact that has a likelihood of being major is possible dam failure.

Environmentally friendly mitigation measures have also been recommended to ameliorate the identified impacts of the project. It is expected that if the recommended mitigation measures are effectively implemented, most of the negative impacts will be reduced as much as possible.

The responsibility of mitigating most of the negative impacts associated with the proposed project rests on the Project Contractor, project consultant, while the IUFMP PIU will play a supervisory role in ensuring recommended mitigation measures are adhered to. Highlight of some recommended mitigation measures include:

- ✓ Engage the host communities and other stakeholders in continuous consultations to forestall possible conflict due to perceived imbalance in employment opportunities.
- ✓ Provide relevant PPEs to all project staff and enforce proper use to reduce potential injuries and loss of lives.
- ✓ Provide relevant training and capacity building for workers on efficient and effective dam rehabilitation and operation management technology
- ✓ Sprinkle water on the construction surface during construction especially in dry season to reduce potential dust emissions during excavation and dust emitting activities.
- ✓ Service all construction and operational vehicles and machines regularly to reduce emission of noxious gases,
- ✓ Regularly monitor ambient air quality within the project area and nearby communities to forestall possible health effect on workers.
- ✓ Provide mobile toilets during construction to reduce the problem of indiscriminate defecation around the project site.
- ✓ Provide waste bins with lids to prevent possible reduction of site aesthetics and deterioration of ambient air (foul odour), which could result to health challenges.

Environmental and Social Management Plan
The EMP contains the following elements:

Health, Safety and Environment (HSE) Plan -The EMP identifies the environmental safeguard specialist as PIU HSE representative for the dam rehabilitation project. It accentuates roles and responsibilities for the environmental safeguard specialist to ensure effective environmental management.

Staffing and Training – Relevant training and capacity building that centres around environmental and social impact assessment should be developed.

Community Plan – Communication including stakeholders' consultation shall be regular and continuous throughout the project lifecycle. The strategy shall include regular meetings with host and communities around the project area to keep them informed of the dam rehabilitation as well as mechanism for redressing possible grievance. Other stakeholders that will be incorporated into the programme may include relevant government authorities.

Environmental and Social Monitoring Plan -The baseline data in this document should be the benchmark database for monitoring activities that will be carried out with regard to this project. A summary of potential impacts, mitigation and estimated cost of mitigation has been developed. In addition, monitoring plan and estimated cost of implementing relevant monitoring is also presented. A total of about =N=67million is estimated to implement the ESMP of the proposed dam rehabilitation.

Item	**Responsibility**	**Cost Estimate Nigerian Naira**	**Cost Estimate Us Dollars***
Mitigation	IUFMP PIU/OYSEPA	22,800,000	72,380.95
Management	IUFMP PIU	10,000,000	31,746.03
Monitoring	IUFMP PIU/Consultants	17,400,000	55,238.1
Training & Capacity Building	IUFMP PIU/Consultants	11,000,000	34,920.63
Sub- Total		***61,200,000***	***194,285.7***
Contingency	10% of subtotal	6,120,000	19,428.57
Total		**67,320,000**	**213,714.3**

AGBAJỌPỌ IṢẸ NI ṢOKI

Afihan ati Ihin Ipilẹ Iṣẹ Yi

Nitori itan ọlọjọpipẹ nipa agbara Ojo arọọrọda ati omiyale ni ilu Ibadan, paapa ni pataki, ojo katakata ti o nlọ bii iwọn ọgọsan-le-meje ati abọ milimita (187.5mm) ti o rọ fun nkan bi wakati mẹrin si marun ni ọjọ kerindinlọgbọn oṣu Ogun, ọdun 2011 (August 26, 2011), ijọba ipinlẹ Ọyọ ni a ta kiji si aini ti o wa lati wa ojutu gbogbogboo ti yio wa pẹ lọ titit si iṣẹlẹ agbara Ojo laarin ilu na. Nitorina, lati le ṣe atunṣe yi, ijọba ipinlẹ Ọyọ ra ọwọ ẹbẹ si ile ifowopamọ ti agbaye (World Bank) lati ṣe iranlọwọ owo fun wiwa ojutu si ọrọ agbara Ojo ni ilu Ibadan. Ikesini yii ni o fa agbekalẹ ile iṣẹ ti o nbojuto agbara ojo ti a npe ni eede gẹẹsi ni "Ibadan Urban and Flood Management Project (IUFMP)", ti o ni ete lati wa ojuutu ti yi o wa fun igba pipẹ si iṣooro omiyale ni aarin ilu na - nipasẹ fifi ifọwọsowọpọ tọka si ojuutu ti o rinlẹ ti yio si wa pẹ titi.

Fun idi eyi, Ijọba ipinlẹ Ọyọ ngbero lati ṣe gbogbo atunṣe to yẹ lara Odi-amomidani Ẹlẹyẹle ti o wa ni ori Odo Ọna lati le mu agbara odi na le sii ni pipese omi mimu loore-koore fun awọn ara ilu. Bakanaa ẹwẹ, ẹkunrẹrẹ atunṣe Odi-amomidani yi ṣe pataki lati dẹkun omiyale ati agbara ya sọbu, ati lati dẹkun ajalu-ibi wiwo odi naa lọjọ iwaju. Ọkan lara ohun elo ti IUFMP fẹ lo fun awọn atunṣe Odi-amomidani yi ni akanṣe ijinlẹ iṣẹ ti yo yananna gbogbo jamba ati anfani ti o le jeyọ tabi ṣẹlẹ si ayika ati awọn eniyan ti o wa lagbegbe Odi-amomidani Ẹlẹyẹle nigbati ẹkunrẹrẹ atunṣe ba nlọ lọwọ. Iru Akanṣe ijinlẹ iṣẹ yi ni an pe ni eede gẹẹsi ni "Environmental and Social Impact Assessment (ESIA)" study, tabi ikẹẹkọọ ESIA fun odi omi Ẹlẹyẹle. Ijinlẹ iṣẹ akanṣe yi yio tun dabaa awọn ojuutu ti o ṣeeṣe fun awọn ewu ti o le somọ iṣẹ atunṣe na.

Odi-amomidani Ẹlẹyẹle wa ni apa oke iṣan-omi odo-Ọna (Upstream of River Ona) ni ilu Ibadan, laarin aworan aye (Geographical coordinates) ti o wa ni Latitudi (Latitude) 7°20' N si Latitudi 7°25'N, ati ni Lọngitudi (Longitude) 3°51' E si Lọngitudi 3°56' E. Agbegbe ti a n ṣe apejuwe rẹ yi wa labẹ ijọba ibilẹ Ido ni ipinlẹ Ọyọ. Odi-amomidani Ẹlẹyẹle wa ninu ile iṣẹ ifọ-omimọ (Waterworks) ti o kalẹ si ipari ọna Waterworks ti a le kan lati orita Ẹlẹyẹle ti o wa ni oju ọna Sango-Ẹlẹyẹle ni ilu Ibadan, ti ko jina rara si ibi ti awon odo meji ti pade – iyẹn Odo Ọna ati Odo Alapata. Odo Ọna, lori eyi ti a kọ Odi-amomidani Ẹlẹyẹle si ni o gba aarin ọpọlọpọ ibi kọja laarin gbungbun ilu Ibadan titi lọ de Apata ati Omi-Adio. Koto ti omi nkorajọ si (Reservoir) ti odi yi ṣokunfa rẹ ni a yi ka pẹlu igbo onigi giga lorişirişi, lẹyin eyi ni ilu ti o ti gbooro ti idagbasoke igbalode yika kaakiri.

Awọn Iṣẹ Atunṣe pajawiri lori Odi-amomidani Ẹlẹyẹle ni ninu:

a. Titun awọn ẹya ara Odi-amomidani Ẹlẹyẹle ṣe bii Weir wall
b. Awọn Iṣẹ atunṣe ni Spill way
d. Kiko pantiri ati awọn eweko danu kuro loju ọna omi
e. Titun awọn Oju ọna agbara ṣe
ẹ. Şişe ayẹwo kikuna nipa ọna igba-şişẹ odi-omi ati awọn aabo ti a pese silẹ
f. Şişe atunṣe gbogbo abawọn ti o wa lara ogiiri odi-amomidani
g. Şişe atunṣe oju omi tooro (Scour tunnel)
gb. Şişe atunṣe Orisun ifa-omi-wọle si ile-iṣẹ ifọ-omi-mọ

Apejuwe Ipo Agbegbe ati Ayika Odi-amomidani Ẹlẹyẹle

A ṣe iṣẹ ayẹwo ayika Odi-amomidani Ẹlẹyẹle ni ọjọ kerinlelogun si ọjọ kerindinlọgbọn oṣu Erena, ọdun 2016 (March 24-26, 2016). Ete iṣẹ ti a lọ ṣe ni ayika Odi-amomidani Ẹlẹyẹle yi ni lati mọ ipo ti eweko, ẹranko, ẹja ati awọn eniyan wa ki atunṣe to bẹẹrẹ lori Odi-amomidani Ẹlẹyẹle. Iwadi imọ ijinlẹ fi ye wa pe afẹfẹ to wa ni ayika Odi-amomidani Ẹlẹyẹle dara pupọ ko si ni ẹgbin ninu. Bi o tilẹ jẹ pe apẹẹrẹ awọn idọti bi (VOC, CO, SO_2, NO_2, NH_3, TSP, and H_2S) diẹ wa ninu afẹfẹ yi, sibẹsibẹ, afẹfẹ yi dara. Ko si idaniloju wipe ẹgbin pupọ ko ni wọnu afẹfẹ yi nigbati iṣẹ-atunṣe ba bẹrẹ lori awọn ẹya Odi-amomidani Ẹlẹyẹle. Awọn eweko ti o wa ni ayika yi jẹ ti igbo kijikiji, ti o kun fun oniruru igi giga, awọn igi kekeeke, ewebẹ ati koriko. Awẹn ẹranko inu igbẹ l'agbegbe yi ni ninu awọn ẹranko igbo, ẹyẹ oju ọrun, ati awọn ẹranko kekeeke ti ko leegun ẹyin. Apẹẹre awọn ẹranko igbo jẹ: ẹran igbẹ bii ewuju, ọbọ, ati bẹẹbẹ lọ. Awọn ẹranko afayafa ti o wa lagbegbe yi ni ninu Ejo, Alangba, Ọga, ati bẹẹbẹ lọ. Lara awọn ẹiyẹ ti a f'ojuri la ti ri ẹiyẹ adaba, odeere koko, lekeleke, ati ẹiyẹ awodi. Ilẹ tabi erupẹ ti o wa ni agbegbe Odi-amomidani Ẹlẹyẹle ni awọn eroja lọpọlọpọ. Awọn Ayẹwo ti a ṣe lori ilẹ fiyewa wipe awọn eniyan ko tii ṣe iṣẹ pupo lori ilẹ yi nitoripe gbogbo eroja ilẹ yi lo ṣi wa ni pipe. Gbogbo eroja heavy metals ti o wa ninu omi yi ko to eyi ti o le ba lilo omi naa jẹ gẹgẹ bi ilana aṣẹ ijọba Nigeria ti FMEnv nsoju fun.

Ẹkọ nipa Igbesi-aye, Ibagbe ati Ọrọ-aje ni Ayika Ẹlẹyẹle

Lati inu iwadii ati isayẹwo oju popo wa lori iṣẹ yii, iye awọn eniyan ti o wa ni awọn Abule ati ayika ti o sunmọ etido ati sakani Ẹlẹyẹle nlọ bii ọgọrun marun sii ẹgbẹrun ni abule kan kan. Ayika iṣẹ atunṣe Odi-amomidani (dam) Ẹlẹyẹle jẹ eyii ti o sunmọ ti Igbalode, bi o ti lẹ jẹ wipe inu gbungbun olu-ilu Ibadan nibi ti idagbasoke ti nwaye ni o wa. Idagbasoke pupọ ko fi bẹẹ waye ni agbegbe yi nipa ti awọn nkan igbalode. Awọn ohun amayedẹrun fun ilo gbogbogboo ni ko fi bẹẹ wọpọ ni ilu ibadan. Iṣẹ owo ti o wọpọ ni awọn agbegbe wọnyii ni ọja tita, ẹgẹ ririn, ata tita, ẹfọ tita, iṣẹ ọgbin agbado, ẹja pipa, gẹdu gige, awọn oko-owo kereje kereje, ati ṣiṣe iṣẹ pẹlu ijọba ninu ọfisi.

Ifọrọlọni ati Kikopa awọn Ara Ilu ninu Iwewee-dawọle iṣẹ

Ifọrọlọni ti a ṣe pẹlu awọn ero ti ọrọ kan ni sakani Odi-Ẹlẹyẹle fihan pe Agbegbe ti o sunmọ odi na timọ-timọ ni Ojo-Busa, Oke Alapẹ ati Ologunẹru. Iṣẹ atunṣe Odi-amomidani (dam) Ẹlẹyẹle yii ni o jẹ ohun ti awọn olugbe agbegbe na tẹwọgba tọwọtẹsẹ, ti won si jẹwọ wipe o ti pẹ ti o ti yẹ ki ijọba ti wa nkan ṣe si ọrọ odi na, nitoripe yi o dẹkun omiyale agbara ya ṣọọbu ti nbawọn finra ni ilu Ibadan. Wọn ṣeleri lati kọwọti gbogbo isapa ijọba lori iṣẹ atunṣe na lati ri wipe o kẹsẹjari.

Ipa Ti O Ṣeeṣe Ki Iṣẹ Atunṣe yi ni ati awọn Ojutu Ti a Le Pese Lati Din Wọn Ku

Awọn ipa ti o s'anfanii melo kan ba iṣẹ atunṣe yii rin. Lakọọkọ na, ipa sisanfaani iṣẹ ni didin agbaara ojo ku, eyi ti o ti jẹ ipenija agbayanu ni ayika fun awọn aladugbo Ẹlẹyẹle lati igba pipẹ saaju akoko yii. Ni afikun, a reti ki iṣẹ atunṣe yii pese iṣẹ abọṣẹ fun awọn eniyan, lati ori awọn lebura titi ti o fi lọ de ọdọ awọn ti o kọṣẹ-mọṣẹ pẹlu iriri ọlọjọ gbọgbọrọ. Nipa bẹẹ, yi o yọrisi ọrọ aje ti o tun gbe pẹẹli si, fun awọn ontaja keekeeke ti awọn oṣiṣẹ Odi-Ẹlẹyẹle yio ma ba raja.

Eyi ti o pọju ninu awọn ipa ti o le mu ipalara wa le ṣẹlẹ nigba ti iṣẹ atunṣe ba nlọ lọwọ. Ninu awọn ipa wọnyi yi o jẹ pipadanu eweko, airi omi lo to nititori wiwajin ti wọn yi o wa odo, kikọ odi nla ti omi, ati bẹẹbẹ lọ. Iniyelori atẹgun ti a nmi simu ni yi o dinku pẹlu, nitori eruku ati eefin lati inu awọn ẹrọ ti a o lo fun iṣẹ na. Awọn ipa miiran yi o jẹ sunkẹrẹ-fakẹrẹ ọkọ, irọwọle awọn ajeji oṣiṣẹ, ati ṣiṣeeṣe ti o wa fun igberu ninu ajalu ọkọ loju titi ọlọda. Ariwo awọn ẹrọ na yi o dakun awọn ipa

aibarade ti a reti nigba ti iṣẹ atunṣe yi ban lọ. Amọ sa o, pupọ ninu awọn ipa wọnyi ni ko rinlẹ to bẹ ju bẹẹ lọ. Ipa ti o rinlẹ gidi ni bi Odi Ẹlẹyẹle ba ṣeṣi yaa. Ipa yii yi o rinle nitori aduru omi ti yio dasilẹ. Nitorina, akitiyan lati dena iru iṣẹlẹ laabi bẹẹ ni a gbodo sa ni gbogbo ọna. Ni afikun, eto idahunsi kiakia ti o muna ti o si peye ni a gbọdọ pese lati dẹkun iru iṣẹlẹ bẹẹ. Awọn eto ti o barade pẹlu ayika ti a ngbe ni a ti damọran wọn lati din ipa ti awọn iṣẹlẹ le ni ku. A nireti wipe bi a ba fi awon aba wonyi silo bi o ti ye, awon ipa ti o le panilara wonyi ni a o dinku niti gidi gan an.

Ẹru iṣẹ didin eyi ti o pọju ninu awọn ipa ti ko barade sinmi le awọn agbaṣẹṣe – kongila ti o ba n ṣe kokaari iṣẹ atunṣe odi na, nigbati awọn agbeṣẹ funni – PIU ti ilu Ibadan yio ṣe ọfintoto bi iṣẹ na ṣe ntẹsiwaju, ati bi agbaṣẹṣe ti ṣe nbojuto didin ipa ti ko barade ku. Nitorina, o ṣe pataki ki gbogbo awọn ti ọrọ kan finufindọ pinu lati ri wipe awọn ipa ti o le ṣe ipalara ni a dinku patapata, ki idagbasoke ati igberu iṣẹ na le di eyi ti a mu daniloju.

Lati le ṣe iṣẹ yi ni aṣeyọri si rere, a reti ki awọn nkan ti o tele yii di ṣiṣe:

- ✓ Awọn olugbe agbegbe ati sakani iṣẹ atunṣe odi-Ẹlẹyẹle yii ni a gbọdọ ma kan si lore-koore,
- ✓ A gbọdọ pese awọn ohun eelo ti ndabobo ara fun gbogbo awọn oṣiṣẹ lẹnu iṣẹ na, ki a si ri wipe wọn lo wọn gẹgẹ bi o ti tọ ati bi o ti yẹ, lati din ipalara si ẹya ara ku tabi din ipadanu ẹmi ku,
- ✓ A gbọdọ ṣe idanilẹkọọ ati atundani lẹkọọ ti o munadoko fun awọn oṣiṣẹ iṣẹ-atunṣe na,
- ✓ A gbọdọ ri wipe a fun omi ka ayika ibi ti iṣẹ ba ti nlọ ni asiko ẹẹrun (ọgbẹlẹ) lati din eruku ku,
- ✓ Awọn ọkọ iṣẹ ati irinṣẹ miran ni a gbọdọ ri wipe wọn wa ni ipo ti o dara ti wọn ko ni maa ṣeefin,
- ✓ A gbọdọ ma lo awọn irin iṣẹ ti a pese lati wọn ipo iniyelori afẹfẹ ti o nfẹ ni ayika iṣẹ na, lati ri wipe ko ni ipa buburu eyikeyi lara ilera awọn oṣiṣẹ Odi na.
- ✓ Pese ile igbọnsẹ alagbeka nigbati iṣẹ atunṣe odi ba nlọ lọwọ, lati din isoro ẹgbin igbọnsẹ ku,
- ✓ Gba awọn oṣiṣẹ akolẹ-kodọti ti wọn ni onte ijọba lati bojuto awọn idọti ti wọn le jẹyọ nigbati iṣẹ nlọ lọwọ,

Ipetepero fun Bibojuto Ayika ni gbogbogboo

'Ipetepero fun bibojuto Ayika' yi ni ninu awọn ohun ti a mẹnuba nisalẹ wonyi:

Imurasilẹ fun Ilera, Idaboobo ati Ayika (HSE Plan)

'Ipetepero' yi fi ẹni ti o nbojuto ayika ni ile iṣẹPIU han gẹgẹ bi Asoju Ilera, Idaboobo ati Ayika fun iṣẹ atunṣe odi yi. Asoju yi yio ri daju wipe gbogbo awọn alaalẹ fun idaboobo awọn eniyan patapata ni a ntẹle lojoojumọ.

Eto Gbigbanisiṣẹ ati Titọnidalẹkọ

Itọdalẹkọ ti o mọyanlori ti o si jẹmọ ikẹẹkọọ lori ibojuto ayika ati agbegbe ti a ngbe ni a gbọdọ gbe dide.

Eto Ilu ati Agbegbe

Ikansi-baraẹnisọrọpọ ti o niiṣe pẹlu ifọrọlọni ati kikopa awọn ara ilu ninu iwewee-dawọle iṣẹ ni a o maaṣe loore-koore ti a o si ri wipe a tipẹlẹ mọ ṣiṣee fun gbogbo igba ti iṣẹ atunṣe yii ba ṣi nlọ lọwọ. Ọna igbaṣe ti a o mulo ni lati ri wipe a nṣe ipade deede pẹlu awọn ti wọn ngbe ni agbegbe odi omi lati mu wọn wa lojufo nipa oun ti a nṣe ninu iṣẹ atunṣe na, ati lati pese ọna lati yanju iṣoro kiṣoro ti o ba jẹyo ti o le mu ikunsinu wa. Awọn ẹlomiran ti a tun le jẹ ki wọn wa ni irufẹ awọn ipade bayii ni ninu awọn aṣoju ijọba ti o tọ lati wa nibẹ.

Eto Iṣọfintoto Amojuto Ayika ati Igbe Aye

Awọn akọsilẹ ti o wa ninu iwe yi ni yi o jẹ awokọṣe akọsilẹ fun eto isọfintoto mimojuto ayika ti a o ṣe lori iṣẹ atunṣe odi yi. Akojọpọ ni ṣoki awọn ipa ti o ṣeeṣe ki wọn na ni lowo bi a o ba saṣeyọri lati

din iṣẹlẹ wọn ku, ati iye ti a lero pe o le na ni lati se aṣeyọri pelu awọn ipa wọnyi ni a ti mudagba ti a si ṣalaye wọn labe akori yi ninu iwe yii. Ni afikun, iye ti ṣiṣe eto ofintoto si amojuto ayika le na ni, ni a tun pese. Gbogbo owo ti a woye pe a le na lati pese ojuutu ti o le din ipa apanilara lati inu iṣẹ atunṣe yi ku jẹ nkan bii miliọnu metadinlaadọrin naira (=N=67 million).

Ohun ti o wa lati ṣe	**Ẹru Iṣẹ Tani**	**Iye ti a lero pe a o na ni Naira**	**Iye ti a lero pe a o na ni US Dollars**
Idinku Ipa Apanilara	IUFMP PIU/OYSEPA	22,800,000	72,380.95
Iṣekokaari Eto	IUFMP PIU	10,000,000	31,746.03
Iṣọfintoto mojuto	IUFMP PIU/Ọjọngbọn	17,400,000	55,238.1
Itọdalẹkọọ ati Ikọnimọṣẹ	IUFMP PIU/ Ọjọngbọn	11,000,000	34,920.63
Sub- Total		***61,200,000***	***194,285.7***
Inawo Airotẹlẹ (Contingency)	Idamewa (10% of subtotal)	6,120,000	19,428.57
Total (Agbajọpọ Owo ti a o na)		**67,320,000**	**213,714.3**

CHAPTER ONE

INTRODUCTION AND BACKGROUND INFORMATION

1.1 INTRODUCTION

Severe flood events are increasingly affecting major urban centers where people and economic activities are concentrated around the globe. Dams are considered as "installations that contain dangerous forces". This is due to the massive impact of a possible destruction of human population and the environment, should the dam fail. Dam failures are comparatively rare globally, but can cause immense damage and loss of life when they occur. Prolonged periods of rainfall, ageing of dams and flooding have contributed in no small measure to many instances of dam failure. The Eleyele dam in Ibadan, Oyo State has not been spared any of the above-mentioned factors.

A major contributor to the hazard potentials of the Eleyele dam is the fact that, as a result of high urban development over the years, it is now located upstream of densely populated and highly developed areas of Ibadan city. Indeed, downstream the Ona River – on which the dam is situated, - land use development and construction have progressively reduced the flood plain of the river. As such, any failure of the Dam will therefore result in heavy loss of lives, and serious damage to homes, schools, roads, bridges, rail lines, public utilities, industries, among others.

1.1.1 The Ibadan Urban Flood Management Project (IUFMP)

Owing to aforementioned flooding events in the city of Ibadan, the Oyo State Government recognized the need for an integrated and long term solution to flooding in the city. The Oyo State Government thus requested the World Bank's support to finance a flood management project in Ibadan. Responses to past flooding events have erstwhile been piecemeal; focusing mainly on alleviating immediate and short-term needs of the residents, such as rebuilding of destroyed assets.

This among other reasons informed the establishment of the Ibadan Urban Flood Management Project (IUFMP), which aims to develop long term flood resilience in the city of Ibadan — by collaboratively identifying and implementing robust and sustainable solutions for mitigating flood risk, and improving flood preparedness.

1.2 ELEYELE DAM

Ibadan, the capital city of Oyo State and one of the largest metropolitan cities in Nigeria, is highly exposed to flooding. Notable of these flooding events was the Ogunpa disaster of 1980 which was recorded to have resulted in a death toll of about 500 people. Another flood event took place after a heavy downpour of 187.5 mm in about 4-5 hours on August 26, 2011. This flooding occasion was induced by the overflow from Eleyele reservoir causing the death of over 120 people and serious damages to infrastructure, with many bridges collapsed, roads washed away, and substantial property lost.

The Eleyele Waterworks (dam, reservoir and treatment works), was built in 1942 and commissioned in 1943. The plant had an installed capacity of 9000 m^3/day. The works were upgraded in 1959 to 18,000 m^3/day and 27,000m^3/day in 1961. Further rehabilitation works were undertaken between 1994 and 2008 that has increased the capacity to 33,000m^3/day. A summary of Eleyele Dam is presented in Table 1.1.

Table 1.1: Summary of Features of Eleyele Dam

Description	Value	Units	Remarks
Reservoir Capacity	7	Mm^3	With a fetch of 2.4km
Surface Area	160	ha	With a catchment area of 320 sq. km
Embankment Crest	14.5	m	
Full Supply Level (FSL)	182.3	m asl	
Gated /not gated spillway crest level	182.3	m	Un-gated Ogee weir spillway
Capacity of Free discharge weirs	367.9	m^3/s	Design flood
Total length of Embankment	244	m	Embankment 138m plus 106m for spillway
Maximum height of foundations	185.4	m asl	
Crest width	4.5	m	Overlaid centrally with 1.5m wide concrete walkway which adjoins a concrete block -work barrier on the upstream side.
Downstream slope gradient	2.1H/1V		
Intake tower	180.6, 177.6 and 174.6	m nasl	with three intake elevation levels

Source: Eleyele Dam Safety Inspection Report, 2016

The dam's embankment has a total length of 244m (embankment 138m plus 106m for spillway) and a crest height of 13.0m. The dam crest has an average width of 4.5m. The crest is overlaid centrally with 1.5m wide concrete walkway which adjoins a concrete block-work barrier on the upstream side. The over-flow of the reservoir is controlled by an un-gated Ogee weir spillway. The length of the spillway is 106m with a crest height of 14.5m, and design flood capacity of 367.9m^3/s. The overflow is directed downstream to a concrete-lined tailrace canal which also acts as flow energy dissipater by means of a series of concrete steps.

To this end, the Oyo State Government proposes to rehabilitate the Eleyele dam on Ona River to enhance the dam's capability to support potable water production and forestall future dam failure. In pursuit of this proposed rehabilitation exercise, IUFMP engaged the services of Triple "E" Systems Associates Limited to carry out an Environmental and Social Impact Assessment (ESIA) for its proposed rehabilitation of Eleyele dam situated on the Ona River in Oyo State. The ESIA is in line with the World Bank Environmental Safeguard policies, Nigerian national regulations as well as the Oyo State Ministry of Environment regulations.

1.2.1 Proposed Rehabilitation Works

The following comprises the proposed Emergency Rehabilitation works on the Eleyele dam:

i. Rehabilitation of the weir wall, where a section of base slab is missing at the toe.
j. Remedial works at the spillway trough and downstream channels repair of the base slab within the trough section and also the spillway channel down to the confluence with the scour channel.
k. Removal of debris and vegetation including trees within the spillway and spillway channels where these are currently impeding the design capacity of the spillway.
l. Repairs of the access road drainage and as a matter of priority reinstatement of the backfill to the retaining walls downstream of the footbridge would be carried out.
m. Full and detailed assessment of the operating and guard valves and there operating mechanisms.
n. Repair of all defects on the embankment.
o. Repair of the intake tower Scour tunnel.

1.3 PROJECT LOCATION

The Eleyele Dam is situated upstream on River Ona, in the city of Ibadan within Geographical Coordinates: Latitude 7°20' - 7°25'N, and Longitude 3°51' - 3°56' E. It falls within the Ido LGA of Oyo State. The dam is an earth dam constructed along the Ona River at Eleyele community in 1942 for the supply of raw water for treatment at the Eleiyele Waterworks to provide potable water for the city of Ibadan, and also to act as flood control during high flow periods through its reservoir holding capacity.

Eleyele waterworks is located at the close end of Waterworks road which is accessed through Eleyele roundabout on Sango-Eleiyele Road, just downstream of the confluence of River Ona and River Alapata. Eleiyele Dam and the treatment plant are in the same vicinity and in the proximity of settlements around the area. The Ona River on which the dam is built traverses many locations within Ibadan Metropolis and goes as far as Apata and Omi-Adio. The reservoir is surrounded by a variable margin of woodland beyond which is urban development on all sides of the reservoir. Figure 1.1 presents the map of the Project Area showing Eleyele dam on Ona River.

1.4 OBJECTIVES OF THE ESIA

The objectives of the ESIA study can be summarized as follows:

a. To obtain baseline information on the biophysical and socio-economic conditions within and around the proposed project area;
b. To evaluate the associated and potential impacts of the proposed dam project on the biophysical and socio-economic conditions of the project area;
c. To recommend cost effective and fit-for-purpose mitigation measures to minimize or completely eliminate the identified negative impacts;
d. To develop environmental management plans; including monitoring programs for the various implementations phases of the proposed project; from site preparation to operation, as well as plans for possible decommissioning of closure;
e. To provide a database for performance evaluation and other relevant future references;

f. To consult with all relevant stakeholders in order to capture their interests and their possible roles/participation in ensuring the overall success of the proposed dam rehabilitation project.

The ESIA study focuses on the following:

i. Acquisition and review of relevant existing literature and related studies to ascertain their conformance with National regulations and international best practices. Relevant literatures include, Environmental and Social Management Framework, Resettlement Policy Framework, Eleyele Dam engineering designs, Ememergency Preparedness Plan, Project Implementation Manual, Project Appriasal Document, Dam Inspection Report as well as Inspection and Safety Reports.
ii. Data and Information acquisition on the social and biophysical environmental characteristics of the proposed project area. Data and information collected include, but not limited to the following:
    a. Elements of the physical environment, including: climate and meteorology, ambient air quality/noise, surface and groundwater quality, vegetation and wildlife, soil, hydrobiology; and
    b. Human environment attributes including socioeconomics, demography, cultural values, land use, concerns and interests of potential affected persons/communities, and living conditions.
iii. Evaluation of the engineering and technological attributes of the project as well as other ancillary facilities. These will facilitate good understanding of the potential environmental impacts sources from the project;
iv. Assessment of all potential and associated (positive and negative) environmental and social impacts from all the activities involved in the rehabilitation project;
v. Development of appropriate, practicable and cost effective mitigation measures for all identified negative impacts. The measures will be designed to either completely prevent or ameliorate negative impacts to barest minimum;
vi. Preparation of appropriate and cost-effective environmental and social management plan that will cover both short and long-term scenarios. It will equally include monitoring plans with estimated cost to ensure compliance to the prescribed mitigation measures and identification of residual impacts with the aim of improving on management approach.
vii. Development of appropriate remediation options in the event of project closure or decommissioning of the proposed project.

1.5 PROJECT EXPECTED LIFESPAN

The proposed Eleyele dam rehabilitation project is anticipated to be sustained for not less than 50 years.

1.6 REGULATORY FRAMEWORK

The legal and regulatory framework that governs this ESIA study covers both national and international environmental guidelines and regulations such as the World Bank, International

Treaties and Conventions (to which Nigeria is a signatory), other national institutions and relevant agencies saddled with the responsibilities of enforcing required stipulations relating to the proposed dam rehabilitation project.

Some of these regulations include guidelines such as those of the Federal Ministry of Environment (FMEnv), Oyo State Ministry of Environment, Ministry of Water Resources, Oyo State Water and Sanitation Agency, Oyo State Ministry of Works, Oyo State Ministry of Physical Planning & Urban Development, Oyo State Ministry of Health, Oyo State Emergency Management Agency, Oyo State Solid Waste Management etc. International regulations to which Nigeria is signatory to such as relevant World Bank operational policies etc also guided this study. Summary of on these regulations are presented in Table 1.2.

Table 1.2: Summary of Applicable National Legislations

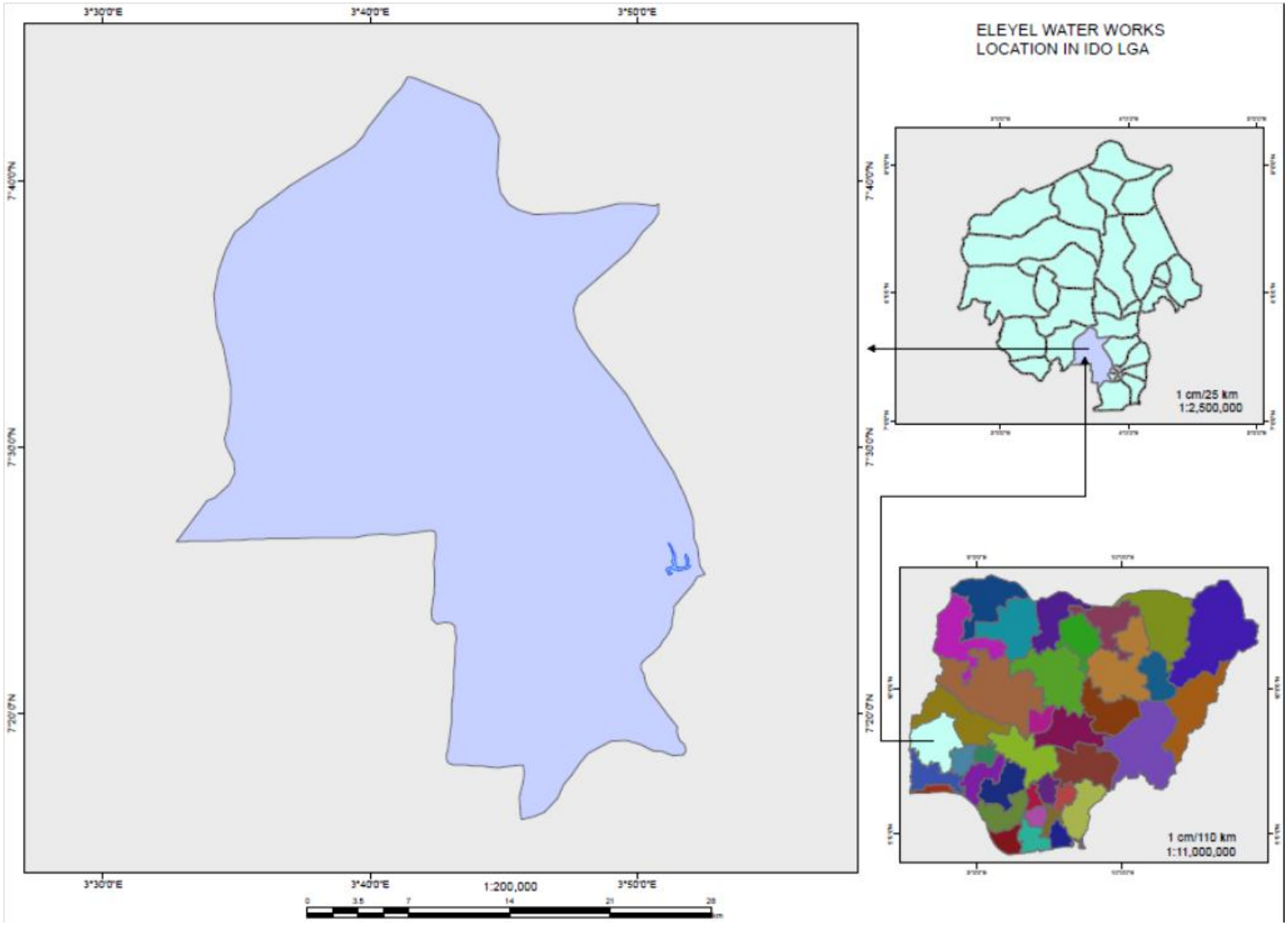
S/No	Applicable Regulations	Year adopted
National		
1.	Federal Ministry of Environment (Formerly FEPA) Act No.58	**1988**
2.	Environmental Impact Assessment Act Cap E12 LFN	**2004**
3.	EIA Sectoral Guidelines	**1995**
4.	National Water Policy	**2000**
5.	Water Resources Decree 101	**1993**
6.	National Water Policy	**1995**
7.	Natural Resources Conservation Council Act 286	**1990**
8.	National Environmental Protection Regulations: • S. I. 8 National Environmental Protection (Effluent Limitation) Regulations. • S.I.9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations • S.I.15 National Environmental Protection (Management of Solid Hazardous Wastes) Regulations	**1991** **2004** **1991**
9.	Harmful Wastes (Special Criminal Provisions etc.) Act	**2004**
10.	Forestry Law CAP 52	**1994**
11.	Factories Act-CAP. F1 L.F.N.	**2004**
12.	National Environmental Standards and Regulations Enforcement Agency	**2007**
13.	The National Policy on the Environment	**1989**
14.	Landuse Act	**1978**
15.	Endangered Species Act No. 11	**1985**
16.	Revised National Health Policy	**2004**
17.	National Inland Waterways Act	**1997**
18.	River Basin Development Authority	**1976**
19.	Oyo State Ministry of Environment	
20.	Oyo State Ministry of Water Resources	**2011**
21.	Oyo State Emergency Management Agency (OYSEMA)	**2008**
22.	Oyo State Waste Management Authority	**1992**

S/No	Applicable Regulations	Year adopted
National		
International		
1.	World Bank OP/BP 4.01: Environmental Assessment (EA) Source Books	**2001**
2.	World Bank OP/BP 4.04: Natural Habitats	**2001**
3.	World Bank OP/BP 4.07: Water Resources Management	**2001**
4.	World Bank OP/BP 4.11: Physical Cultural Resources	**2001**
5.	World Bank OP/BP 4.12: Involuntary Resettlement	**2001**
6.	World Bank OP/BP 4.37: Safety of Dams	**2001**
7.	World Bank OP/BP 17.50: Public Disclosure	**2001**
8.	United Nation Framework Convention on Climate Change (UNFCCC)	**1992**
9.	Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal	**1987**
10.	Protocol Concerning Cooperation in cases of Emergency in the West and Central African Region	**1981**
11.	Convention Concerning the Protection of the World Cultural and National Heritage (World Heritage Convention)	**1972**
12.	Convention on wetland of international importance, especially as water habitat, RAMSAR, 1971	**1971**
13.	Convention on Biological Diversity, Rio de Janeiro	**1992**
14.	African Convention on the Conservation of Nature and Natural Resources, Algiers	**1968**

1.7 STRUCTURE OF REPORT

This report presents the findings emanating from the ESIA conducted at on Proposed Eleyele dam rehabilitation project. It elucidates an outline of the proposed project, a description of the baseline conditions around the project area, the associated and potential impacts of the project and mitigation options for negative impacts as well as a sound and cost-effective environmental and social management plan for the project. The report is arranged as follows:

- Prelimnary pages (Cover Page, Table of Contents, List of Figures, List of Tables, List of Plates and List of Acronyms.
- Executive Summary
- Chapter One: Introduction and Background Information
- Chapter Two: Project and Process Description
- Chapter Three: Baseline Conditions
- Chapter Four: Consultation and Public Participation
- Chapter Five: Potential Impacts and Mitigation Measures
- Chapter Six: Environmental and Social Management Plan
- Chapter Seven: Decommissioning and Remediation Plan
- Chapter Eight: Conclusion and Recommendations
- Appendices



(Source: Triple E; GIS/Fieldwork, March 2016)

Figure 1.1: Map of the Project Area Showing Eleyele Dam on Ona River

CHAPTER TWO

PROJECT AND PROCESS DESCRIPTION

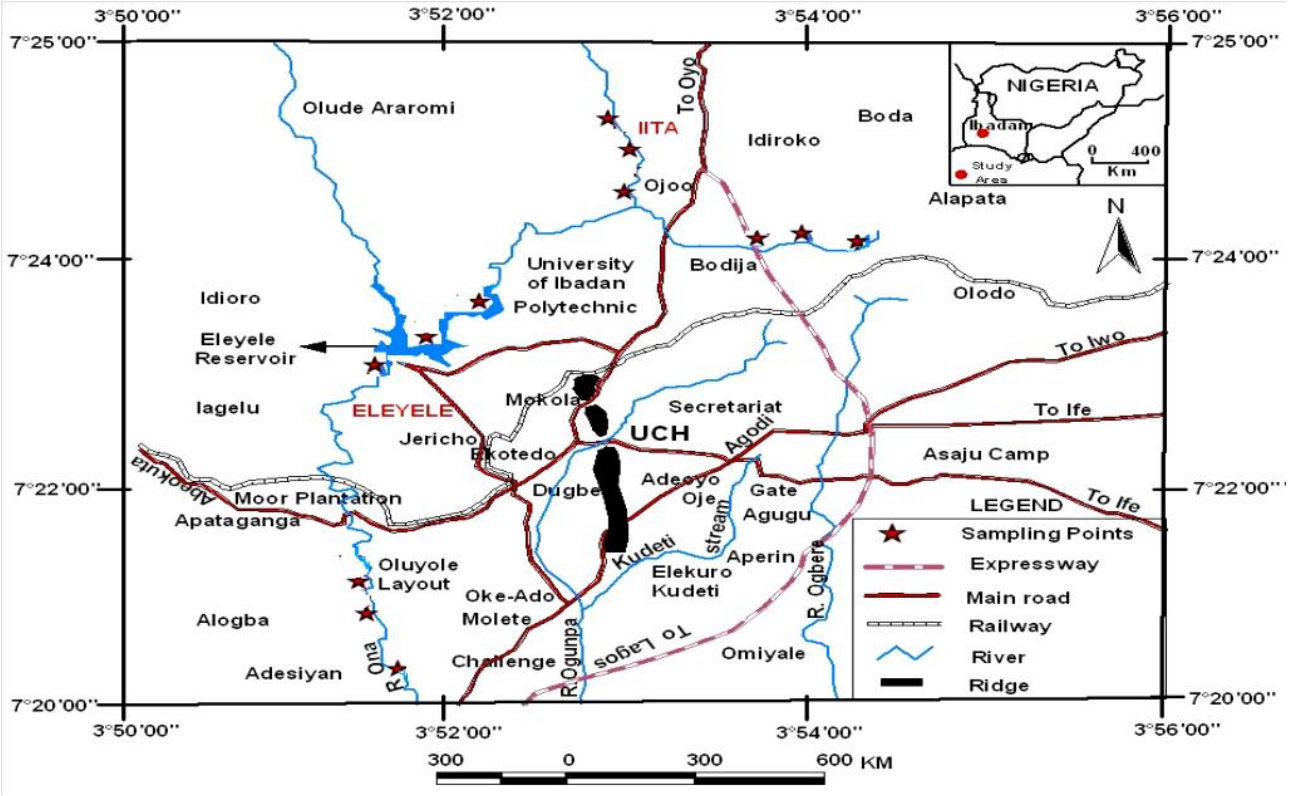
2.1 ASSESSMENT OF EXISTING DAM INFRASTRUCTURE

During the data collection and site assessment, certain infrastructures were observed to be in state of disrepair. Some of these infrastructures include:

- A 138 m long embankment about 14.5 m high. The crest has an average width of 4.5m and is partly covered by a central 1.5m wide concrete walkway bordered by a concrete block work wall on the upstream side;
- A 106 m long free overflow concrete spillway of 13.0 m height, designed for a capacity of some 368 m^3/s;
- A lateral concrete spillway chute channel which receives and returns the overflow to the Ona River through a series of concrete steps;
- An intake structure located upstream of the dam embankment equipped with gates and their operating systems.
- A tunnel under the embankment functioning for flushing accumulated sediment (scour tunnel) through which the draw-off pipe to the treatment plant runs.
- A return channel joining the tunnel with the river.

2.2 DESCRIPTION OF ELEYELE RESERVOIR

- Eleyele reservoir is located to the north-west of the Ibadan City centre bounded by Eleyele urbanisation in the south, the areas of Apette in the east, Awotan in the north and Ologuneru in the north-west.
- The catchment area of the reservoir is about 320 km^2 while the lake surface area is 160 ha and a fetch of 2.4km.
- The reservoir capacity of the Lake is 7MCM and the maximum reservoir yield is about 2700cu.m/day. The catchment area is shown in figure 2.1.
- The River is also abstracted by the Oyo States Water Corporation at Eleyele Treatment Works for treatment and supply of potable water to Ibadan's people.
- The surrounding area of the reservoir is made up of light forest with a wetland margin around the perimeter of the lake.



Source: Triple E, 2016

Figure 2.1: Eleyele Catchment Area

2.3 ELEYELE DAM DETAILS

- The reservoir is contained by an earth fill embankment and side channel ogee spillway with the line of the spillway crest an extension of the center line of the embankment.
- The embankment section is 138 m long with a quoted maximum crest height of 14.5 m.
- The downstream slope was constructed to an angle of 2 horizontal to 1 vertical slope. At the toe, the slope meets natural ground, which within the central part of the embankment is relatively flat. Within the central lower slope the slope was covered by flat platy rockfill, 300 to 400 mm size.
- The crest width is measured to be approximately 2.85 m with 1.1 to 1.2 m high solid concrete block work wall founded on a concrete strip, which divides the crest width into a 1.8 m wide strip on the downstream side and a 0.8 m wide strip on the upstream side.
- The concrete kerb strip runs along the crest to define a crest path of 1.3 m width with a set of concrete steps leading from the toe to the crest of the embankment at the left end.
- The exposed area of upstream slope above reservoir water level is constructed to an angle of 1 horizontal to 1 vertical.
- Crest level to reservoir water level (just spilling) was about 1.48 m.
- The intake tower is equipeed with: one metallic access bridge, three metallic floors, Three level of intake pipes, one raw water pipe to supply the water treatment plant and one bottom outlet pipe.
- The dam has been under operation for more than 70 years since it was built in 1942.

- The dam is built along the Ona River at Eleyele community in to supply raw water for treatment to Eleyele Waterworks.
- The treated water is conveyed to the city for various uses. Also, the dam serves as flood control during high flow periods through its reservoir holding capacity.

2.4 COMPONENTS OF THE PROPOSED REHABILITATION WORK

In this section we present brief description of the major components of the dam that will undergo rehabilitation. The components that required rehabilitation works include:

- Weir wall
- Spill way
- Access road drainage
- Embankment
- Scour tunnel
- Intake tower

Summary description of the dam features enumerated above is presented below:

2.4.1 Weir Wall

- Constructed with concrete and divided in to sections by construction joints.
- Ogee section is built with a monolithic block with a joint just beyond the lower curved transition where it adjoins the spillway trough base slab.
- The down slope side of the trough is at an angle of 1 horizontal to 1 vertical and lined by concrete revetment panels.
- At the downstream end of the spillway trough as it turns there is a transition from sloping wall on the left side to a vertical wall retaining wall.
- On the right side there is a transition from a vertical wall to part sloping and part vertical.
- Within the stepped section of the spillway channel the left vertical wall is of concrete construction.
- The right wall has a lower sloping part of concrete revetment slabs with a vertical section of crib wall construction.

2.4.2 Spillway

- Comprises a free overflow side channel spillway with ogee shaped crest with length of about 106 m.
- Maximum ogee wall height is 5.2 m from crest to level of trough base slab.
- Design flood is quoted as 367.9 m^3/s.
- Side channel spillway varies in base width from 1.4 m at the far left end, where the ogee wall height is a minimum to 12.5 m.
- At the downstream end of the spillway trough the spillway channel turns through an angle of about 65° where the channel becomes of constant base width and of straight alignment to re-join the original stream channel invert after a distance of about 65 m.
- From the end of the spillway trough to the original stream channel invert the channel drops down in series of steps. At each of the steps is a low height wall across the channel to create a pond upstream of each step.

2.4.3 Access Road Drainage

- Access is via tarmac roads through the Eleyele urbanisation, off the Sango Eleyele Road.
- Within the waterworks is the main access road that passes the works and is routed past the downstream side of the spillway and circles the waterworks.
- Pedestrian access to the embankment, spillway and draw-off tower is via a footbridge over the spillway channel just downstream of the trough section.

2.4.4 Scour Tunnel

- Exit beyond the toe of the embankment at a distance of about 15 m.
- The scour tunnel is an approximate standard 'D' shape with a width of 2.3 m and height of 2.2 m.
- The tunnel length is about 56 m with a straight alignment.
- The tunnel is constructed with a thick masonry lining with cement screed surfacing. The raw water pipe to the treatment works is located within and on the left side of the tunnel.
- The trapezoidal drainage channel meets the river channel just below the end of the stepped section of the spillway channel.
- Overall length of scour channel is approximately 55 m. The side slopes of the drainage channel are at a slope of 1 horizontal to 1 vertical and lined with grouted stone pitching to full height.
- The headwall has a 50 mm diameter pipe exiting the wall.

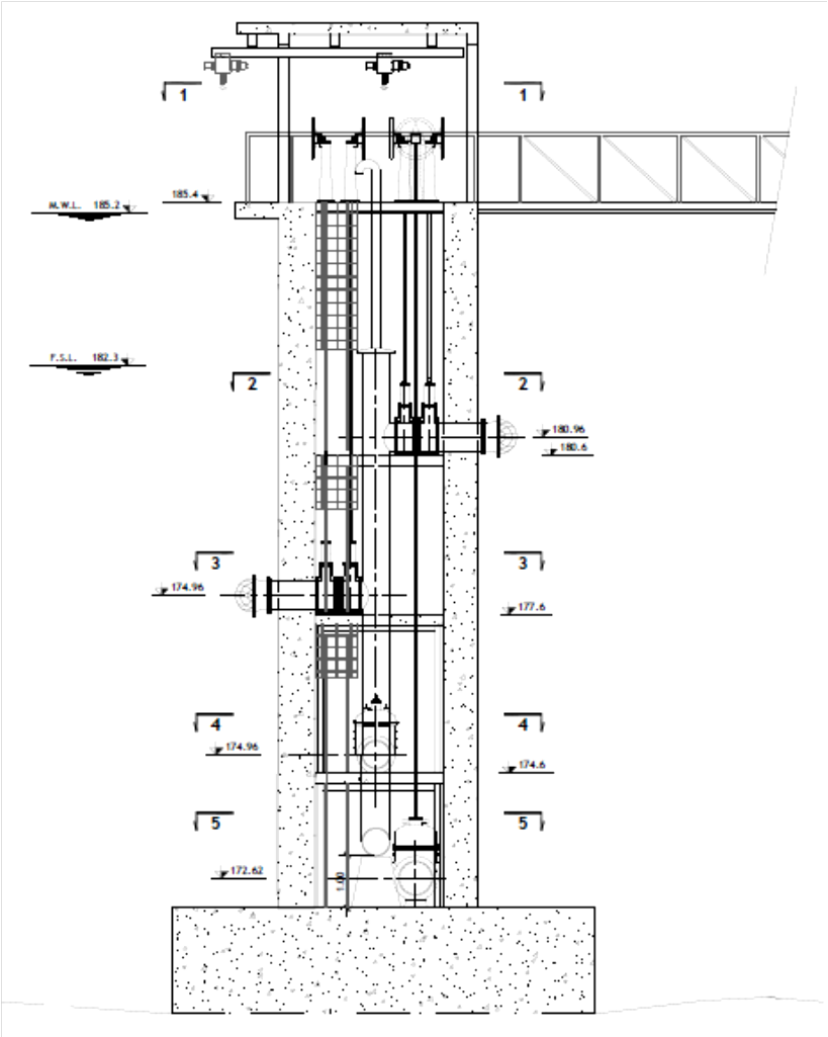
2.4.5 Embankment

- Embankment length and height of about 138 m and about 14.5 m respectively.
- Crest average width of 4.5m and partly covered by a central 1.5m wide concrete walkway bordered by a concrete block work wall on the upstream side.
- Crest width measures approximately 2.85 m. The crest has a 1.1 to 1.2 m high solid concrete blockwork wall founded on a concrete strip, which divides the crest width into a 1.8 m wide strip on the downstream side and a 0.8 m wide strip on the upstream side.
- Concrete kerb strip running along the crest to define a crest path of 1.3 m width.

2.4.6 Intake Tower

- Plays two primary functions; water supply and dam safety
- The intake tower has three intake levels (at Elevations 180.6 m asl, 177.6 m asl and 174.6 m asl) and receives water at any levels depending on water elevation per time.
- The objective of these three levels of intake is to always take the best quality of raw water (in term of turbidity and suspended matters
- He intake tower also protect the dam in case of imminent failure of the dam to rapidly lower the water level. The bottom outlet valves are used in this case to rapidly empty the reservoir
- The intake tower is equipped with: one metallic access bridge (from the dam crest to the intake tower); three metallic floors; three levels of intake pipes; one raw water pipe to supply the water treatment plant; and one bottom outlet pipe.
- The intake tower is not equipped with any electrical equipment (no light, no sensors, and no electrical actuators on valves).

An illustration of proposed rehabilitated intake tower is presented in figure 2.2.



(Source: Detailed esign report – Intake rehabilitation, October 2016)

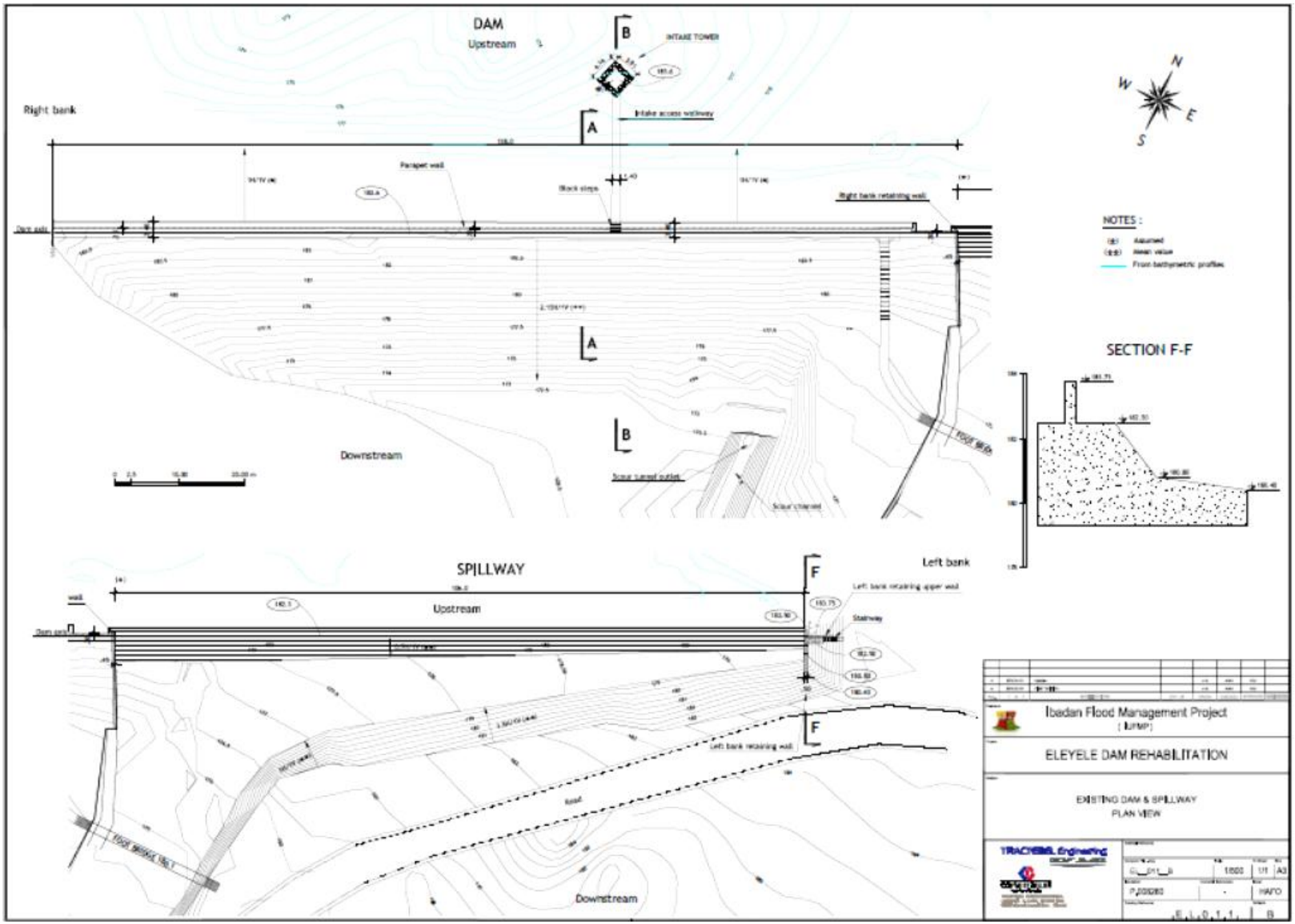
Figure 2.2: Illustration of Rehabilitated Intake Tower

2.5 THE PROPOSED REHABILITATION WORK

Major components of Eleyele dam are in the state of disrepair and cannot function optimally hence the plan for rehabilitation.. The proposed rehabilitation encompasses the under listed components:

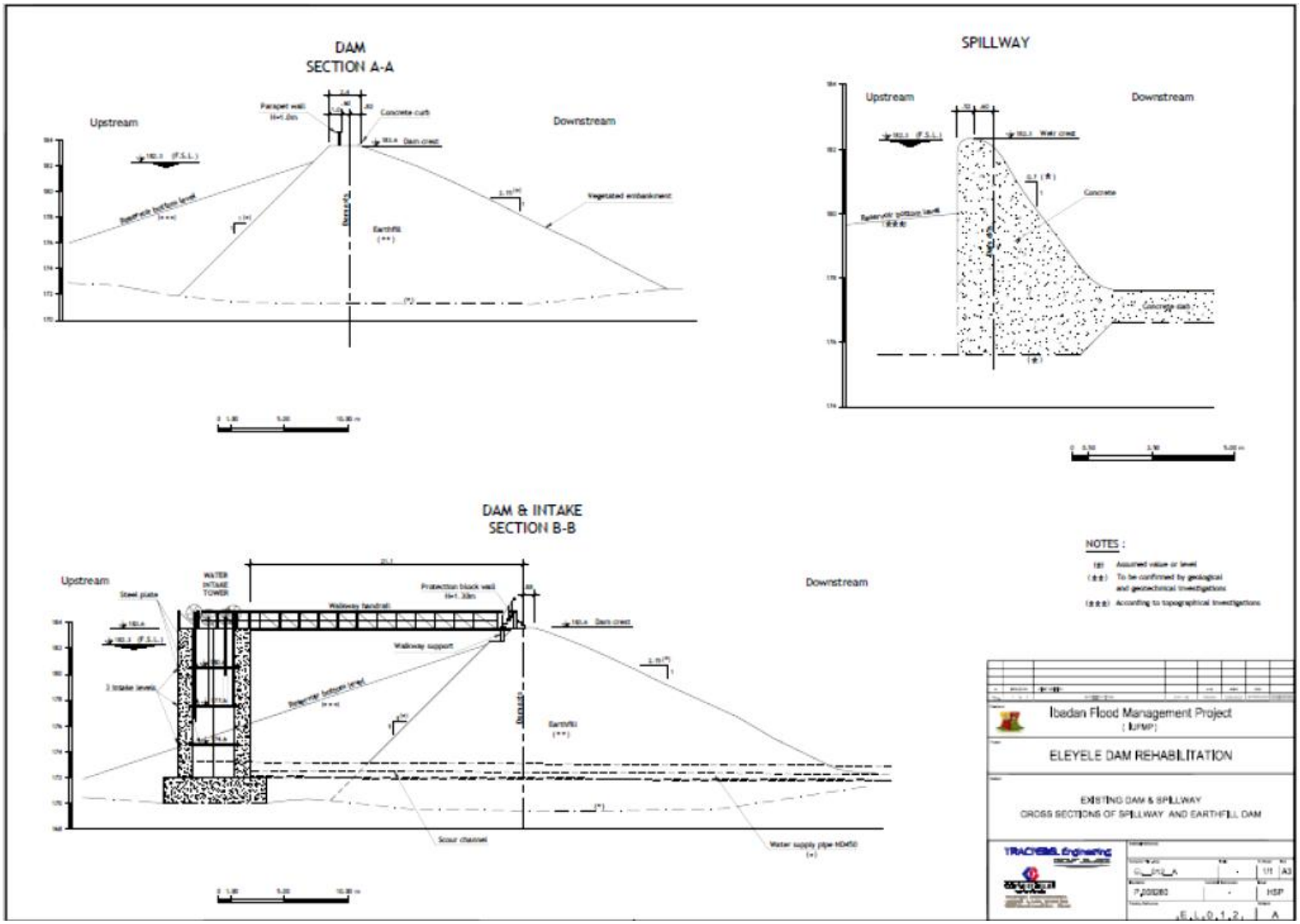
- The Eleyele reservoir on Ona river;
- The Eleyele dam;
- The water intake structure upstream of the dam embankment equipped with gates and their operating systems;
- The tunnel under the embankment functioning for flushing sediments (scour tunnel) through which the draw-off pipe to the treatment plant runs;
- The 106 m long and 13 m high free overflow lateral concrete spillway;
- The lateral concrete spillway chute channel which receives and returns the overflow to the Ona River through a series of concrete steps;
- A return channel joining up the tunnel with the river.

The proposed rehabilitation project of Eleyele dam is presented in figures 2.3 and 2.4.



(Source: Detailed design report of Eleyele dam rehabilitation, May 2016)

Figure 2.3: General Layout of Eleyele Dam Proposed Rehabilitation Project-Plan View



(Source: Detailed design report of Eleyele dam rehabilitation, May 2016)

Figure 2.4: Cross-Section of Existing Earth-fill dam & spillway

2.6 ADEQUACY OF REHABILITATION WORKS DESIGN FROM A DAM SAFETY PERSPECTIVE

ITEM	DESCRIPTION	REVIEW HIGHLIGHTS	COMMENT
Design Flood		Design Flood with a return period of 10,000 years was used in the upgrade design.	For the dam size and high hazard potential, Probable Maximum Flood (PMF) would have assured that failure is improbable. Thus there is still a risk of failure once in 10,000 years. The reservoir volume loss could not be assessed as no bathymetric survey has been conducted of the whole reservoir since its commissioning in 1942. There is thus a probability that the Area-Capacity-Elevation curve is optimistic. Furthermore, storm precipitation data was not available leading to flood estimation from mean monthly rainfall using NRCS method. These factors introduce uncertainty in the results.
Spillway	Discharge capacity	The current spillway is designed for a peak inflow of 368 m^3/s. It's capacity is proposed to be increased to contain a peak inflow of 1269 m^3/s by raising reservoir level. This raises head allowable over spillway and provides sufficient freeboard for the design condition. Peak outflow over spillway would move up from 821 m^3/s to 1068 m^3/s,.	The design of the rehabilitation works is adequate for the design flood adopted.
	Stability	Stability of the spillway after rehabilitation, was checked and necessary measures to ensure this were proposed in Section 7.3 of Detailed Design	

ITEM	DESCRIPTION	REVIEW HIGHLIGHTS	COMMENT
		report	
Embankment	Failure Mode Assessment	The embankment was checked to ensure stability of upstream and downstream slopes under the worst conditions, using Geostudio 12 and SLOPE/W software.	It is not clear if failure due to piping was taken into account by the software used. Also, the analysis established stability in a rapid drawdown situation only if initial water level is not more than 180 m asl. There is thus risk of failure of dam upstream slope if there is a rapid drawdown of reservoir from an initial water level that is more than 180 m asl.
	Seepage estimation	The seepage rate through dam was not estimated	Experience does not indicate seepage to be a problem. In any case this does not pose any safety risk.
Downstream River channel	Flow capacity	Measures to enhance channel capacity to convey design flow were proposed for Stilling basin, scour channel and river channel, in Section 7.4 to 7.6 of Detailed design report	The design of the rehabilitation works is adequate for the design flood adopted.

2.6.1 Necessary Immediate Maintenance Measures for the Safe Operation of Eleyele Dam

ITEM	DESCRIPTION	REVIEW HIGHLIGHTS	COMMENT
Reservoir	Upstream	The boundary banks of the lake are covered by weeds to thick forest where there is no development Surface erosion of the medium to coarse sand occurs in developed areas, depositing silts into the lake Lake surface is covered with water hyacinth the quantity of which is inversely proportional to the discharge flow	Re-grassing of the reservoir banks a few kilometres upstream of the dam is necessary. Measures to remove water hyacinth and prevent its future growth, and to remove vegetation within the reservoir and adjacent to the spillway, should be taken.

ITEM	DESCRIPTION	REVIEW HIGHLIGHTS	COMMENT
		Vegetation within the reservoir and adjacent to spillway is an important hazard to dam safety	.
	Size	Siltation may reduce reservoir size over time	There is need to put in place regular de-siltation process
	Intake structure	The link bridge between the embankment and the intake structure is rusty and unsafe for use.	A replacement for the assess bridge is required.
	Intake structure	The valves for the scour and water abstraction are faulty and not adequately protected from damaging.	There is need to replace faulty valves and overhaul the washout system.
	Miscellaneous	The catchment of the lake is threatened by the people settlement due to high rate of Ibadan Urbanization	Encroachment of lake land should be prevented
Embankment	Upstream Slope	.The embankment slope upstream is regular and stable. There is no movement.	There is need for replacement of missing embankment stone-pitches
	Crest	The crest is stable, no movement except the left end adjacent to the spillway where there are cracks on the blockwall.	
	Downstream Slope	The embankment is stable and no sign of seepage. There was no sign of dampness at the downstream of the embankment	
Spillway	Ogee Crest and Retaining wall	No sign or trace of any movement or settlement of the ogee spillway or the embankment. The expansion joint aids the growth of weeds during dry season when the rate of discharge is low.	Rehabilitation should include the sealing of the expansion joint to avoid the growth of weeds
	Bottom slab downstream	A bay of the slab has collapsed. Collapse of bottom slab of the spillway	Collapsed slabs should be reconstructed.
	Chute	The chute upstream of the collapsed base slab is okay. Possibility of its failure may start from joint of the collapsed slab	There is need to properly anchor the slab
Spillway downstream	River channel downstream	"Vegetation clearing is necessary along the Ona river from the dam to the Ologun Eru bridge that means cutting trees without uprooting in the main channel.	The river channel downstream of the dam should be cleared of all encumbrances,

ITEM	DESCRIPTION	REVIEW HIGHLIGHTS	COMMENT
		Rehabilitating the existing protection walls is also necessary along the Ona river..”	including vegetation, debris, etc
		Log of wood carried by flood and crossed by the bridge at Ologun Eru Road.	
	Transition channel	To transit from the bottom of the spillway to the natural river channel is a channel comprising of base slab and concrete-lined embankment. The base slab consists of four gravity cascading system with wall breakers beam across. The wall breaker has collapsed due to probably faulty design or construction errors. On the right hand side of the channel, the embankment wall has collapsed and this can lead to erosion of the bank. On the left hand side is a threatened embankment and retaining wall with a cavity at its back due to the 2011 flood.	Proper attention must be given to the construction of the channels to be able to protect and break the speed of the discharge from the spillway.
	Wash out	As at the time of investigation, the washout valve was not functioning	There is need to overhaul the washout system.
	Intake structure	The access bridge from the embankment to intake has corroded. The intake valves not functioning	The access bridge need to be replaced and facilities of the intake structure need to be rehabilitated in line with the intake rehabilitation detailed design report.
Others	Drainage system	The drainage channel discharging run-off from the hilltop of the water works into the river channel on the right hand side has collapsed at point of discharge into the river course.	The drainage channel at point of discharge into river should be reconstructed

2.6.2 Recommendations for the Regular Operation and Maintenance of Eleyele Reservoir to Ensure Safety

The operation and maintenance of the dam is very important for its safety. Following are recommendations about operation and maintenance practices that will enhance the safety of Eleyele Dam.

- Reservoir Operation

  There is a need to develop reservoir operating rule to optimize water releases for use and flood protection. This ensures that there will be a good balance between availability of water for use and availability of space in the reservoir for flood mitigation and hence safety.

- Monitoring

  In addition to the monitoring recommendations in Section 7 of the Design Report, there should be routine physical monitoring and/or instrumentation with appropriate warning/alarms systems for Headwater and Tailwater levels, Horizontal and Vertical Alignment of dam and dam settlement. Proper measurements of water levels at short intervals during floods, short duration rainfall measurement in the catchment are also desirable. As part of the schedule of the station officers, records of the flood level must be taken and kept. This will aid forecasting water level in the reservoir and downstream river channel.

  Reservoir silt survey should be done at regular intervals and the area-capacity curve of the reservoir should be accordingly revised. If some major slides/mishaps take place in the reservoir which considerably affect its capacity, silt surveys must be conducted immediately thereafter. These surveys should be more frequent in the initial years so as to know the trend of silting (sedimentation).

- Maintenance

  There should be a maintenance schedule and records for Control Gates and Operating Machinery, Approach and Outlet Channels, Drainage, Safety and Performance Instrumentation, Headwater and Tailwater Gages, Horizontal and Vertical Alignment Instrumentation, slope protection, spillway structures, Stilling Basin (Energy Dissipators).

  It is important to check the spillway outflow rating as well as the carrying capacity of the river channels downstream of the spillway regularly at an interval of no more than five years.

CHAPTER THREE
BASELINE CONDITIONS

3.1 BASELINE ENVIRONMENTAL CHARACTERISTICS OF THE PROJECT AREA

3.1.1 Climate and Meteorology

Ibadan, which is located in south-western Nigeria, lies completely within the tropical forest zone but close to the boundary between the forest and the derived savannah. The climate of Ibadan is tropical with distinct wet and dry seasons and a mean minimum annual temperature of 20.9°C. Between April and October, the prevalent winds in the city is the moist maritime South-west monsoon which blows inland from the Atlantic Ocean, this is the period of rainy season. November to March is the period of dry season when the dry dust laden winds blow from the Sahara desert during which the city experiences harmattan, which climatically influences many cities in West Africa, is less pronounced in the area. Since the project site is located in Oyo State, meteorological data obtained from the Nigerian Meteorological Agency (NIMET), whose averages are presented in Table 3.1 was considered.

Table 3.1: Climatic Data Averages of the Project Area (2005 - 2014)

Month	Rainfall (mm)	Wind Speed (m/s)	Relative Humidity (%) A.M	Sunshine (hrs)	Temperature (°C)	
					Tmin	Tmax
Min	2.56	3.76	68.90	3.93	20.93	27.75
Max	243.81	6.39	88.50	7.30	22.98	34.77
Mean	120.47	5.19	81.81	5.67	21.96	31.45

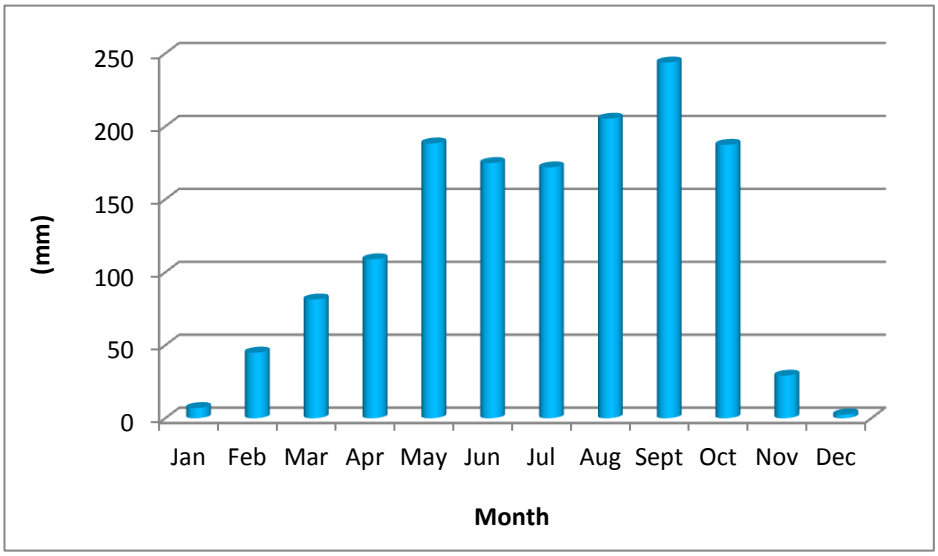
Source: NIMET, 2005-2014

Rainfall

Of the two seasons identified: the rainy season (April to October) and the relatively dry season (November to March) with an annual average rainfall of 120.5mm, only the months of December and January truly qualifies as dry season months in the area (Figure 3.1). Rainfall pattern shows two rainfall peaks in May and September, Rainfall is heaviest during the months of August and September.

Relative Humidity

Relative humidity (RH) in the study area was observed to be relatively constant ranging between 68.9-88.5% at 09:00 Hrs with an aaverage of 81.8% (Table 3.3). The relative humidity in the area is lowest in the months of December to March, while the maximum levels are within June-September (Figure 3.2). The measured relative humidity of 58.6 – 78.9% with an average of 67.2% at 9:00 Hrs recorded during the fieldwork (Table 3.2) compare with the data provided by NIMET on project area for the month of March.



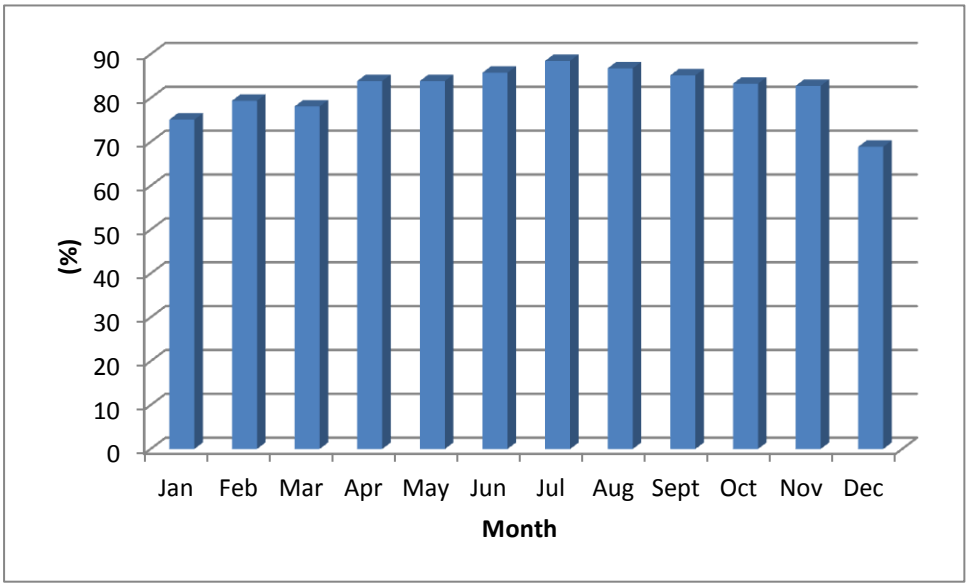
Source: NIMET, 2005-2014

Figure 3.1: Rainfall Characteristics of the Study Area

Table 3.2: Measured Field Meteorological Average Data within Project Area, Eleyele

Sampling Locations	Temperature	Relative Humidity
	(°C)	(%)
Min	29.7	58.6
Max	35.3	78.9
Mean	32.61	67.21

Source: Fieldwork, March 2016



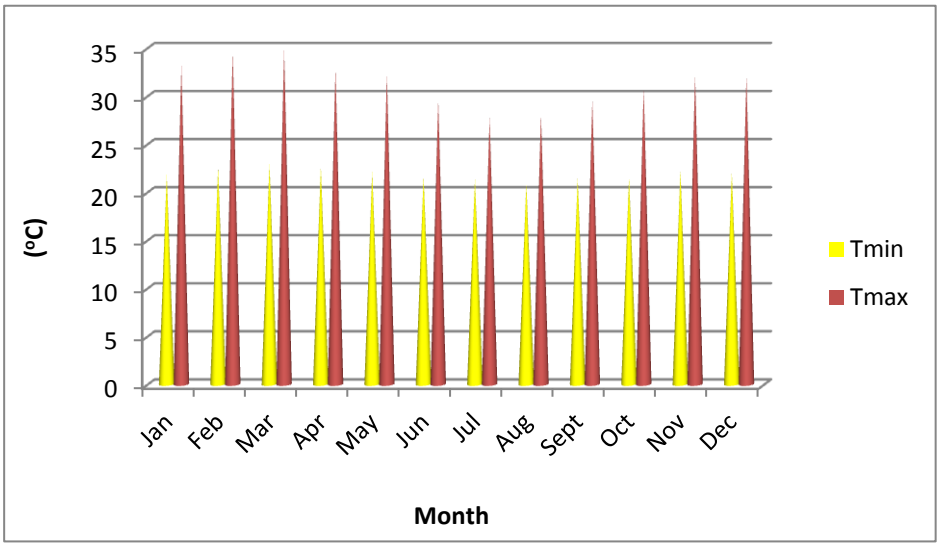
Source: NIMET, 2005-2014

Figure 3.2: Relative Humidity at the proposed project area

Temperature

The monthly average temperatures ranged between 20.9-23.0°C for minimum temperature and 27.8-34.8°C for maximum temperature, while the mean yearly minimum and maximum temperatures were 22.0^{0}C and 31.4^{0}C respectively. The lowest temperatures were recorded in the

months of July and August while the highest temperatures were recorded from November to April (Figure 3.3). During field survey, the atmospheric temperature range of 29.7-35.3^{0}C with an average of 32.6^{0}C was obtained which compares with the available temperature data of the study area.

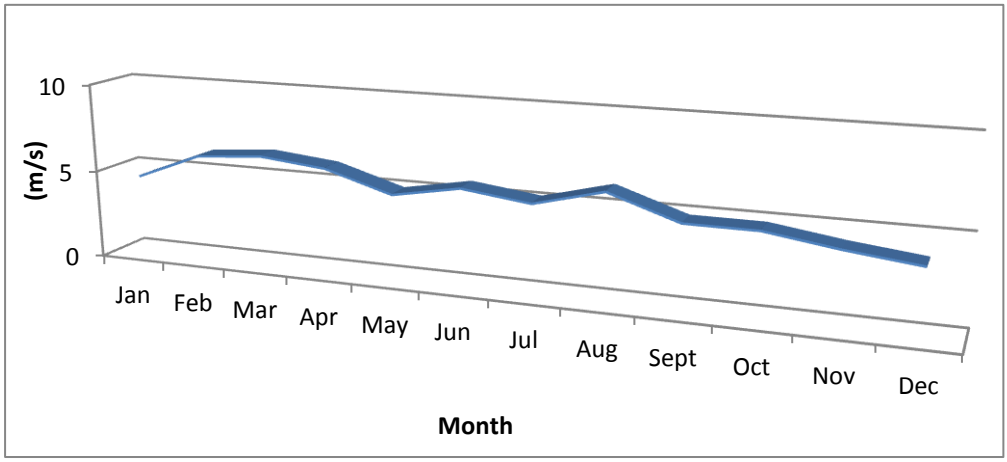


Source: NIMET, 2005-2014

Figure 3.3: Temperature characteristics of the Study Area

Wind Speed and Direction

The surface wind data distribution of the Study area gives an average range of 3.76 – 6.39 m/s. Wind distribution pattern for the study area shows that the wind predominantly blows from the south-westerly (SW) direction (about 63% of the time). Other prevailing wind direction was from the westerly (W) direction and southerly (S) direction.

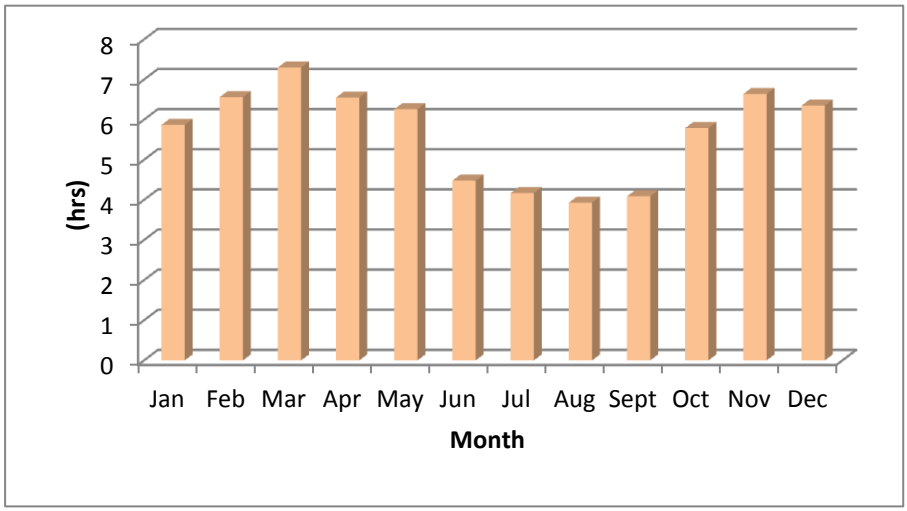


Source: NIMET, 2005-2014

Figure 3.4: Monthly Average Wind Speed around Study Area (2005-2014)

Sunshine Pattern

The study area receives a monthly average sunshine of 3.93– 7.30 hours per day with an annual average of 5.67 hours. It receives its longest sunshine period between November and May with March recording the longest sunshine duration of 7.3 hours, while shortest sunshine duration is recorded between June and September (Figure 3.5).



Source: NIMET, 2005-2014

Figure 3.5: Average Monthly Sunshine Hours around Study Area (2005-2014)

3.1.2 Air Quality Study

The results of air quality and noise level monitoring around the project area (Eleyele Dam) are presented in Table 3.3. Parameters measured were Total suspended particulate (TSP), gaseous emissions including Carbon (II) Oxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), volatile organic compounds (VOCs), hydrogen sulphide (H_2S) and ammonia (NH_3).

Table 3.3: Measured Air Quality and Noise Average Results around the Eleyele Dam

	VOC	H_2S	CO	SO_2	NO_2	CO_2	NH_3	TSP (µg/m³)	Noise Level dB(A)	
	(ppm)								Min	Max
Min	0	0	2.6	0.1	0	300	0	13	40.9	46.6
Max	0	0	2.6	0.1	0	500	0	57	63	67.1
Mean						371.4		42.7	49.2	53.8
FMEnv	0.1	-	10	0.01	0.04-0.06	-	-	250	90(8 hrs)	

Source: Fieldwork, March 2016)

Generally, most of the parameters were recorded below the applicable regulatory limits. TSP range of 13 – 57 µg/m³ with a mean value of 42.7µg/m³ was obtained (Table 3.6). Airborne particles in Nigeria, have been documented to have wide seasonal variations (Ukpebor et al; 2012) with lower concentrations associated with the wet season. This relatively low particulate level could be as a result of the little or no anthropogenic influences around the project area. It is important to note that recorded average particulate level for field investigations was below the FMEnv (250µg/m³) standard for ambient air quality.

Based on the classification of air quality developed by Jain *et. al*. (1976) and shown in Table 3.4, with regard to particulates (mean of 42.7µg/m³) around the project area fall within the high quality range.

Table 3.4: Air Quality Classification Based on TSP Concentration

Range of TSP Values (µg/m³)	Class of Air Quality
0 – 75	High Quality
76 – 230	Moderate Quality
231 – 600	Poor Quality

Source: Jain, et al. 1976

Nitrogen dioxide is a criteria air pollutant (WHO, 2000), most commonly used to assess air quality. In this study NO_2 was found in relatively low concentration with values all less than 0.1 ppm. Carbon monoxide is an indirect "greenhouse" gas, partly responsible for climate change. It is also highly toxic at elevated concentrations. The CO concentrations in the study area were below the detection limits of the measuring equipment used during field investigations.

Sulphur dioxide (SO_2) levels in the project area were below measurable quantity of the equipment used in all the locations for the dry season field study. Ammonia is a "non- criteria" air pollutant (WHO, 2000), and therefore not frequently used for air quality assessment. However, NH_3 is a respiratory irritant with a profound choking smell. In this assessment, NH_3 levels in were below measureable quantity of the equipment used in all the locations.

VOCs were not present in measurable quantities at any of the sample locations around the study area.

Summarily, the baseline air quality of the project area as it relates to the measured air pollutants (VOC, CO, SO_2, NO_2, NH_3, TSP, and H_2S) is pristine and does not reflect any significant level of anthropogenic alterations. However, these current low gaseous and particulate levels around the project may be altered with increased activities during the rehabilitation works.

Noise Level

The Federal Ministry of Environment (FMEnv) in its effort to protect workers and other individuals, who are exposed to loud noise, recommended a maximum daily (8 hours) noise exposure of 90 decibels for individuals (workers) as presented in Table 3.5.

Table 3.5: Noise Exposure Limits for Nigeria

Duration Per Day (hour)	Permissible Exposure Limit (dB (A))
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Source: Guidelines and Standards for Environmental Pollution Control in Nigeria (FEPA, 1991)

Noise levels measured around the project area ranged between 46.6 and 67.1dB (A) with an average value of 53.8dB for the maximum, while the minimum value ranged between 40.9 and 63.0dB (A) and a mean value of 49.2.0dB (A) (Table 3.3). The low noise level observed is expected given the current relatively pristine nature of the project area. However, this trend may be altered with the commencement of noisy generating rehabilitation activities.

Generally, the proposed Emergency Rehabilitation project is likely to result in increased noise levels from movement of construction vehicles and machines and the other rehabilitation activities. Therefore, adequate precautions need to be taken to ensure that such elevated noise levels do not have negative impact on individuals, especially among project workers and other people in the immediate vicinity of the project area.

3.1.3 Landuse Pattern

The categories of Land use around the study area includes: Built up areas, Agriculture/Light Forest Plantation, Auto-Mechanic Workshops, Concrete and Block Moulding Factories, Cassava Processing Units, Gathering of Firewood, Hunting and Fishing.

Built up Areas

As a result of urbanization and industrialization, a lot of human activities have taken its toll in and around the Eleyele Dam. The study site is surrounded by Eleyele neighbourhood in the South, Apete in the North- East, Awotan in the North and Sango in the east. There is a notable quartz-ridge hill towards the downstream section where the Eleyele Dam barrage is located separating the study area from the built up areas. The residential and commercial plots have tarred roads accessing them. The Eleyele-Sango road is the major link road connecting the study area (Eleyele Dam) from the Southern part. On this major road lies the Ibadan Polytechnic, Commercial Banks, Hotels, Administrative centers, Private Residences and Markets. All adjoining settlements such as Awotan, Apete, Sango and Eleyele also consists of tarred road networks, Private residences, Schools, Motor parks and Commercial centers.

Plate 3.1: Built up portions of the Project area

Agriculture/Light Forest Plantation

Farming is being carried out on various plots and patches of the watershed with some only few meters away from the dam's distributary. Agricultural practices observed on the watershed include planting of crops like Cocoyam, Yam, Cassava and Maize. There are also fruit trees such as Pear (Avocado), Mango, Cashew and Guava. Plantain and Banana, plus vegetables such as Pumpkin (Ugwu) and Spinach (Tete) are also common along the wetland areas. There is a nursery where orange seedlings are raised and sold to the public. Also surrounding the Eleyele dam like a bufter zone is an expansive wetland lowland area covered with riparian wetland forest and light to dense vegetation interspersed with various types of deciduous and evergreen trees.

Auto-Mechanic Workshop

The main access road to the Eleyele Dam from the southern axis plays host to an auto-mechanic workshop at about 600m away from the Dam. Several others also abound at various locations on the dam watershed close to the access roads in the built up areas. Spent oil spill from vehicles repair may have significant

Plate 3.2: Auto-mechanic workshop on the Dam watershed

Plate 3.3: Cassava Processing Units on the Dam's watershed

Cassava Processing Units

A whole community of cassava processors is located about 500m away from the dam on its watershed. The use of the dam's watershed by the cassava processors started a couple of years ago. Small shops originally belonging to fishermen for the sale of their catches were leased to cassava processors. The most common type of cassava used is the bitter cassava (manihot utilissima) which contains hydrocyanic acid. The cassava is processed into dough, cassava flour, garri etc. They stated that the watershed is very conducive for their business activities, since water is always available all year round from the dam. The processors stated that the use of well water is not good enough for the soaking of the cassava tubers and this is the major reason why they prefer to locate their processing unit closer to the river side. There is also a ready market for their products from the people around the dam as well as the environs.

Hunting, Fishing and Gathering of Firewood

Fishing is one of the prevalent activities in the Eleyele reservoir area even though the fishermen's major complaint is the widely spreading presence of water hyacinth. These water plants provide a safe haven for fishes to hide which has resulted to dwindling catches thereby impacting their business negatively. Gathering of firewood is also noticed around the dam while hunting for games, though practiced within the forested zones around the dam is the least activity recorded.

3.1.4 Vegetation Study

Observations on Vegetation Types

The species nomenclature is in accordance with Hutchinson and Dalziel of Flora of West Tropical Africa (Hutchinson and Dalziel, 1954-1972). On the basis of density, proportion of plant species and their distribution, the major types of vegetation were revealed.

The vegetation on the shoreline of the proposed Dam rehabilitation project site is lowland rainforest, made up of mixtures of trees, shrubs, herbs and grasses.

Floristic Composition, Distribution, Density and Diversity of Vegetation

The floristic composition of the vegetation of the proposed Dam rehabilitation site is diverse in species even over a relatively homogenous area. A total of 23 plant species belonging to12 families/sub-families and comprising trees/shrubs, herbs and grasses were recorded within the proposed project area.

The results of the mean plant density and diversity, as well as biomass of the herbaceous/aquatic macrophytes layer are presented in Table 3.6.

Table 3.6: Plant density, diversity and biomass of vegetation within the study area (March 2016 & July 2016)

S/N	Vegetation Type	Mean Plant Density		Biomass of herbaceous layer (kg/ha)	Species Diversity Index
		Trees and Shrubs (No/ha)	Herbaceous layer (No/m²)		
1	Shoreline Vegetation/Fallow	895	185	1250	0.750
2	Farmland	110	215	525	0.410
3	Aquatic macrophytes	-	388	-	0.255

Source: Fieldwork, March 2016

Economic Plants

A checklist of the common economic plants within the study area is presented in Table 3.7. The density of the economic plants in the study area is about 80/ha.

Table 3.7: Checklist of Common Economic Trees/Plants in the Study Area (March 2016)

S/N	Scientific Name	Family/Sub family	Common Name	Uses/Economic Importance	Density (No./ha)
1	*Terminalia catapa*			Edible fruit	25
2	*Psidium guajava*		Guava	Edible fruits	30
3	*Gmelina arboreus*		Teak	Electric pole	74
4	*Carica papaya*		Paw paw	Edible fruits	25
5	*Anacardium occidentale*	Anacardiaceae	Cashew	Edible fruit, Medicinal	17
6	*Mangifera indica*	Anacardiaceae	Mango	Edible fruit, Medicinal	10
7	*Elaeis guineensis*	Palmae	Palm	Edible fruit	11

Source: Fieldwork, March 2016

Agriculture

Few plants belonging to some families are cultivated in farms downstream of the dam (Table 3.8). The system of farming practiced in the area is mainly land rotation and bush fallowing with mixed cropping. The farms were weeded regularly using the hoe to reduce competition from weeds during the rainy season and more crops were enumerated during the rainy season.

Table 3.8: Comparative Features of the Vegetation Types found in the Study Area

Vegetation Types	Grid Co-ordinate and Station	Dominant plant species	Density of Woody species	Species diversity	Maximum tree height
Lowland Rainforest/Fallow	(i) 07⁰ 25.287'N 003⁰ 51.280'E	*Albzia zygia, ,Waltheria indica, Elaeis guineensis,*	Medium	Medium	22 m

Vegetation Types	Grid Co-ordinate and Station	Dominant plant species	Density of Woody species	Species diversity	Maximum tree height
	(ii) 07^0 25.310'N 003^0 51.260'E (iii) 07^0 25.209'N 003^0 51.194'E	*Cassia siamea, Mangifera indica, Psidium guajava, Morinda lucida, Newbouldia laevis, Termunalia catapa, Combretum* spp			
Aquatic macrophytes/ Water surface	07^0 25.256'N 003^0 51.316'E	*Andropogon gayanus, Elaeis guineensis,Typha australis. Pistia stratoides*	-	Medium	-
Lowland Rainforest/Fallow	(i) 07^0 25.250'N 003^0 51.152'E (ii) 07^0 25.275'N 003^0 51.144'E	*Newbouldia laevis, Termunalia catapa, Combretum* spp, *Alchornea cordifolia*	Medium	Medium	11 m
Aquatic macrophytes/ Water surface	07^0 25.288'N 003^0 51.269'E	*Nephrolepis pilosa, Typha australis, Grass spp*	-	Medium	-
Fallowland	07^0 25.230'N 003^0 51.286'E	*Leucena leucocephala, Chromolaena odorata, Panicum maximum*	low	medium	7 m
Farmland	07^0 25.290'N 003^0 51.335'E	*Manihot esculenta* (cassava), *Musa sapietum*	low	low	4m
Farmland	07^0 25.208'N 003^0 51.260'E	*Gliridia sepium, Elaeis guineesis, Leucena leucocephala*	Low	Low	6 m
Fallowland	07^0 25.313'N 003^0 51.119'E	*Alchornea cordifolia, Elaeis guineensis, Nephrolepis pilosa*	Low	Low	5 m
Fallowland	07^0 5.285'N 003^0 51.141'E	*Nephrolepis pilosa*	Very low	Very low	

Source: Fieldwork, March 2016

3.1.5 Wildlife Study

The terrestrial wildlife fauna of the region based on available literature and oral interviews with locals consist of mammals, birds, herpetofauna and invertebrates.

Mammals

Table 3.9 and Plate 3.4 reveal the Result of investigations into mammalian diversity

Table 3.9: Mammals recorded in the project area

Common Name	Biological Name	Status	Local (Yoruba) Name
Mona Monkey	*Cecopithecus mona*	Common	Obo
White-bellied Pangolin	*Manis tricuspis*	Common	Akika
Black-bellied Pangolin	*Manis tetradactyla*	Common	Akika
Giant Pangolin	*Manis gigantean*	Common	Akika
Grasscutter	*Thyronomys swinderianus*	Common	Ooya
Gambian Giant Rat	*Cricetomys gambianus*	Common	Okete
Nile Harsh-furred Rat	*Arvicanthis niloticus*	Common	Emo
Fruit Bat	*Eidolon helvum*	Common	Adan
Red-legged Sun Squirrel	*Heliosciurus rufobrachium*	Uncommon	Okere
Fire-footed Tree-Squirrel	*Funisciurus pyrrhopus*	Common	Okere
Ground Squirrel	*Xerus erythropus*	Uncommon	Okere
Blotched Genet ("Bush cat")	*Genetta tigrina*	"	Akata
Marsh Mongoose ("Fox")	*Atilax paludinosus*	Uncommon	Kolokolo
Sitatunga ("Antelope")	*Tragelaphus spekei*	Common	Etu
Grimm's Duiker	*Sylvicarpa grimmi*	Uncommon	Egbin
Red River Hog	*Potamocherus porcus*	Uncommon	Imado
Crested Porcupine	*Hystrix cristata*	Uncommon	Oore
Brush-tailed porcupine	*Artherurus africanus*	Common	Oore

Source: Fieldwork, 2016

Plate 3.4: Burrow suspected to be dug by *Cricetomys emini* (giant rat)

Herpetofauna

These animals are found both on land as well as in water, and their representatives were encountered. Few specimens were caught and released including *Agama agama* (rainbow lizard), *Mabuya affinis* (skink), *Dendroaspis jamesoni* (green mamba), *Bufo maculates* (African toad) and *Dicroglossus occipitalis* (bull frog). Locals attested to a healthy population of herpetofaunal species

in the area (Table 3.10). In the sampling square quadrat, families of Amphibians and Reptiles were identified. Lizards were encountered on the project site grounds. Tadpoles were seen in pools of water by the river bank. The specimens seen were crawling on trees, basking in the sun, feeding or hopping away.

Table 3.10: Reptiles and Amphibians reported to be present in the area

Common Name	Biological Name	Status	Local (Yoruba) name
Serrate Hinge-backed Tortoise	*Kinixys erosa*	Common	Ijapa
African Python	*Python sebae*	"	Ojola
Egg-eating Snake	*Dasypeltis fasciata*	Common	Monomono
Green Mamba	*Dendroaspis jamesoni*	Common	Bewere
Spitting Cobra	*Naja nigricollis*	"	Oka
Common Chameleon	*Chameleo gracilis*	Common	Oga
Red neck Lizard	*Agama agama*	Common	

Source: Fieldwork, 2016

Avifauna (Birds)

The bulk of the birds commonly sighted within the project area during the period were mainly, the diurnal birds of prey, seed-eaters and scavengers such as Ploceidae (Weavers), Covidae (Pied Crow), Accipitridae (Kites, Hawks, Palm nut vulture), Bucerotidae(Hornbills), Ardeidae (Egrets), Alcedinidae (Kingfishers), Apopidae (Swifts), Hirundinidae (swallows), Pycnonotidae (Bulbuls), and Columbidae (Doves) (Table 3.11).

Table 3.11: Birds of the Project Area

Common Name	**Biological Name**	**Local (Yoruba) Name**
Little Egret (white phase)	*Egretta garzetta*	*Lekeleke*
Grey Heron	*Ardea cinerea*	-
Green-backed Heron	*Butorides striatus*	-
Hammerkop	*Scopus umbretta*	-
Crowned Hawk Eagle	*Stephanoaet-us coronatus*	*Awodi*
Senegalese Coucal	*Centropus senegalensis*	*Eluulu*
Palm-nut Vulture	*Gypohierax angolensis*	*Igun*
Black Kite	*Milvus migrans*	*Ash~~h~~a*
Red-eyed Dove	*Streptopelia semitorquata*	*Adaba*
Vinaceous dove	*Streptopelia vinacea*	*Oodere kooko*
Senegal Kingfisher	*Halcyon senegalensis*	-
Pied Kingfisher	*Ceryle rudis*	-
Square-tailed Rough-winged Swallow	*Psalidoprocne nitens*	-
Plain-backed Pipit	*Anthus leucophyrs*	-
Carmelite Sunbird	*Nectarinia fuliginosa*	-
Olive-bellied Sunbird	*Nectarinia chloropygia*	-
Common Bulbul	*Pycnonotus barbaetus*	-
Francolin (bush fowl)	*Francolinus bicalcaratus*	*Aparo*
Grey-headed Sparrow	*Passer griseus*	*Ologoshe*
Village Weaver	*Ploceus cucculatus*	*Ega*

Source: Fieldwork, 2016

Invertebrates

They make up 95% of the species in the animal kingdom, they outnumber the vertebrates, both in species and individuals, and they show a greater variety of forms. In the study area butterflies, moths and other insects such as beetles, ants, flies and mosquitoes mainly represented these groups of animals. Other Arthropods that were observed include centipede, scorpion etc. Other classes of Arthropods include Arachnida e.g. spider, Diplopoda e.g. millipede and Chilopoda e.g. centipede while Gastropoda e.g. snail represents the molluscs (Table 3.12). Some of the arthropod species found on site are shown in Plates 3.5 -3.7.

Table 3.12: Invertebrates Observed in the Study Area

Phylum	Scientific name and Common name
Annelida	**Oligochaeta**: *Hyperriodrilus africasnus, Libydrilus violaceus*
Arthropoda	**Arachinida**: *Lycosa sp., Salticus sp., Torania variata & Scodra griseips* (Jumping spiders), *Loxosceles sp.* (Brown spider), *Scorpionidapandinus imperator, Buthus hottentous, Dermacentor variabilis* (wood tick), *Armadillidium sp.* (wood lice)
	Diplopoda (Millipedes): *Pachybolus ligulatus, Prepodesmus sp., Oxydesmus sp., Habrodesmus sp.*
	Trichoptera: *Agraylea sp., Leptocella sp., Limnephilus sp., Rhodanella minos* (Collembola springtail)
	Coleoptera: *Canthon sp., photinus sp., Photuris sp., Hydroporus sp., Dytiscus sp., Leptocella sp., Cybister sp., Belostoma sp., Mellodon downer* (longhorn beetle), *Adalia bipunctata* (ladybird)
	Diptera*: Chironomus sp.* (midge), *Culex and Anopheles sps.* (Mosquitoes), *Simulium sp.* (Black fly), *Tipula sp., Psychoda sp., Chrysops sp., Musa domestica* (House fly), *Drosophila sp. Glossina sp.* (Tse tse fly), *Tabanus sp.*
	Orthoptera: *Schistocerca & Locusta sp.* (Locusts), *Zonocerus variegatus, Sphedromantis lineola* (Praying mantis*) Gryllotalpa africana* (Cricket), *Conocephalus sp.* (Longhorn grasshopper).
	Homoptera: *Tibicen sp*. (cicada), Aphid
	Isoptera (Termites): *Reticulitermes sp., Amitermis sp., Cubitermis sp., Macrotermis sp.*
	Lepidoptera (Butterflies): *Papilio sp., Limentis sp., Danaus sp., Heliothis sp., Spinx Sp., Acrea sp., Precis sp., Neptis sp.*
	Hymnoptera: *Apanteles sp., Oecophylla sp.,* (white/tailor ant), *Monomorium destructor (black ant), Apis sp.,* (honey bees), *Polistes sp., and Vespa sp* (Wasps).
Mollusca	*Limocolaria sp.* (Garden snail)

Source: Fieldwork, 2016

Plate 3.5: Millipede (Diplopoda)

Plate 3.6: *Pachydesmus crassicutis laticollis*

Plate 3.7: Romalea guttata

3.1.6 Soil Study

Soil Physico-Chemical Characteristics

Average Soil Physico-Chemical Characteristics are presented in Table 3.17 below:

Table 3.13: Average pH, Conductivity and Total Organic Carbon (TOC) of soil within the project Area

Sample Values	pH		EC. (µS/cm)		%TOC	
	Top	Sub	Top	Sub	Top	Sub
Min	6.46	6.8	59	53	0.25	0.66
Max	7.75	7.8	370	312	2.81	3.74
Mean	7.32	7.30	168.57	169.36	1.77	1.92

Source: Fieldwork, March, 2016

By the classification system of Udo, 1986 (Table 3.14), the soil collected around the project area is faintly alkaline.

Table 3.14: Soil pH Classes

pH	Classes
4.5 – 5.5	Very Acidic
5.5 – 6.0	Distinctly Acidic
6.0 – 7.0	Acidic
7.0	Neutral
7.0 – 7.5	Faintly Alkaline
7.5 – 8.0	Alkaline

Source:Udo, 1986

- **Particle Size Distribution:** The results of particle size distribution of the soil in the project area are shown in the (Tables 3.15). Textural analyses of the soil within the project area showed a predominance of sand particles.

Table 3.15: Particle Size Distribution of Soil within the Project Area

Sample ID	% Sand		%Silt		%Clay	
	Top	Sub	Top	Sub	Top	Sub
Min	75.23	64.03	2.17	2.15	8.21	6.84
Max	84.9	89	14.59	13.55	21.08	33.1
Mean	80.70	79.88	6.26	6.13	13.04	13.98

Source: Fieldwork, March, 2016

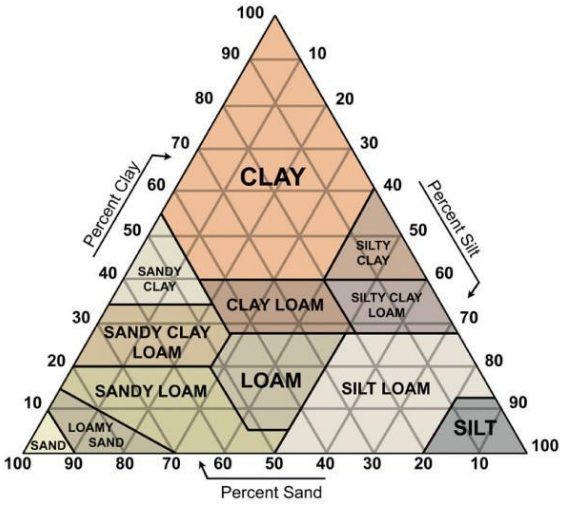


Figure 3.6: USDA Soil Textural Triangle

From the soil textural triangle in Figure 3.6, the soil around the project area could be classified as sandy clay loam.

- **Heavy Metal Concentration:** The results of the heavy metals in the soil from the project area are shown in Tables 3.16 and 3.17.

Table 3.16: Average Heavy Metal Concentration in the Proposed Project Area

Sample ID	Cd		Cu		Fe		Pb	
	(mg/kg)							
	Top	Sub	Top	Sub	Top	Sub	Top	Sub
Min	0.002	0.006	0.053	0.034	14.6	16.6	0.03	0.02
Max	0.028	0.014	0.272	0.27	123.4	91.8	1.5	1.63
Mean	0.0106	0.0087	0.160	0.167	44.4	51.4	0.67	0.83

Source: Fieldwork, March, 2016

Table 3.17: Average Heavy Metal Concentration in the Project Area (Cont.d)

Sample ID	Mn		Zn	
	(mg/kg)			
	Top	Sub	Top	Sub
Min	0.078	0.081	0.0107	0.0099
Max	0.682	0.201	0.8769	1.822
Mean	0.170	0.128	0.2364	0.5451

Source: Fieldwork, March, 2016

Overall, the heavy metal concentration detected in the soil samples were within the corresponding naturally occurring heavy metal concentration in soils as reported by Allen et al. (1979) in table 3.18.

Table 3.18: Naturally Occurring Heavy Metal Concentrations

Metals	Limits (mg/kg)
Cadmium	0.03 - 0.3
Nickel	5 – 500
Lead	2 – 20
Zinc	10 – 50

Source: Allen et al (1974)

3.1.7 Soil Microbiology

The microbiology result of soil samples within the study area is presented in Table 3.19. The total heterotrophic bacterial counts of topsoil and control in the study area ranged between 0 $x10^5$ and 240.0 $x10^5$cfu/g with a mean value of 108.75 $x10^5$cfu/g. Total bacterial counts of bottom soil and control recorded values between 103.0 $x10^5$ and 192.0 $x10^5$ cfu/g, with a mean value of 130.63 $x10^5$cfu/g. The total hydrocarbon utilizing bacteria (HUB) load in the top soil and control ranged between 0 and 75.00 $x10^5$cfu/g with a mean of 40.00 $x10^5$cfu/g, while the bottom soil and control ranged between 20.0$x10^5$cfu/g and 65.0 $x10^5$cfu/g with an average value of 39.25 $x10^5$cfu/g.

Faecal coliform were detected in soil samples analyzed. Total coliform count, MPN/g was recorded in top and control soil samples with mean values of 11.25 MPN/g while in the bottom and control soil samples about 12.50MPN/g were recorded (Tables 3.19 and 3.20).

Table 3.19: Population Densities of Microorganisms in Soil Samples

Sample Codes	THB 10^5 (cfu/ml)	HUB 10^5 (cfu/ml)	% HUB	Coliform count (MPN/100ml)	THF 10^5(cfu/ml)	HUF 10^5(cfu/ml)	% HUF
Min	0	0	0	0	0	0	0
Max	240	75	62.96	20	640	135	44.32
Mean	108.75	40.00	27.45	11.25	202.38	53.13	30.27

Source: Fieldwork, March, 2016

Table 3.20: Population Densities of Microorganisms in Soil Samples

Sample Codes	THB 10^5 (cfu/ml)	HUB 10^5 (cfu/ml)	% HUB	Coliform count (MPN/100ml)	THF 10^5(cfu/ml)	HUF 10^5(cfu/ml)	% HUF
Min	103	20	14.29	7	0	0	0
Max	192	65	38.60	20	168	56	47.73
Mean	130.63	39.25	30.38	12.50	72.50	25.38	32.29

Source: Fieldwork, March 2016

3.1.8 Surface Water Quality

The physico-chemical properties of water samples collected from the Eleyele reservoir, on Ona River are presented in Table 3.21.

Table 3.21: Physico-chemical parameters of Eleyele Reservoir

Sample ID	pH	Temp (^oC)	Cond (µS/cm)	TDS (ppm)	Salinity (%)	DO	BOD	COD	Alkalinity ($mgCaCO_3/L$)	Acidity ($mgCaCO_3/L$)
						(mg/L)				
Min	4.90	29.00	304.00	153.00	0.10	5.30	0.70	76.00	220.00	64.00
Max	7.03	33.20	339.00	168.00	0.12	15.20	3.60	876.00	400.00	170.00
Mean	6.08	30.31	317.58	158.75	0.11	8.73	1.74	474.00	308.33	115.17
FMEnv	6-9	NS	NS	2000	-	NS	50	NS	NS	-

Source: Fieldwork, March 2016

Physico-Chemical Characteristics

- **pH** ranged between 4.90 and 7.03 with an average value of 6.08 during the dry season. Temperature averaged 30.31^{0}C, and ranged from 29.00^{0}C to 33.20^{0}C during the dry season.
- **Conductivity** ranged between 304.0µS/cm and 339.0µS/cm with an average of 317.58µS/cm while
- **TDS** ranged between 153.00ppm and 168.00ppm with an average of 158.75ppm. These values are indicative of fresh water conditions and suggest that there has not been substantial input of materials that could be construed to cause pollution and/or contamination in the surface water of the Eleyele reservoir.
- **DO** values ranged between 5.30mg/L and 15.2mg/L, with an average value of 8.73mg/L. This wide range of dissolved oxygen in the surface water reveals that chemical and biological interactions in the water vary widely along the course of the Ona river via the Eleyele dam.
- **BOD** in the surface water of Eleyele reservoir during the dry season had an average value of 1.74mg/L, ranging between 0.70mg/L and 3.60mg/L. This low BOD values can be attributed to the absence of high levels of contaminating organic materials in the water body.

- **COD** ranged between 76.00mg/L and 876.00mg/L, with an average of 474.00mg/L during the dry season. The alternating values recorded for COD are consistent with the varying values for BOD, showing that the Eleyele dam water suffers some ecological stress at certain locations, but is highly unaffected by environmental stressors at most parts of the Ona river. Hence, the project area is generally unpolluted. The observed levels of COD in the surface water along with the acceptable DO levels do not impact living organism thriving in the available water body.

Heavy Metals: The results of the heavy metals analyses carried out are presented in Table 3.22. The concentrations of heavy metals recorded in the study area were generally low. Cadmium (Cd) and Manganese (Mn) levels were less than the detection limit of the measuring equipment (<0.002mg/L, Cd and Mn); Zinc (Zn) varied between 0.0803mg/L and 0.5919mg/L, while Lead (Pb) varied between <0.01mg/L and 0.160mg/L. Copper varied similarly from below the detection limit of the measuring equipment (<0.003mg/L) to 0.045mg/L. Iron ranged between 1.815mg/L and 6.615mg/L with an average value of 3.986mg/L during the dry season. Most of the heavy metals recorded values that fell within regulatory limits of the FMEnv.

Table 3.22: Heavy metals concentration in Eleyele Reservoir

Sample ID	Cd	Pb	Cu	Zn	Mn	Fe	Na	K	Mg
	(mg/L)								
Min	<0.002	<0.01	<0.003	0.0803	<0.002	1.815	5.7958	0.4241	0.5283
Max	<0.002	0.160	0.045	0.5919	<0.002	6.615	9.3539	0.7804	0.8566
Mean	<0.002	0.047	0.016	0.3285	<0.002	3.986	7.7315	0.6231	0.7064
FMEnv	5	-	-	5	-	1	-	-	-

Source: Fieldwork March, 2016

3.4.9 Ground Water

Physico-chemical properties of water samples collected from underground sources within the study area during the sampling exercise are presented in Table 3.23.

Table 3.23: Physico-chemical parameters of Eleyele Reservoir

Sample ID	pH	Temp (°C)	Cond (µS/cm)	TDS (ppm)	Salinity (%)	DO	BOD	COD	Alkalinity ($mgCaCO_3/L$)	Acidity ($mgCaCO_3/L$)
						(mg/L)				
Min	6.22	26.4	236	116	0.03	4.3	0.2	24.6	260	52
Max	6.86	27.9	397	197	0.06	5.1	0.9	29.0	500	60
Mean	6.59	27.2	310.8	154	0.04	4.72	0.56	26.8	368	56
FMEnv	6-9	NS	NS	2000	-	NS	50	NS	NS	-

Source: Fieldwork March, 2016

Physico-Chemical Characteristics

- pH values ranged between 6.22 and 6.86 with an average value of 6.59.
- Conductivity ranged between 236.0µS/cm and 397.0µS/cm with an average of 310.8µS/cm,
- TDS ranged between 116.00ppm and 197.00ppm with an average of 154.00ppm.
- DO values ranged between 4.30mg/L and 5.1mg/L, with an average value of 4.72mg/L
- BOD had low ranges in the ground water with an average value of 0.56mg/L, ranging between 0.20mg/L and 0.90mg/L. This low BOD values can be attributed to the absence of high levels of contaminating organic materials in the underground water body.

- COD measured between 24.6mg/L and 29.0mg/L, with an average value of 26.8mg/L.
- Heavy Metals: The average results of the heavy metals analyses carried out are presented in Table 3.24. The concentrations of heavy metals recorded in the ground water of the study area were low. Cadmium (Cd) and Zinc (Zn) levels were each lower than the detection limit of the measuring equipment (<0.002mg/L, Cd); and (<0.0010mg/L. Zn). Other heavy metals present in the water samples measured low values. Most of the heavy metals recorded values that fell within regulatory limits of the FMEnv.

Table 3.24: Heavy metals concentration in Eleyele Reservoir

Sample ID	Cd	Pb	Cu	Zn	Mn	Fe	Na	K	Mg
	(mg/L)								
Min	<0.002	0.31	0.035	<0.0010	<0.006	<0.006	10.8147	0.3735	0.2773
Max	<0.002	0.56	0.062	<0.0010	0.011	10.582	16.2643	0.6506	0.4643
Mean	<0.002	0.414	0.0502	<0.0010	0.0055	5.6428	13.0113	0.5053	0.3849
FMEnv	5	-	-	5	-	1	-	-	-

Source: Fieldwork March, 2016

3.1.9 Sediment Study

The physico-chemical properties of sediments collected from various sampling points within the study area are presented in Table 3.25.

Table 3.25: Physico chemical Properties of Sediment in the Project Area

SAMPLE ID	pH	EC (µS/cm)	%TOC	Sand	Silt	Clay
			(%)			
Min	6.00	200	0.81	81.62	1.55	0.45
Max	6.34	1706	1.20	91.63	9.60	11.52
Mean	6.13	1117.57	0.99	87.89	5.99	6.11

Source: Fieldwork, March, 2016

Physico Chemical Properties

- pH values ranged between 6.00 and 6.34 with a mean value of 6.13.
- All locations fell within an acidic range of sediment.
- Electrical conductivity ranged from 200 to 1706 µS/cm with a mean value of 17.57µS/cm.
- The total organic carbon content in the sediments of the study area was in medium category class, ranging between 0.81 and 1.20% with a mean value of 0.99%.
- Average composition of textural classes of sediment indicated the predominance of sand-sized particles. The percentage sand composition in the sediment ranged between 81.62 and 91.63% with a mean value of 87.89%.Silt content ranged between 1.55 and 9.60% with a mean value of 5.99%, while clay ranged between 0.45 and 11.52% with a mean value of 6.11%.

Exchangeable Cations

Concentration of exchangeable cations in sediment samples around the project area is presented in Table 3.26.

Table 3.26: Sediment Exchangeable Cations Concentrations

SAMPLE ID	Mg^{2+}	Na^{+}	K^{+}
	(Mg/kg)		
Min	0.2466	2.4893	0.0055
Max	0.4388	2.7216	0.4907
Mean	0.3625	2.5978	0.0993

Source: Fieldwork, March 2016

The concentrations of cations (Mg^{2+}, Na^{+} and K^{+}) are presented below:

- Magnesium ranged from 0.2466 to 0.4388mg/kg (mean, 0.3625mg/kg).
- Sodium, ranged from 2.4893 to 2.721mg/kg (mean, 2.5978mg/kg).
- Potassium, ranged from 0.0055 to 0.4907mg/kg (mean, 0.0993mg/kg). From the results, it could be concluded that the exchange complex of sediments in the study area is dominated by sodium, followed by magnesium and potassium.

Heavy Metal Concentration

The heavy metal results of the sediment samples collected from the project area are shown in table 3.27. Heavy metal pollutants present in the sediment samples collected from the project area exhibited the following ranges and values:

Table 3.27: Heavy Metals in Sediment of the Project Area

SAMPLE ID	Cd	Cu	Fe	Pb	Zn	Mn
	(mg/kg)					
Min	<0.002	0.287	15.9	0.21	0.0403	0.044
Max	<0.002	0.384	153.3	0.95	0.1426	0.062
Mean	<0.002	0.351	63.3	0.58	0.0816	0.054

Source: Fieldwork, March, 2016

- Cadmium was not detected in any of the samples collected within the project area.
- Copper ranged from 0.287 to 0.384mg/kg (mean, 0.351mg/kg)
- The concentration of iron ranged from 15.9 to 153.3mg/kg (mean, 63.3mg/kg).
- Lead concentration was found only in sediments 3 and 7 with values of 0.95mg/kg and 0.21mg/kg respectively(Mean,0.58mg/kg)
- Manganese concentration ranged between 0.044 and 0.062mg/kg (mean 0.054mg/kg)
- Zinc ranged from 0.0403 to 0.1426mg/kg (mean 0.0816mg/kg).

3.2 SOCIAL AND SOCIOECONOMICS STUDY

3.2.1 Population and Settlement

As at 2006 census, the population of Oyo state was 5,591,589 while estimated population was assumed to be around 6,617,720 in 2007. Table 3.28 shows the population figures of the affected Local Government Areas.

Table 3.28: 2006 Population Distributions by Affected Local Government Area and Sex

S/N	Local Government Area	Population	Male	Female
1	Ido	103261	51750	51511
2	Ibadan North West	152834	75311	77523
3	Ibadan South West	282585	139515	143070

Source: Calculated from Population Census 2006

According to the data gathered during the field survey on all the communities in the affected areas, the population figure in each of these communities range between 500 – 1000. Many new settlements were sighted in some of the communities visited (plates 3.8 and 3.9). The types of settlement patterns common in the study are dispersed and linear settlements (plates 3.10 and 3.11).

Plate 3.8: A typical settlement in the study area

Plate 3.9: A new settlement sighted in the Study Area

Plate 3.10: A residential building at the river bank

Plate 3.11: Building under construction

3.2.2 Social and Economic Infrastructures

The project area is a semi-urban setting although it is within the vicinity of Ibadan capital city development area. There is no much development going on in the project area with respect to urbanization. Public services and infrastructures are virtually absent. The communities lack most basic community facilities such as post office, recreational centre, government/public primary school, government/public secondary school, fire station, and government hospital. There is a

market at the junction leading to these communities. There is also a police post and two private hospitals serving the communities.

There are few business activities of urban nature and most of the people earn their living by self-employment while a few others are civil servants. Most business owners amongst them operate outside the project area. During consultation, it was discovered that most of the landlords are settlers from neighbouring states, towns and villages.

(a) Water supply and Sanitation

The major and most reliable sources of potable water in all communities visited are deep well and borehole. A major complaint in one of the communities, especially in Oke Alape, is that, despite their proximity to the Dam, they do not get drinkable water from the Dam but rather have to depend on water supply from vendors who were seen gathering near Eleyele water front (Plate 3.13).

Plate 3.12: Some Youths playing Table tennis by the River Bank close to the

Plate 3.13: Potable water suppliers stationed at Eleyele junction

All but one of the households said they had WC toilets, while one household used a private VIP toilet. There are no public refuse dumps in all communities under the study area. However, it was gathered that burning of refuse is popular in the communities after accumulating so much of it at a designated point (plate 3.14).

(b) Transport

Apart from trekking, the major means of transportation in the community were private cars, commercial motorbikes (popularly called Okada), buses and cabs. The only major road which is tarred in the study area is Ologuneru/Eruwa road (plate 3.15)

Plate 3.14: Waste dump sighted near the river bank upstream

Plate 3.15: Ologuneru/Eruwa road

(c) Electricity and Telecommunication Services

Currently, the area is connected to the national grid system through Ibadan Electricity Distribution Company (IBEDC). The major complaint with regards to power supply is that it is very irregular. The irregular nature of power supply has prompted some households who could afford to generate power using domestic generators. There are no street lights in the communities. All the households have GSM networks as the major operators in the sector (Airtel, MTN, GLO and Etisalat) have excellent signal in all the communities within the study area.

3.2.3 Economic Activities

The common economic activities in the community were said to be trading, cassava processing (plate 3.16), pepper selling, vegetable selling, maize farming, fishing, lumbering, small and medium scale enterprises and working in the civil service. During the survey, it was observed that fishing is a big business in the study area and this prompted the Oyo State Ministry of Natural Resources to build a kind of resting place for the fishermen at Eleyele water front (plate 3.17) Although there was no evidence of quarrying activities in the study area, it was gathered also that the project vicinity is naturally endowed with laterites and gravel.

Plate 3.16: Cassava processing sites

Plate 3.17: Fishermen's resting place at Eleyele water front

Plate 3.18: Domestic farming near the river bank

With particular reference to male youth, common economic activities were said to include working in the civil service, commercial motorcycle riding (okada), farming (plate 3.18), working in factories, vulcanising, welding and block-making. Many other young people were reported to be students. On the other hand, the female youths were said to engage mainly in hair-dressing, fashion designing, trading, and being housewives, while some were also reported to be students.

From field observations, the dominant types of businesses in the community are those that are built around the waters. Fishing activity is mostly carried out by adult male and male youth. Many women, on the other hand, are engaged cassava processing business which heavily relies on water for the processing of cassava. Some men provide services for cassava processing in the form of grinding machine that turns the cassava into paste used in making fufu. Also, other people are engaged in Fadama farming, planting vegetable during dry season with the dam serving as a source of irrigation for them. A few other men are involved in piggery situated very close to the river bank. It should be noted that these set of people were all seriously affected by the 2011 flooding incident. While some of the women involved cassava processing businesses have gone back to business, others badly affected have not recovered from the aftermath of the 2011 flooding. These are the main businesses that may be significantly affected by the dam rehabilitation programme.

3.2.4 Religious, cultural, historical and archaeological Resources

Site investigation by the ESIA Consultant and discussions with relevant stakeholders and the inhabitants of the area themselves confirm that there are no recorded historical, cultural and archaeological heritage sites in the area. Similarly, there are no monuments, historical buildings, holy trees/springs or old burial grounds identified within the project area. But there are one churches and mosques located in strategic positions within the project area.

3.2.5 Social/Community Network

- **Traditional Leaders**

The traditional leaders in the community mentioned by the respondents were:

- Ojo Busa family
- Rafiu Adefioye (Baale, Idi Oro Elewa).

❖ **Existence of Community Development Associations (CDAs)**

All the respondents confirmed the existence of Community Development Associations (CDAs)/Landlords/Residents' Associations (RAs) in the community, some of which were mentioned to include:

- Oke Alaafia Landlords Association (OALA)
- Teretayo Estate CDA
- Itesiwaju CDA
- Olantinwo/Olaifa CDA
- Oriola Close CDA
- Ojobusa CDA
- New Eleyele CDA
- Olaifa Residents' Association
- Unity Residents' Association.

The CDAs were said to contribute to community development by embarking on lighting projects, road repair works, rendering assistance to the less-privileged in the community, installation of transformers, payment of night security guards, ensuring security of the community, and collection of contributions for community projects.

In this regard, the CDA may be said to be the most influential association/group in the community. The CDAs were noted to be very effective for community mobilization and information dissemination. The affairs of the Association were said to be managed by the Chairman, Secretary, Treasurer and other members of the Executive Committees. As indicated above, it should be noted that different areas have different CDAs and Executives. For issues that cut across the various areas of the community, it may therefore be necessary to bring together all the pertinent CDAs.

❖ **Membership of Trade/Business Associations**

Business or Trade associations are not very strong or prominent in the community, as only two respondents mentioned the existence of one association – the Welders Association.

❖ **Youth-Based Groups in the Community**

The fieldwork did not indicate any strong coordination of youths in the community, as the only youth association or group that was mentioned by a few respondents is the Muslim Youth Association.

❖ **Existence of Vigilante Groups in the Community**

All the respondents affirmed the existence of vigilante groups in the community. The vigilante groups are often tasked with responsibility for the security of the community. The vigilante groups, which usually comprise young and middle aged men, were said to be funded by the CDAs and paid from community funds.

❖ **Other Regulatory Agencies**

When asked about other state regulatory agencies that are known in the community, some of the respondents mentioned the State Sanitation Agency and the State Internal Revenue Agency. Though not mentioned by any of the respondents or discussants, an agency that is believed to have regulatory jurisdiction in the community and which has an important role in terms of

environmental management is the Ministry of Works and Housing, which is statutorily mandated to grant approval for the construction of building. Given the statutory set-back from the river bank, the regulatory functions of this Ministry are important in examining the construction of many existing buildings, as well as new structures that are still being put up in the community.

- **Decision-Making in the Community**

Important decisions in the community were said to be usually taken through votes at meetings, public fora by CDAs and meetings of CDAs and Landlords' Associations. It was reported that the Chairman and members of the Executive Committee could also take some decisions on behalf of the community and inform people later. This lends further credence to the importance of the CDAs in the community.

CHAPTER FOUR

CONSULTATIONS AND PUBLIC PARTICIPATION

This chapter describes the process of the public consultation and public participation followed to identify the key issues and impacts of the proposed Eleyele dam rehabilitation project. Views from the local residents, local leaders, surrounding institutions and development partners who in one way or the other would be affected or have interest in the proposed project were sought through interviews and public meetings. The result of the findings is summarised in the table below:

Items	Description
Date of Public consultation	23rd and 24th July, 2016
Name of Stakeholders (community)	Ojo Busa, Oke Alape, and Ologuneru
Language of communication	*English/Yoruba*
Introduction	The Eleyele Dam rehabilitation project has been conceived by both Oyo State Government and the Federal Government of Nigeria to finally put a check to the incessant menace of flooding that has plagued Ibadan City and its environs for decades. This informs the reason why the Federal Government of Nigeria on behalf of Oyo State Government applied for financing from the World Bank toward the cost of the Ibadan Infrastructural Rehabilitation Project (IIRP), and intends to apply part of the proceeds to carry out an Environmental and Social Impact Assessment (ESIA) of the proposed Eleyele Dam rehabilitation project. As part of the exercise, this public consultation and participation was conducted to sample opinions from the stakeholders.
Response /Feedback of stakeholders about the project	When asked about the awareness of the rehabilitation project, the following responses were got; • Only three of the eight individual/household respondents said they were aware of the proposed rehabilitation of Eleyele Dam, while the five other respondents said they were not aware. • The respondents who said they were aware of the proposed rehabilitation said they became aware through the activities of World Bank consultants. • Some of them said they became aware of the proposed rehabilitation works when they saw some workers on site clearing the water ways. Our investigations indicated that there was a dredging exercise recently. On attitude toward the proposed rehabilitation exercise, the responses were as follows; • Generally, all categories of respondents were favourably disposed to the dam rehabilitation exercise. For instance, all but one of the

Items	Description
	individual household respondents were favourably disposed to the rehabilitation exercise. The same positive disposition was displayed by other categories of respondents in the community, including the youth. The positive disposition may be attributed to two main factors: the bitter experience of the August 2011 flooding, and expectations of improvement in their lives as a result of the rehabilitation works. • Many people noted that the dam in its current state constitutes a source of fear to them particularly during the rainy season. Indeed, the fear of flooding was palpable as many of the residents, particularly those leaving within close proximity of the dam were absent from their homes during data collection. Some people were actually said to have relocated away from the community. They claimed that heavy and continuous rainfall for upward of three hours constitutes a threat to the community and their livelihood. This has reinforced the positive perception of the rehabilitation among diverse groups in the community. Thus, many of the respondents expressed joy about the proposed rehabilitation, saying if not rehabilitated another flooding incident could have more serious consequences, and as far away as Apata area and beyond. Some of the fishermen interviewed said they were now afraid of fishing in the rainy season, in case the dam walls give way. Some of the respondents also claimed that the foundation of the dam had been damaged and weakened by the water, and feared that if another flooding incident should occur now, the damage would be more severe than the 2011 incident • Many of them concluded spiritually by saying: 'May God forbid a re-occurrence'. Thus, it is believed that the rehabilitation programme would bring an end to their fears about repeat flooding. Various possible benefits of the proposed Rehabilitation exercise to households were also highlighted as follows: • Increased safety and security in the area for residents. • Elimination/control flooding. • Creation of employment opportunities for people in the community through the demand for skilled and unskilled workers for the works. • Increased trading and business opportunities in the community. • Improved water supply to the community and thereby reduce their reliance on untreated water from boreholes. On whether there could be possible resistance to the rehabilitation programme, it was observed that the generality of the respondents did not foresee any resistance/objection to the rehabilitation work, because they believed it is good for the community. They all pledged there will be no disturbance from the community members. This pledge was given by the

Items	Description
	community leaders, the elders, as well as the youth in the community. However, the community leaders, elders and youths advised that people in the community, especially the youth, most of whom were said to be unemployed, should be employed on various aspects of the rehabilitation works that they may be suited for, including skilled and unskilled works. The youth, on their part, said they had approached some people they noticed in the recent past to be doing some work clearing the water ways, telling them that they (youth) were available for any work they may have for them. The community leaders also gave assurance about the security of the equipment of rehabilitation contractors and the safety of their staff, saying the community will ensure that the personnel and equipment are safe. They said the community could also provide storage facilities for their equipment, if the contractor would be ready to pay for the storage facilities and the safety of the equipment. Also, in order to reduce resistance to rehabilitation works, the respondents again reemphasized the need for adequate financial compensation for project affected persons, as well as the need for awareness creation and sensitization/information dissemination. Based on what they said had happened in some other places, the community people warned that the government should not claim dispossess them of their land and sell the land to other people.
Concerns/Complaints	The respondents mentioned various ways in which they thought the rehabilitation exercise could affect them. Some of the possible negative effects are highlighted below: • Potential demolition of houses and business premises, and other properties by the river bank. • Farming, farmlands and fishing activities could also be affected by the dam rehabilitation programme. • Fears of negative economic impact for Fadama farming/vegetable planting activities in the area, as well as people engaged cassava planting and fufu processing. • The rehabilitation works may lead to security issues as a result of the influx of many people (strangers) into the community. • Could lead to conflict among the community members, especially between those whose houses and properties may be affected and those whose properties may not be affected. • The rehabilitation works and the movement of contractors vehicles could lead to traffic congestion in the community • Indiscriminate parking of vehicles by the contractors could make it difficult for them and their customers to access their business premises.

Items	Description
	• May lead to further flooding in the community, if not done properly. Although none of the respondents mentioned it, there is likely to be traffic congestion between Eleyele and Ologuneru communities, which are linked by one bridge if the rehabilitation of the dam will lead to the reconstruction of the bridge. If this is the case, the flow of traffic between these two communities will be hampered as the only alternative routes through the National Institute for Horticultural Research (NIHORT) are usually not open to the public. Besides, it is a very long tedious drive which could complicate mobility for community members going out or returning home or travelling to Iseyin.
Remarks/Recommendations	The following recommendations are made to mitigate the potential social and economic impact of the proposed dam rehabilitation project in the community: • It is imperative to work closely with the leadership of the Community Development Associations (CDAs)/Landlords/Residents' Associations (RAs) in the communities, to carry them along and to secure their support for the dam rehabilitation programme. • There should be adequate awareness creation in the community about the proposed dam rehabilitation programme in order not to allow negative/erroneous rumours to fester/spread in the community, especially about demolition of houses and relocation of people. The CDAs should be briefed in this regard as appropriate. • Houses and properties should be demolished only if it is inevitable and as a last resort. • There should be adequate compensation for people whose houses, properties and livelihood may be affected by the rehabilitation project. • There should be adequate notice to people who own properties or who have gardens and farms along the river bank before the commencement of rehabilitation works, so that they will be able to harvest their gardens and relocate. • Competent firms should be engaged for the dam rehabilitation project in order to ensure quality work. • As much as possible, members of the community, especially unemployed youths should be considered for employment by the contractor during the rehabilitation programme. This can help to

Items	Description
	reduce restiveness among the youth and also help to ensure the security of the lives and property of the contractor. • Efforts should be made to reach the vulnerable and disadvantage groups in the community who may be affected by the dam rehabilitation programme for special consideration/assistance. • In order to prevent future violations of building regulations, the Ministry of Works and Housing should be enjoined to monitor and ensure compliance with statutory setbacks from the river bank. • Traffic wardens should be deployed to the community for the control of traffic during the period of rehabilitation works. The contractor's staff should also be properly sensitized about the need for responsible driving and parking in the community. • Efforts should be made to ensure regular and reliable potable water for the community, if only as a form of Corporate Social Responsibility to the host community for the dam. • Although this is outside the purview of this ESIA, the government may be advised to consider the possibility of constructing a second bridge to link the communities and to prevent community members being cut off in case of damage to the single bridge. • The government should also consider the possibility of making the road a dual carriage in order to enhance the free flow of traffic.

Source: Socioeconomic field survey, 2016

CHAPTER FIVE

ASSOCIATED AND POTENTIAL IMPACTS AND MITIGATION MEASURES

5.1 INTRODUCTION

This section identifies the primary environmental and social impacts of construction and operation of the proposed rehabilitation of Eleyele dam. It also provides relevant mitigation measures to the neative project impacts. For each subject area (i.e. air quality, soil, water quality, noise etc.), the nature of the impact is discussed along with its potential significance, given the existing characteristics of the site and the local and international Guidelines for dam projects. It presents an overview of the impact assessment methodology as well as results of impact screening followed by detailed qualitative and quantitative impact assessment. The various stages from preconstruction, through construction and post construction/operations as well as decommissioning of the project shall be assessed.

Appropriate impact identification and prediction methods are essential to a successful ESIA. Generally, a number of impact assessment methods have been developed over the years and new approaches continue to emerge. Some of these approaches include the Overlays technique (McHarg, 1968); Leopold matrix (Leopold *et al*., 1971); Battelle Environmental Evaluation System (Dee *et al*., 1973) and Peterson Matrix (Peterson *et al.,* 1974) and ISO 14001, which are amongst the most widely used methods employed for impact assessment. All good methods have certain elements in common, which are widely accepted as essential to ESIAs. The Scientific Committee on the Problems of the Environment (SCOPE) (1979) suggested that the following qualities should be considered while choosing Impact assessment methods:

Comprehensiveness: The method should detect the full range of important elements and combinations of elements, directing attention to novel or unsuspected effects or impacts, as well as to the expected ones.

Selectivity: A good method focuses attention on major factors. It is often desirable to eliminate as early as possible (i.e., during identification) un-important impacts that would dissipate effort if included in the final analysis. However it is true that screening at the identification stage requires some pre-determination of the importance of an impact. Lindblom (1959), Beer (1967), and Holling (1978) provide some guidelines on how to deal with this issue.

Mutual exclusiveness: Where possible, it is important to avoid double counting of effects, although experience has shown that this is difficult because of the many interrelationships existing in the environment.

Confidence limits: Subjective approaches to uncertainty are common in many existing methods and can sometimes lead to quite useful predictions. However, explicit procedures are generally more acceptable, as their internal assumptions are open to critical examination, analysis, and, if desirable, alteration.

Objectivity: The importance of objectivity in impact assessments has been emphasized by many including the World Bank and Federal Ministry of Environment (FMEnv). Objectivity minimizes the possibility that the predictions automatically support the preconceived notions of the promoter and/or assessor. These prejudgments are usually caused by a lack of knowledge of

local conditions or insensitivity to public opinion. A second reason for objectivity is to ensure comparability of EIA predictions amongst similar types of actions. An ideal impact prediction method contains no bias.

Prediction of Interactions: Environmental, social and economic processes often contain feedback mechanisms. A change in the magnitude of an environmental effect or impact indicator may then produce unsuspected amplifications or dampening in other parts of the system.

Given the nonuniversality of method that can be applied to all project types in all environmental settings (Canter, 1996), the United Nations Environment Programme (UNEP, 1996) emphasizes the need to use tools from existing methodologies that best suit the specific project situation. Lohani *et al*., (1997), further pointed out that since no single method will meet all the necessary criteria of an EIA, selection of an array of methods that collectively meet assessment needs should be employed. These methods include but not limited to the following:

- The Leopold matrix approach
- The Battelle environmental evaluation system
- Checklists
- Matrices
- Flowcharts and Networks
- Mathematical/Statistical and computer models
- Overlays using maps and GIS

Each of the above approaches has merits and demerits. In order to comprehensively assess the impacts of the proposed dam rehabilitation project, relevant methods were combined systematically at various steps of the assessment process (Figure 5.1).

5.2 IMPACT ASSESSMENT METHODOLOGY

Because assessment of impacts is crucial for sound environmental management of project activities, and communicates relevant information to stakeholders, the following approaches were employed in the impact assessment:

- ***Activity led assessment of Impacts and development of mitigation measures*** **–** This approach links every project activity to related impacts and thus suitable for implementation of management actions. For instance, this approach can provide information on the effect of an activity on ambient noise level, and helps in development of appropriate/adequate noise control mechanisms.
- ***Resource/Receptor or key issues led assessment of Impacts and development of mitigation measures*** **–** This approach meets stakeholders' needs. For instance, environmental quality regulator may require that all impacts on biodiversity be discussed together.

The approach adopted in this impact assessment was geared towards addressing both requirements. The methodology used for the proposed dam rehabilitation is summarized in Figure 5.1.

- Superimposing project components on existing environmental conditions to identify potential impact areas and critical issues;
- Field investigations;

- Consultation with experts, stakeholders and nearby residents;
- Development and maintenance of a comprehensive database on the biophysical and socio-economic characteristics of the environment of the project area;
- Experience from similar projects;
- Discussions with project proponents and design contractors;
- Published and unpublished documents providing guidance on performing impact analysis.

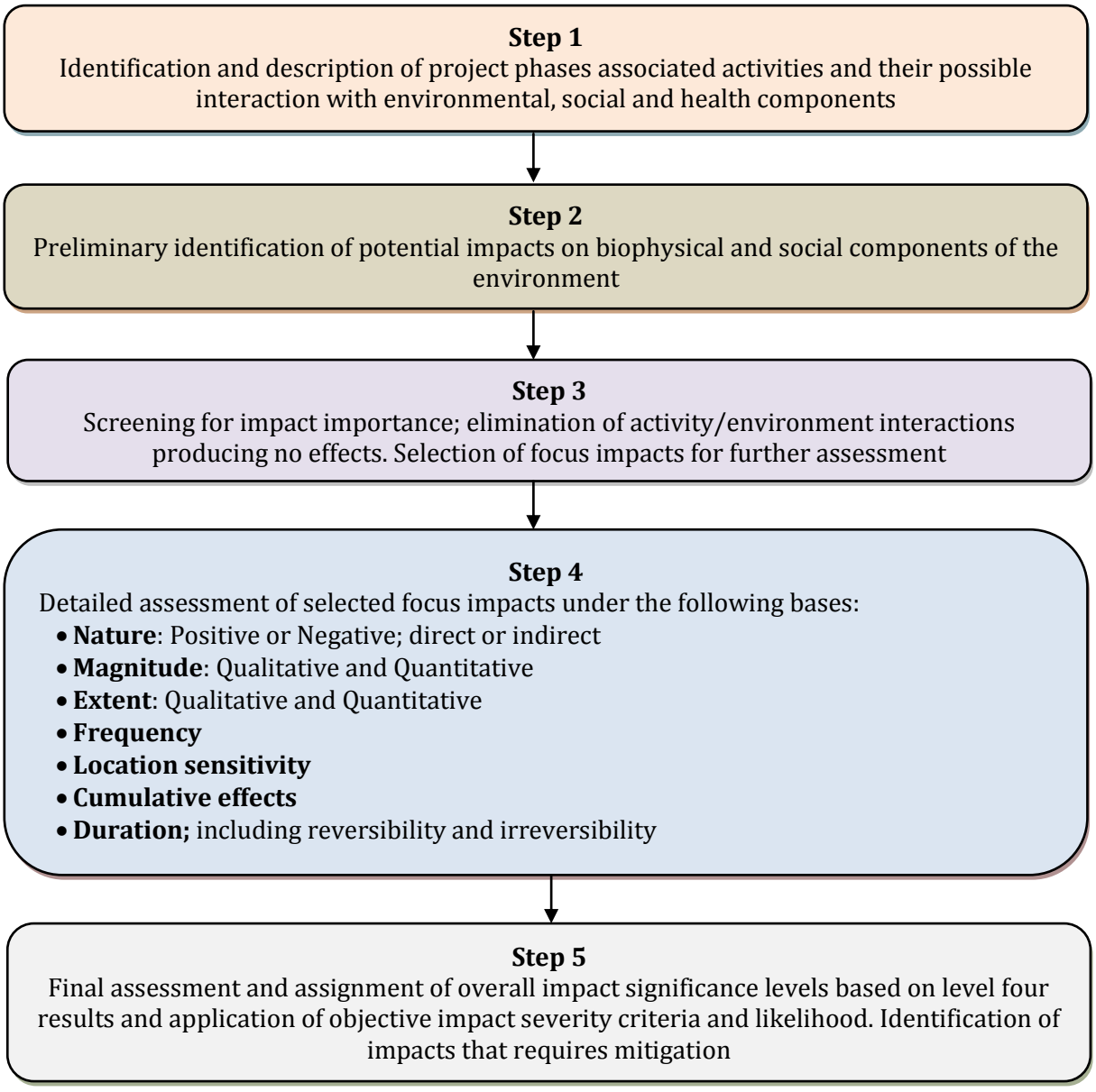


Figure 5.1: Schematic of the Impact Assessment Methodology

5.2.1 Screening of Impacts

Screening of impacts was implemented using a modified Leopold matrix (Leopold, 1971). The matrix arrays project activities against environmental (biophysical and socio-economic) components. The matrix supports a methodical, comprehensive and objective identification of

impacts that each activity could have on the environmental components. The matrix presents vertical list of biophysical and socioeconomic environmental components versus a horizontal list of project activities; which represent sources of impacts associated with each project phase. The basis for the screening was derived from the following:

- Knowledge of the project activities, types of project equipment and layout
- Understanding of likely interaction of project activities with environmental and social attributes.
- Review of other environmental reports on similar projects/environment, and
- Series of expert group discussions, meetings and experience on similar projects.

The matrix's cells are colour coded to represent the severity of specific impacts on particular components based on preliminary screening. Table 5.1 shows the colour codes for the various impact categories.

Table 5.1: Impact Ranking Categories

	Positive Impact
	Negligible/No Impact
	Minor Impact
	Moderate Impact
	Major Impact

5.3 POTENTIAL POSITIVE IMPACTS

Potential positive impacts for the various phases of the proposed project implementation are presented in Table 5.2.

Table 5.2: Potential Positive Impacts Associated with the Eleyele Dam Rehabilitation

Project Phase	Activity/Source of Impact/Issue	Potential Positive Impact
PRE-CONSTRUCTION/PRE-REHABILITATION	Site clearing and preparation	• Improved access to nearby farms and other areas. • Increase in income for local businesses and vendors around the project area. • Employment opportunity for locals • Improved aesthetics of the general dam area
CONSTRUCTION/REHABILITATION	Removal of Vegetation within spillway	• Removal of vegetation within the spillway will improve flow over the spillway thereby improving the dam safety, which in turn makes flooding and erosion unlikely events. • Employment opportunity for residents of the local communities
	Dredging	• Employment opportunity for residents of the local communities • Increase in income for local businesses and vendors around the project area. • Increased upper watershed area required for large volume reservoir.
	Excavation	• Employment opportunity for residents of the local communities • Increase in income for local businesses and vendors around the project area.
	Weir wall	• Employment opportunity for residents of the local

Project Phase	Activity/Source of Impact/Issue	Potential Positive Impact
	rehabilitation	communities • Increase in income for local businesses and vendors around the project area. • Improvement of the dam integrity and safety, which in turn makes flooding and erosion unlikely events.
	Remedial works at spillway	• Employment opportunity for residents of the local communities • Increase in income for local businesses and vendors around the project area. • Improvement of the dam integrity and safety, which in turn makes flooding and erosion unlikely events.
	Downstream channels repair	• Prevention of flooding and erosion • Employment opportunity for residents of the local communities • Increase in income for local businesses and vendors around the project area. • Reduced river bank erosion downstream due to turbulent flow.
	Maintenance of Construction Vehicles and machines	• Employment opportunity for residents of the local communities.
	Repair works on the embankment	• Increased water availability for upstream users. • Increased water volume required for continuous water availability for the treatment plant; • Improvement of dam safety and seepage control. • Reduced river bank erosion due to turbulent flow. • Employment opportunity for residents of the local communities.
	Rehabiltation of Intake Tower	• Improved water supply to the treatment plant • Enhanced safety of the dam
OPERATION/MAINTENANCE	Daily Operation of Dam	**Management of Upper watershed** • Minimization and control of flooding along Ona River • Potential opportunities for tourism and commercial activities; • Prevention of ground water pollution along the flood plains; • Potential opportunity for fishing and other aquaculture activities at the reservoir; • The rich organic materials at the reservoir will enhance proliferation of fishes, thereby providing a unique opportunity for fishing activities; • Adequately regulated and controlled fishing will also lead to revenue generation for the host community. • Employment opportunities for residents of the Eleyele community. • Adequate supply of water to the water treatment plant to ensure availability of potable water Ibadan, Eleyele etc.

Project Phase	Activity/Source of Impact/Issue	Potential Positive Impact
		Lower Watershed Management • Potential improvement in flood control downstream (dam toe). • Protection of soil quality and quantity through improved drainage and flood protection systems.
	Routine Inspection and Maintenance	• Preserves the integrity and life of the dam. • Erosion and flooding control. • Local employment opportunities for both skilled and unskilled labour. • Increased sales for local business owners around the Eleyele dam. • Improved aesthetics of the dam area as bush re-growth are kept under control.
	Reservoir Dredging	• Potential suitable substrate for agricultural activities; • Increased water volume in the reservoir; • Flooding and erosion control; • Potential source of income to dredging contractor.
DECOMMISSIONING	Removal of Dam and Structures	Local employment opportunity for dismantling activities.
	Site Restoration	Restoration of the ecosystem to its original state.

5.4 POTENTIAL NEGATIVE IMPACTS AND MITIGATION MEASURES

Table 5.3 presents the potential and associated negative impacts (environmental and social/health) as well as the recommended mitigation measures of the proposed Eleyele dam rehabilitation project on various components of biophysical and social environment. The presentation is based on specific activities of the different phases of the proposed project. In order to avoid undue repetition of impacts and mitigation that may occur at different project phases, all identified impacts on various environmental/social attributes and mitigation measures are presented together irrespective of project phase. For the same reason, the various project phases and associated activities are presented in a single column.

Table 5.3: Potential Negative Impacts and Mitigation Measures of the Proposed Eleyele Dam Rehabilitation

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
Vegetation	***Environmental*** • Clearing of bushes and uprooting of trees around the dam area could lead to loss of vegetation. • The process of mechanical clearing of vegetation could lead to the introduction of exotic species of plants, which could out-compete native species leading to an alteration of species composition and abundance • Potential loss of vegetation as a result of movement of vehicles • Potential loss of vegetation as a result of dismantling of dam structure and other civil works. ***Social*** • Clearing of vegetation may result to potential loss of medicinal plants, which may lead to prevalence and protraction of some ailments that may have hitherto been treated with some of these plants.	Pre-construction/Rehabilitation *Site clearing and preparation*	Moderate	• Restrict bush clearing to required portion of the project area. • Only trees marked to be critical to the repair works and dam design should be removed. • Ensure vehicles only ply paved/tarred roads. • IUFMP's PIU should encourage residents of host communities to patronise orthodox health care. However, the portion that would be cleared is relatively small and any impact on medicinal plants that may arise by this activitiy will be negligible.	Minor
		Pre-construction/Rehabilitation *Equipment mobilization*	Minor		Negligible
		Construction/Rehabilitation *Removal of Vegetation within Spillway, Vehicular/Traffic Movement, Downstream Channels Repair, Wastes Generation/Management*	Minor		Negligible
		Construction/Rehabilitation *Repair Works on the Embankment*	Moderate		Negligible
		Operation/ Maintenance *Wastes generation and handling*	Minor		Negligible
		Decommissioning *Dismantling of Structures, Wastes generation/management*	Minor		Negligible
Impact on Aquatic environment (surface water, hydrobiology and sediment)	***Environmental*** • Potential use of harmful chemical products during bush clearing and potential seepage of hydrocarbons from powered construction machineries, solvents and other hazardous substances from construction machinery and	Pre-construction/Rehabilitation *Site clearing and preparation*	Moderate.	• Ensure that no harmful chemicals are used for bush clearing. • Properly clean all clearing equipment before use. • Use of best engineering practice during dredging activities to protect the water	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	equipment could lead to contamination of aquatic environment and species. • Potential bush clearing activities around dam area may lead to emission of particulates and increase in water turbidity that could contaminate surface water making it unfit for riparian use. • Potential use of foreign materials during rehabilitation works may alter the present ecology of the Dam and the Ona River downstream. • Dredging activities may require in-stream actions such as dewatering, blasting and sediment removal, which may result in water pollution. • Rehabilitation of intake tower may lead to disruption of aquatic ecology and increased turbidity. • Potential indiscriminate discharge of wastewater and other wastes from construction/rehabilitation activities could increase the water turbidity and also contaminate the surface water. • Dismantling of dam structure and other civil works may increase surface water turbidity and alter the river bed composition. ***Social*** • Potential disruption of artisanal fishing activities downstream due to these activities. • Potential increased sedimentation and surface water turbidity may cause migration of fishes making fishing downstream unprofitable during excavation activity.	Construction/Rehabilitation *Removal of Vegetation within Spillway, Weir Wall Rehabilitation, Downstream Channels Repair, Wastes Generation/Management, Repair Works on the Embankment.*	Moderate.	body. • Provide mobile toilets on site during the construction phase. • Ensure adequate provision of waste bins with lids at strategic location around project site and enforce use. • Ensure solid and liquid wastes are handled properly. • Engage the services of accredited waste manager to dispose wastes as and when due. • Restrict clearing of debris and all earth moving activities to required portions of the project area. • Provide alternative water supply for affected citizens.	Negligible
		Construction/Rehabilitation *Dredging*	Major.		Minor
		Construction/Rehabilitation *Excavation, Remedial Works on Spillway, Operating and Gourd Valves Assessment, Construction Vehicle/machines Maintenance, Repair of Scour Tunnel and intake tower*	Minor		Negligible
		Operation and Maintenance *Maintenance of on-site generators and engines, Wastes generation and handling*	Minor		Negligible
		Closure *Dismantling of Structures, Wastes generation/management*	Minor		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	• Use of harmful chemical products for removal of vegetation, use of contaminated materials during embankment rehabilitation and potential indiscriminate discharge of construction wastes, sewage and other contaminants could lead to surface water contamination (increased heavy metal concentration) and poisoning of life form in the water adversely affecting fishing downstream during remedial works on spillway. • Potential lack of access to surface water by riparian users during dredging, Remedial Works on Spillway, Operating and Gourd Valves Assessment. • Potential disruption of water supply to the treatment plant during dredging, Remedial Works on Spillway, Operating and Gourd Valves Assessment. • Use of harmful chemical products during bush clearing around dam area could lead to contamination of surface water (increased heavy metal concentration) leading to health complications for riparian users • Indiscriminate defecation by construction workers around project area, poor solid wastes and sewage management could foul up the environment and surface water (feacal coliform); this could bring about the proliferation of disease causing vectors.				
Aquatic/Benthic Species	***Environmental*** • Potential site clearing/preparation and equipment mobilization may lead to	Pre-construction/Rehabilitation *Site clearing and preparation*	Minor	• Ensure that only required portion of the project is cleared. • Ensure harmful chemicals are not	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	reduction of benthic species. • Potential use of harmful chemicals for vegetation removal could lead to loss of benthic species. • Potential dredging, excavation works, grading and filling activities could lead to reduction of benthic species • Rehabilitation of intake tower could lead to disruption of aquatic and benthic species. • Potential fuel/oil seepage from powered dredging machinery could contaminate the surface water and river bed (increased hydrocarbon content) leading to loss of benthic species • Potential indiscriminate disposal of waste oils from construction vehicles and machinery, debris and other wastes during construction could lead to contamination (increased hydrocarbon content) of the surface water and river bed causing loss of benthic species.			used for vegetation removal and that all clearing equipments are free of contamination before use. • Restrict all earth-moving activities to required portions of the project area. • Ensure all construction machineries meet international standards for such machineries. • Ensure only well-trained personnel are engaged to carry out the specialized tasks. • Avoid the use of contaminated fill materials for these activities. • Provide mobile toilets on site during the construction phase. • Ensure adequate provision of waste bins with lids at strategic location around project site and enforce use. • Engage the services of accredited waste manager to dispose wastes	
		Construction/Rehabilitation *Removal of Vegetation within Spillway, Excavation, Weir Wall Rehabilitation, Remedial Works on Spillway, Downstream Channels Repair, Operating and Gourd Valves Assessment, Construction Vehicle/machines Maintenance, Repair of Scour Tunnel and Repair Works on the Embankment and repair of intake tower.*	Minor		Negligible
		Construction/Rehabilitation *Dredging*	Major		Minor
		Construction/Rehabilitation *Wastes Generation/Management*	Moderate		Negligible
		Decommissioning *Dismantling of Structures, Wastes generation/management*	Minor		Negligible
Impact on Ground Water	• Potential use of toxic materials during construction works could result in contamination (increased heavy metal concentration) of ground water. • Potential seepage of hydrocarbons, solvents and other hazardous substances from powered construction machines could also	Construction/Rehabilitation *Remedial Works on Spillway, Downstream Channels Repair, Repair Works on the Embankment*	Moderate	• Ensure all materials used for these activities are contamination-free. • All machineries used during the rehabilitation works shall be pre-mobbed before use to prevent accidental seepage of hydrocarbon or leakage of hazardous substances.	Negligible
		Construction/Rehabilitation *Wastes Generation/Management,*	Minor		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	lead to ground water contamination (increased hydrocarbon content). • Potential indiscriminate discharge of wastewater and other wastes could lead to ground water contamination (increased BOD, reduced dissolved oxygen).	*Construction Vehicle/machines, Maintenance*		• Maintain and service powered machinery regularly. • Effective waste disposal/management strategy shall be developed and adopted.	
		Operation/Maintenance *Maintenance of on-site generators and engines*	Minor		Negligible
		Operation/Maintenance *Wastes generation and handling*	Moderate		Negligible
		Decommissioning *Dismantling of Structures, Wastes generation/management*	Minor		Negligible
Impact on the Air Quality	***Environmental*** • The process of clearing bushes and uprooting trees around the dam area may introduce particulates into the environment especially when this activity is carried out during the dry season. • Cleared vegetal matter, if open-incinerated on site, may generate a lot of smoke, with the accompanying gaseous and particulate emissions. This could lead to degradation of ambient air quality within the immediate vicinity of the project area. • Noxious emission from vehicles, diesel powered stationary construction and earth moving machineries could lead to deterioration of air quality around project area. • On-site excavation and movement of earth	Pre-construction/Rehabilitation *Site clearing and preparation, Equipment mobilization*	Minor	• Advise the project contractor/engineer to sprinkle water on the construction site prior to clearing, especially in the event that this activity is carried out in the dry season; • Open-incineration of cleared vegetal matter shall be strictly prohibited. • Provide efficient nose mask and other relevant PPEs for workers • Turn off all powered machineries when not in use. • Strictly adhere to international emission standards for stationary equipment. • Duly service construction vehicles. In addition, ensure that international emission standard for each vehicle is met	Negligible
			Minor		Negligible
		Construction/Rehabilitation *Vehicular/Traffic Movement, Emission from Stationary Equipment, Wastes Generation/Management*	Minor		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	materials during rehabilitation works could lead to emission of fugitive dust. • Emission of odours from improperly disposed waste and open defecation during rehabilitation works. • Open incineration of solid wastes such as woods, paper etc could deteriorate the ambient air quality around project area. ***Social*** • Equipment/materials mobilization could engender exhaust pipe and dust emissions leading to respiratory problems.	Operation/Maintenance *Vehicular/Traffic Movement, Wastes generation and handling*	Minor		Negligible
		Decommissioning *Dismantling of Structures, Wastes generation/management*	Minor		Negligible
Impact on Habitats and Ecosystems	***Environmental*** • Clearing of the vegetation may deprive wildlife species of their habitats, displace them, and expose them to predation, especially by man, leading to a reduction in the abundance of wildlife in the area • Civil works may affect biodiversity • Potential migration of wildlife due to noise from increased vehicular/traffic movement around the otherwise serene dam environment. • Potential ecosystem fragmentation. • Open incineration may lead to fire outbreak which may destroy vegetation thereby depriving wildlife species of their habitats. • Potential destruction of soil and water fauna and flora downstream of the dam in the event of dam failure.	Pre-construction/Rehabilitation *Site clearing and preparation*	Moderate	• Clear vegetation within the required area. • Ensure avoidance of killing of animals by workers and support for biodiversity conservation efforts of government and the community. • As much as possible, restrict movement of equipment to during the day only; In addition, service machines and vehicles used for mobilization and ensure lubrication of friction parts to reduce possible noise impact. • Turn off all powered machineries when not in use. • Open incineration shall be strictly prohibited. • Effective waste disposal/management strategy shall be developed and adopted	Minor
		Pre-construction/Rehabilitation *Equipment mobilization*	Minor		Negligible
		Construction/Rehabilitation *Vehicular/Traffic Movement, Dredging and Excavation, Weir Wall Rehabilitation, Remedial Works on Spillway and Downstream Channels Repair*	Minor		Negligible
		Construction/Rehabilitation *Wastes Generation/Management, Repair Works on the Embankment*	Moderate		Negligible
		Operation/Maintenance	Major		Minor

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
		Daily Operation of Dam			
		Decommissioning *Dismantling of Structures, Wastes generation/management*	Minor		Negligible
Impact on the Soil	***Environmental*** • Clearing of vegetation and uprooting trees around dam area could expose the soil to wind and rain thereby leading to soil erosion and alteration of soil structure and fauna. • There could be scarification of the landscape around project area as a result of increased vehicular movement • Excavation, compaction, filling and other related activities could change the soil structure and composition which may lead to erosion around excavated portions. • Demolition of existing dilapidated concrete slabs along the downstream channel, earthmoving activities, excavation works, installation of a drainage system for the retaining walls and other activities involved in the downstream channels repair could lead to soil degradation • The introduction of fill materials sand and gravel for this activity could lead to contamination (increased pH, heavy metals) of the soil, especially if the fill materials are contaminated. • High sediment from construction activities could also alter the soil flora and fauna. • Improper disposal of construction wastes and excavated material could lead to soil pollution (increased heavy metal, suffocation	Pre-construction/Rehabilitation *Site clearing and preparation, Equipment mobilization*	Moderate	• Monitor clearing to ensure that only required portions are concentrated upon. • Ensure vehicles ply tarred/paved roads/paths to prevent degradation of the landscape • Restrict all earth-moving activities to required portion of the project area • Properly reinforce dug out portions and protect from rainfall. • Ensure fill materials are free from possible contamination and where available, source materials around the project area; • Ensure proper disposal of excavated material.	Negligible
		Construction/Rehabilitation *Vehicular/Traffic Movement, Wastes Generation/Management*	Minor		Negligible
		Construction/Rehabilitation *Excavation and Downstream Channels Repair.*	Moderate		Negligible
		Operation/Maintenance *Vehicular/Traffic Movement*	Minor		Negligible
		Decommissioning *Dismantling of Structures,*	Minor		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	of soil fauna and fauna). • In the event that the site is not adequately reinstated, there may be soil erosion and flooding. ***Social*** • Increased vehicular movement especially, heavy duty construction vehicles could lead to scarification of the soil which could in turn lead to erosion and loss of land assets.	*Wastes generation/management*			
Noise and Vibration	***Environmental*** • Noise and vibration from heavy machineries/vehicles could scare off wildlife around project area. • Vibrations from heavy machineries/vehicles could compromise the integrity of nearby structures thereby causing damages over time. • Potential increased noise as a result of vehicular/traffic movement during rehabilitation works ***Social*** • Potential increase in noise levels along the access road could lead to psychological stress to residents of nearby communities especially the sick and aged. • Noise and vibrations from the heavy construction machinery could adversely affect the health of the site workers and residents of nearby communities especially the aged.	Pre-construction/Rehabilitation *Site clearing and preparation*	Minor	• Service construction machines and vehicles and lubricate friction parts to reduce possible noise impact. • Discourage indiscriminate use of horns by construction vehicles. Instead institute speed limit with signs at sensitive locations. • Ensure that there is controlled use of all equipment and that equipment engines are turned off when not in use. • Fit combustion engines with effective silencers.	Negligible
		Construction/Rehabilitation *Vehicular/Traffic Movement*	Moderate		Minor
		Construction/Rehabilitation *Dredging, Excavation, Weir Wall Rehabilitation, Remedial Works on Spillway, Downstream Channels Repair, Repair of Scour Tunnel, Repair Works on the Embankment*	Minor		Negligible
		Decommissioning *Dismantling of Structures*	Minor		Negligible
Influx of Temporary Workers	• Increased congestion due to influx of temporary workers all through the	Construction/Rehabilitation *Dredging, Excavation, Weir Wall Rehabilitation,*	Minor	• Ensure the services of significant number of the local labours are engaged	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	rehabilitation and decommissioning phase works. • Influx of migrant workers for these construction activities may result to alterations and adulteration in values and customs of the people around the project area. • Influx of some individuals of questionable character among the migrant workers and low standards of living of residents of the host community may result in proliferation of social vices and increased crime rates such as robbery, vandalism, prostitution and other anti-social behaviors. • Influx of construction workers may lead to potential increase in rate of teenage pregnancies and concomitant unsafe abortion among the young especially of school age • Potential influx of migrant workers to the project area may put pressure on the limited social infrastructures e.g. houses, power supply etc. in the host communities.	*Remedial Works on Spillway, Downstream Channels Repair, Repair Works on the Embankment, rehabilitation of intake tower.*		from nearby communities. • Provide alternative accommodation with relevant facilities for construction workers. • Make adequate security arrangements for the rehabilitation project. • Educate workers on safe sex and possible abstinence.	
		<u>Decommissioning</u> *Dismantling of Structures*	Minor		Negligible
Labour Displacement	• Potential loss of jobs and source of income for the engaged laborers • Potential loss of jobs and source of income for both skilled and unskilled workers mostly drawn from the host communities.	<u>Decommissioning</u> *Dismantling of Structures*	Moderate	• Encourage employees, especially those still in their productive ages, to consider other sources of income e.g. farming and fishing. Small-medium businesses and possibly provide trainings.	Negligible
Business/Income	• Potential decline in sales/income for business owners around the host community at the end of rehabilitation works. • Potential loss of income among dam workers in the event of decommissioning.	<u>Decommissioning</u> *Dismantling of Structures*	Minor	• Encourage affected business owners around the project area to consider other sources of income e.g. farming and fishing.	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
Erosion/Flooding	• Uprooting of trees around embankment, if not properly carried out, could compromise the stability of the dam thereby leading to potential flooding over land assets. • Increased sedimentation and local runoff could result to flooding of the nearby terrain. • Potential loss of lives, properties and income in the event of dam failure. This could result to decreased economy in Ibadan and Oyo State in general. • Potential flooding over land assets and other protected areas in the event of dam decommissioning.	<u>construction/Rehabilitation</u> *Repair Works on the Embankment*	Moderate	• Ensure removal of trees around the embankment is carried out as recommended in order not to compromise the integrity of the dam or cause soil degradation • Ensure proper and regular maintenance/assessment of Dam structure to circumvent flooding. • Ensure strict and effective implementation of IUFMP Emergency Preparedness Plan • Engage the services of qualified Engineers/Technicians for the management and maintenance of the Dam. • Effective waste disposal/management strategy shall be developed and adopted.	Negligible
		<u>Operation/Maintenance</u> *Daily Operation of Dam*	Major		Minor
		<u>Decommissioning</u> *Dismantling of Structures*	Moderate		Minor
Sexually Transmitted Diseases	• Potential increase in illicit sexual activity could lead to a spread of STDs especially among young females in nearby communities and the temporary construction workers.	<u>Pre-construction/Rehabilitation</u> *Site clearing and preparation*	Minor	• Educate workers on safe sex and possible abstinence.	Negligible
		<u>Construction/Rehabilitation</u> *Removal of Vegetation within Spillway, Dredging, Excavation and Weir Wall Rehabilitation*	Minor		Negligible
		<u>Construction/Rehabilitation</u> *Remedial Works on Spillway, Downstream Channels Repair and Repair works on Embankment, rehabilitation*	Moderate		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
		of intake tower.			
		Decommissioning *Dismantling of Structures*	Minor		Negligible
Aesthetics and Recreation	• Excavation, grading, compaction, filling and other activities involved in the weir wall rehabilitation and reinforcement, may impact of the topography and geology of the area thereby reducing the aesthetics of the area. • Improper disposal of excavated material, vegetative and solid wastes could reduce the aesthetics of the area. • Improper disposal of construction wastes and excavated material, vegetative and solid wastes from embankment repair works and waste oils and used parts from construction vehicle/machines maintenance could reduce the aesthetics of the area making it unfit for recreational purposes. • Indiscriminate defecation by construction workers around project area could foul the environment, pollute surface water and reduce the aesthetics of the area. • During rehabilitation works, the dam area will be off-limits to people who come for recreational purposes such as swimming and game fishing. • Dismantling of the dam structure would engender increase in solid wastes reducing the aesthetics of the area.	Construction/Rehabilitation *Excavation, Weir Wall Rehabilitation; Downstream Channels Repair, Remedial Works on Spillway, Wastes Generation/Management; Construction Vehicle/machines Maintenance; Repair Works on the Embankment*	Minor	• Restrict excavation, grading and other such activities to required portions of the project area. • Develop and enforce a robust Waste Management Plan • Provide mobile toilets at strategic location around the project site. • Ensure proper restoration of project site after decommissioning.	Negligible
		Operation and Maintenance *Maintenance of on-site generators and engines; Wastes generation and handling*	Minor		Negligible
		Decommissioning *Dismantling of Structures and Wastes generation/management*	Minor		Negligible
Transportation and Roads	• Potential traffic congestion during equipment mobilization rehabilitation works could make life difficult (psychological stress) for	Pre-construction/Rehabilitation *Equipment mobilization*	Minor	• Engage the services of road traffic managers to manage traffic along the	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	resident road users. • Possible obstruction of the road across the Eleyele Bridge for safety purposes during downstream channels repair could make life difficult for other road users.	Construction/Rehabilitation *Vehicular/Traffic Movement*	Minor	affected road especially during the movement of equipment and materials to the project site. • Erect a sign to inform road users of possible road diversion before commencement of repair works.	Negligible
		Construction/Rehabilitation *Downstream Channels Repair*	Moderate		Minor.
		Operation and Maintenance *Vehicular/Traffic Movement*	Minor		Negligible
		Decommissioning *Dismantling of Structures*	Minor		Negligible
Educational Institutions (Schools)	• Increase in the number of school drop-out as a result of young people seeking job opportunities as unskilled labor at the project site	Pre-construction/Rehabilitation, and decommissioning	Minor	• Completely discourage engagement of youths of school age by liaising with community youth leaders in temporary employment process.	Negligible
Interest Group Activities/ Disturbance	• Potential agitation among youths for increased job opportunity quota and privileges. • Potential disturbance and interruption of fishing activities and other commercial activities around the dam area and downstream who depend on access to water e.g. the cassava processing and car wash business owners downstream. • Complaints from the nearby community due to increase in noise and vibrations from rehabilitation activities.	Construction/Rehabilitation *Weir Wall Rehabilitation, Remedial Works on Spillway, Downstream Channels Repair, Repair Works on the Embankment and rehabilitation of intake tower*		• Develop a robust and sustainable CSR programme for nearby communities • Duly consult with the host community of the project objectives as well as the sensitivity to possible fishing and other activities. • Liaise with community and youth leaders in engagement of local labours. • Ensure all construction machineries meet international standards for such equipments. • Ensure that there is controlled use of all equipment and that equipment engines are turned off when not in use • Fit combustion engines with effective silencers	Negligible
		Decommissioning *Dismantling of Structures*	Minor		Negligible
Accidents	• The construction workers may suffer work-related accidents or suffer attacks from wild animals during pre-construction and	Pre-construction/Rehabilitation *Site clearing and*	Moderate	• Provide and enforce usage of PPE by field workers. • Provide First aid/Anti venom and	Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
	construction/rehabilitation phases.	*preparation*		insect repellent on site. • Create awareness among site workers and nearby communities on the likelihood of exposure to wildlife/insect attack. • Ensure that all chemicals, paints, thinners and other hazardous materials are properly stored and used in a safe manner to prevent possible damage to people and the environment.	
	• Potential increased road traffic could lead to road accidents. • Potential fall or other work-related accidents during rehabilitation activities. • Potential accident and injuries especially to pedestrians (farmers and fishers) who may not be aware of this activity especially in the dark early morning hours while going to farm. • Dam/maintenance workers may be exposed to accidents during routine dam operation and maintenance. • Increased water in the reservoir could lead to overflow and eventual dam collapse	Pre-construction/Rehabilitation *Equipment mobilization*	Moderate	• Install appropriate road signs (Appendix 5.1) and also engage the services of traffic police to manage traffic and control pedestrians. • Educate drivers on safe driving and maintain a safe driving limit on the road. • Ensure that vehicles are duly serviced. The vehicles • Develop a robust emergency response plan. In addition, ensure incorporation of all safety precautions and device for sensitive activities. • Provide appropriate PPE and enforce proper use. • Put in place a well-equipped sick bay and MEDIVAC for injured or ill personnel. • Duly consult with the host community of the project objectives as well as the sensitivity/dangers to possible farming and fishing activities. • Ensure that work area shall be condoned off as restricted areas with	Negligible
		Construction/Rehabilitation *Vehicular/Traffic Movement, Downstream Channels Repair*	Moderate		Negligible
		Decommissioning *Dismantling of Structures*	Moderate		Negligible
		Construction/Rehabilitation *Daily Operation of Dam, Maintenance of on-site generators and engines*	Minor		Negligible

Environmental/ Social Attributes	Potential Impacts	Project Phase/Activity	Impact before mitigation	Mitigation Measures	Impact After Mitigation (residual)
				ample warning signals. • Ensure that health talks and awareness and job hazard analysis are carried out prior to work activities. • Rehabilitation of effective intake tower woud reduce potemtial dam collapse due to reserviour overflow.	

CHAPTER SIX

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

6.1 INTRODUCTION

An Environmental and Social Management Plan (ESMP) is an important component of an ESIA as it provides an important tool that can be used to measure and check, in a continuous mode, the efficacy of the mitigation measures and project commitments incorporated in an ESIA to minimize or eliminate identified negative impacts. In addition, the ESMP may also be used to ensure compliance with statutory requirements and corporate safety and environmental policies.

The application of the ESMP produced in an ESIA usually starts from the project planning phase, when such tools are used to ensure that mitigation measures generated during the EIA study are implementable. Other components of the EMP usually find application during project construction and operations, as monitoring tools for specific environmental attributes.

6.2 OBJECTIVES OF THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The objectives of the ESMP include:

- To monitor the project proponent's compliance with all the mitigation measures and commitments to ensuring environmental sustainability as spelt out in the ESIA report.
- To provide early warning signals on potential environmental changes, so that appropriate actions can be taken to prevent or minimize environmental and social impacts.
- To put in place a sound and cost-effective contingency plan that can be activated for prompt response to any accidental occurrence such as dam failure.
- To routinely check all measures/devices put in place for effective monitoring of project functions and activities.
- To routinely establish the effectiveness of applied mitigation measures on environmental and social receptors, in order to recommend environmental and social audit as preparedness and risk prevention measure.

6.3 PROJECT PROPONENT AND REGULATORY AGENCIES PLAN

The proposed dam rehabilitation will no doubt have both positive and negative impacts on the biophysical and social environment within and around the study area as presented in chapter 5 of this report. The responsibility of maintaining a sustainable environment of the proposed project area lies on IUFMP and the various contractors and relavant agencies involved in this project. This section identifies roles and responsibilities to all the various parties involved in the implementation of the dam rehabilitation project.

6.3.1 Staffing and Training

IUFMP shall ensure that for the purpose of the proposed dam rehabilitation every category of its contractor and personnel is adequately trained on the various aspects of the work. Personnel will be trained on effective waste management, environmental protection, safety and safety checks and maintenance of dam facilities. IUFMP shall also reinforce staff (including contract staff) training with regular induction courses and refresher courses/programmes.

IUFMP shall equally ensure that all personnel attend orientation meetings, which will include discussions on the following:

- materials hazardous to the environment;
- first actions in case of emergency;
- pollution prevention – pipework, materials transfer, handling and storage procedures;
- waste management –standards, procedures for waste minimization;
- segregation, storage, transfer and/or disposal procedures;
- monitoring and reporting responsibilities and procedures, as applicable;

The environmental safeguard specialist shall keep a log of the attendance of this orientation meeting and periodic 'refresher' briefings that will be conducted by the Project Contractor for new members of the dam rehabilitation operation. Table 6.1 presents a summary of the relevant training and capacity building plan for the proposed dam rehabilitation project.

Table 6.1: Training and capacity building plan

s/n	Capacity Needs	Participant	Subject	Resource Person	Cost per Participants (Naira)	Duration (days)
1	General training on environmental and social management	IUFMP PIU and Oyo State Ministry of Environment Project personnel and participants from other related institutions	• World Bank project cycle and relevant Safeguard Policies. • Environmental and Social Impact Assessment • Monitoring and Inspections	• World bank accredited Consultant • World bank accredited Environmental and social safeguard consultant • Dam safety engineer and environmental consultant	250,000	5
2	Health Safety and Environment (HSE) training	IUFMP PIU Project team and participants from other related institutions	General principles of Health Safety Environment (HSE) Practice and Management	HSE auditor, Dam safety engineer and environmental consultant	250,000	5

A total of about =N=11,000,000 (Table 6.4) is estimated for training and capacity building. This is based on our assumption that apart from the local resource persons, other resource persons

may be coming from Europe or America and would therefore require travel allowances. In addition, participants from other related institutions would be paid per diem.

6.3.2 Emergency Preparedness and Response Plan

IUFMP has in place an Emergency Preparedness Plan (EPP), which among others spells out the framework for responding to emergency incidents as well as relevant institutional arrangement for responding to such emergencies in the State. The Oyo State Emergency Management Agency (OYSEMA) will be responsible for emergency responses for the Eleyele dam rehabilitation project. Other stakeholders that shall be deployed in the event of any emergency include: State fire services, Nigeria Security and Civil Defense Corps, Ministry of Environment and Habitat, Rural water sanitation agency, Nigeria Police, Ministry of Physical and Urban Development, Ministry of Works, Local Emergency Management Agency, Nigerian Red cross society, Host Communities Emergency Response Team, Host community development association and other relevant organisations.

6.3.3 Facilities/Material Inspection

This is a salient requirement for the environmental sustainability of the proposed dam rehabilitation project. Constant inspection of dam rehabilitation equipment and facilities will be necessary for early detection of malfunctioning or deterioration of equipment/facilities, with the aim of taking prompt corrective/repair measures. IUFMP shall put in place an inspection schedule/plan that will be operative throughout the dam rehabilitation period.

6.3.4 Health, Safety and Environment (HSE) Plan

The IUFMP PIU Environmental Safeguard specialist shall play the role of HSE representative for the proposed dam rehabilitation project. The HSE representative shall ensure that the contractor complies strictly with guidelines for people safety, which shall form a guiding tool for IUFMP's daily decisions. In addition, the HSE representative shall ensure that contractor's Safety Officer conducts "Tools Box Talk" every day prior to commencement of work and minutes of safety meetings and HSE monthly statistics records submitted to IUFMP PIU as and when due.

Other responsibilities of the HSE representative/Environmental Safeguard Specialsit shall include:

- review of all safety and environmental protection issues identified in the ESIA report with the purpose of implementation;
- implementation of safety and environmental provisions of the ESIA report;
- implementation of the contingency plan of IUFMP and all legislative requirements mentioned in the ESIA report;
- keeping adequate records and making them available to regulators and relevant interested third parties.

The Project Contractor shall ensure that all personnel engaged in this rehabilitation project are adequately trained in safety, environmental management and emergency procedures. IUFMP PIU through her Environmental specialist shall monitor all project contractors' operations in Eleyele dam and ensure conformity with environmental standards. In particular, personnel must have an understanding of the rationale for the recommended mitigation measures and monitoring programme. This is essential to ensure compliance with good practices and other

special requirements to mitigate adverse impacts and detect any impact, which may occur so that corrective actions can be initiated. All chemicals, paints, thinners and other hazardous materials must be properly stored and used in a safe manner to prevent damage to people and the environment.

6.3.5 Communication Plan

Continuous communication shall be instituted on the proposed dam rehabilitation project. Critical aspect of the communication plan shall be stakeholders engagement plan and grievance redress mechanism.

Stakeholders Engagement

IUFMP PIU shall put in place a robust strategy for engagement with relevant stakeholders. This responsibility shall rest on the Social Safeguard Specialist of the PIU. Stakeholder engagement shall be an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to affected communities/persons. The nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development.

Grievance Redress Mechanism

IUMFP shall establish a grievance redress mechanism to receive and facilitate resolution of Affected Communities/persons' concerns and grievances about the dam rehabilitation environmental and social performance. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project on Affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate and readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The PIU Social safeguard specislist will inform the possible affected communities/persons about the mechanism in the course of the stakeholder engagement process.

6.3.6 Waste Management Plan

Poor waste management strategy can be deleterious to the prevailing environmental conditions, causing health challenges that could result in social unrest and therefore, hinder project development. Waste generated during various phases of the project must be properly managed to ensure prudent and responsible collection, segregation, storage, transportation, treatment, recycling and disposal. A waste, be it solid, semisolid, liquid materials or any contaminated solid material must be properly segregated and adequately disposed in accordance with regulatory standards. All Hazardous wastes and domestic wastes shall not be disposed of unless adequately treated. All wastes generated from the operations shall be packaged and transported to government accredited waste handlers for treatment prior to final disposal.

The Project Contractor shall adhere strictly to the PIU waste management plan for this project (Appendix 6.1). All site workers shall also be mandated to comply with the requirements of this

waste management plan, keeping waste tracking documentation and making it available to the PIU Environmental safeguard specialist on demand for inspection and verification.

6.3.7 Project Planning and Implementation Strategy

Dam development/rehabilitation project usually entails a number of activities. IUFMP intends to carry out these activities to ensure the following.

- Avoid injury to personnel by implementing appropriate HSE policy throughout the duration of the project.
- Reduce to the minimum, the environmental and social impacts that are likely to result from the dam rehabilitation activities. This will be achieved by:
  - the integration of environmental and social management issues into the proposed project plan;
  - the development and implementation of a waste management plan for the proposed project;
  - the review of environmental and social issues during project review meetings;
  - the promotion of environmental and social management awareness among personnel and
  - verification via surveillance by regulatory agency and IUFMP environmental and social safeguard personnels, of the implementation and effectiveness of the various impact mitigation measures described in the environmental and social management plan.

IUFMP, in compliance with regulatory and requirements, shall ensure that the dam rehabilitation contractor implement the programme in accordance with relevant guidelines such as World Bank OP 4.37- Safety of dams as well as industry best practices including use of best available technology (BAT).

6.3.8 Environmental and Social Monitoring Plan

Environmental and social monitoring is essentially a process aimed at detecting negative impacts of a project on the biophysical and social environment early enough to take remedial actions.

For the proposed dam rehabilitation, the main focus of the environmental monitoring shall be the proper management and disposal of the various wastes that shall be generated. The Project Contractor shall be responsible for monitoring and reporting of waste generated. However, IUFMP PIU Environmental Safeguard Specialist shall ensure the effective collection and disposal of all waste generated in line with regulatory guidelines. Major sources and characteristics of waste that may be associated with the project can be categorized as follows.

- Atmospheric emission from exhaust of engines and other ancillary equipment.
- Solid wastes such as wood, vegetation debris, metals, concrete debris from demolished portions of the dam facilities.

The benchmark for environmental monitoring shall be the database contained in environmental baseline section of this ESIA report while standards shall be in accordance with FMEnv environmental and social monitoring programme for all activities.

In this sub-section, we present a concise description of the parameters of each relevant environmental and social attribute, potential impact, recommended mitigation measures, and estimated cost of mitigation. It also highlights parameters to be monitored, the timing and frequency of monitoring that is deemed necessary to ensure that even the most subtle of negative environmental and social changes are detected as well as the party responsible for implementing the monitoring. Table 6.2 shows the impacts, mitigation measures as well as estimated cost of mitigation for the proposed dam rehabilitation project, while table 6.3 shows the monitoring plan of various relevant environmental and social components and estimated cost of monitoring.

Table 6.2: Impact, Mitigation Measures, Implementation Schedule, Responsibilities for Mitigation, Monitoring and Mitigation Cost

Impact	Phase	Mitigation	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
					Implementation	Supervision		
Indiscriminate defecation especially during construction and decommissioning	Construction and decommissioning	Provide mobile toilets	Faecal material around project site	During construction and decommissioning	Project contractor/Project Consultant	PIU Environmental safeguard specialist	weekly	2,100,000
Indiscriminate disposal of solid waste	Construction and decommissioning	Provide waste bins with lids at strategic location around project site and enforce use	Litter and wastes around project site	During construction and decommissioning	Project contractor/Project Consultant	PIU Environmental safeguard specialist	weekly	250,000
		Engage the services of accredited waste manager to dispose wastes as and when due						3,150,000
Disruption of downstream artisanal fishing	Construction	Adequately consult with the host community of the project objectives sensitivity to possible fishing activities.	Loss/reduced fish catch	During dredging and impoundment	Project contractor/Project Consultant	PIU Environmental safeguard specialist	weekly	250,000
Potential shortage of water supply to riparian users	Construction	Provide alternative supply of water for the affected communities e.g. boreholes.	Shortage of water	During dredging and impoundment	Project contractor/ Consultant	IUFMP PIU Project engineer/PIU Environmental and social safeguard specialists	Weekly	2,500,000

Impact	Phase	Mitigation	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
					Implementation	Supervision		
Gaseous emissions from construction vehicles and machines	Construction and decommissioning	Regular service and maintenance of construction vehicles and machines	Soil, surface water and vegetation	After routine service and maintenance of construction vehicles and machines	Project contractor/ Consultant	Project engineer/PIU Environmental safeguard specialist	Monthly	2,100,000 250,000
Increase in particulate during construction	Construction and decommissioning	sprinkle water on the construction site prior to clearing and earth moving activities, especially in the event that this activity is carried out in the dry season	Ambient air total suspended particulates (dust)	During Construction	Project contractor/ Consultant	Project engineer/PIU Environmental safeguard specialist	Weekly	640,000
Influx of temporary workers	Construction and decommissioning	Provide alternative accommodation with relevant facilities for construction workers	Population change in host communities	During Construction	Project contractor/ Consultant	Project engineer/PIU Social safeguard specialist	Monthly	1,260,000
Potential increase in social vices (robbery, vandalism, prostitution etc)	Construction and decommissioning	Provide adequate security arrangements during construction and decommissioning phases.	Increased population and socioeconomic activities	During Construction	Project contractor/ Consultant/Security personnel	Project engineer/PIU Social safeguard specialist	Weekly	2,100,000

Impact	Phase	Mitigation	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
					Implementation	Supervision		
Potential increase in STIs, AIDs and teenage pregnancy	Construction and decommissioning	Educate workers on safe sex and possible abstinence	Influx of migrant workers and increased social activities	During Construction	Project contractor/ Consultant	Project engineer/PIU Social safeguard specialist	Monthly	500,000
Potential increase in traffic congestion along Eleyele-Ologuneru road	Construction and decommissioning	Engage the services of road managers to ensure free movement of vehicles especially at peak periods	Traffic congestion on adjoining roads	During mobilization of equipment and materials to site	Project contractor/ Consultant/Traffic managers	Project engineer/PIU Social safeguard specialist	Daily	1,050,000
Pressure on limited community infrastructure	Construction and decommissioning	Erect a sign to inform road users of possible road diversion before commencement of repair works	Unusual traffic congestion on adjoin roads	During mobilization of equipment and materials to site	Project contractor/ Consultant	Project engineer/PIU Social safeguard specialist	Daily	250,000
Potential communal clashes due to perceived differences in employment opportunities	Construction and decommissioning	Engage community leaders to consult with qualified youths on employment opportunities	Cases of community/youth grievance	During employment of temporary construction workers	Project contractor/ Consultant/community leaders	Project engineer/PIU Social safeguard specialist	Weekly	250,000
Potential road accidents due to increased vehicular	Construction and decommissio	Educate drivers on safe driving and maintain a safe	Near misses, accident reports	During construction	Project contractor/ Consultant	Project engineer/PIU Social	Weekly	750,000

Impact	Phase	Mitigation	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
					Implementation	Supervision		
movements	ning	driving limit on the road				safeguard specialist		
Potential work related accidents	Construction, operation and decommissioning	Provide and enforce usage of PPE by field workers	Injuries and accident reports	During construction	Project contractor/ Consultant/community leaders	Project engineer/PIU Environmental safeguard specialist	Weekly	2,000,000
		Put in place a well-equipped sick bay and MEDIVAC for injured or sick personnel.						3,500,000
Total								**22,800,000**

Table 6.3: Monitoring Plan

Phase	Component (Environmental and Social)	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
				Implementation	Supervision		
Construction and decommissioning	Air Quality	Emissions (CO, NO_X, SO_X, VOC) from construction vehicles and machines as well as dusts from construction surface.	During and after site clearing	Project contractor/Project Consultant	IUFMP PIU Project engineer/PIU Environmental safeguard specialist	Weekly	4,500,000
Construction and decommissioning	Noise	Noise Level (dBA)	During construction and decommissioning	Project contractor/Project Consultant	PIU Environmental safeguard specialist	weekly	350,000
Construction and decommissioning	Soil Quality	pH, TOC, Heavy metals, THC	During construction and after decommissioning	Project contractor/Project Consultant	PIU Environmental safeguard specialist	Monthly during construction and a month after decommissioning	3,500,000
Construction	Surface water (Reservoir and downstream)	pH, TSS, DO, BOD_5, Heavy Metals, hydrocarbon, turbidity, and faecal coliform,	During construction (dredging and impoundment)	Project contractor/Project Consultant	PIU Environmental safeguard specialist	Weekly	3,500,000
Construction and decommissioning	Solid Waste	Indiscriminate disposal of construction wastes, equipment packaging materials, plastics, sanitary and office wastes.	During construction and decommissioning	Project contractor/Project Consultant	PIU Environmental safeguard specialist	Weekly	350,000
Construction	Vegetation and	Loss of plants and crops	During site	Project	PIU	Weekly	250,000

Phase	Component (Environmental and Social)	Monitoring Indicators	Implementation Schedule	Responsibility		Frequency	Cost Estimate (=N=)
				Implementation	Supervision		
	wildllife		clearing	contractor/Project Consultant	Environmental safeguard specialist		
Construction to decommissioning	Community Consultation	Discussion of issues that border on the health of project and community.	Throughout project life cycle	Project contractor/Project Consultant	PIU Social safeguard specialist	Monthly	2,500,000
Construction	Traffic	Traffic	During construction	Project contractor/Project Consultant/Traffic manager	PIU Social safeguard specialist	Daily	750,000
Construction, operation and decommissioning	Soil Erosion/Flooding	Scarification of land surface and flooding	During excavation, operation and decommissioning	Project contractor/Project Consultant	PIU Social safeguard specialist	Weekly	1,000,000
Construction	Community Infrastructures	Influx of workers and people will put pressure on the very limited and non functional infrastructures	During construction	Project contractor/Project Consultant	PIU Social safeguard specialist	Monthly	350,000
Construction	Community conflict	Equity in employment opportunity among the host communities	During engagement of temporary constrcution workers	Project contractor/Project Consultant	PIU Social safeguard specialist	Monthly	350,000
Total							**17,400,000**

6.4 ESMP BUDGET

A total of about =N=68million is estimated to be the cost of implementing the ESMP for the proposed dam rehabilitation.

Table 6.4: Summary of indicative budget breakdown and responsibility of the cost for implementing the ESMP Instruments

Item	Responsibility	Cost Estimate in Nigerian Naira (N)	Cost Estimate in Us Dollars (US$)*
Mitigation	IUFMP PIU/OYSEPA	22,800,000	72,380.95
Management	IUFMP PIU	10,000,000	31,746.03
Monitoring	IUFMP PIU/Consultants	17,400,000	55,238.1
Training & Capacity Building	IUFMP PIU/Consultants	11,000,000	34,920.63
Sub- Total		***61,200,000***	***194,285.7***
Contingency	10% of subtotal	6,120,000	19,428.57
Total		**67,320,000**	**213,714.3**

*Official exchange rate of =N315 to 1USD (October, 16, 2016)

CHAPTER SEVEN

REMEDIATION PLANS AFTER DECOMMISSIONING

7.1 INTRODUCTION

This chapter presents the plans that have been put in place by IUFMP to recover and/or restore the project site to its original state after the project's life cycle.

Remediation plans after decommissioning requires a sound understanding of all the environmental components of the project on the ecosystem during its lifespan. It is therefore a best-practice requirement to take this component into cognizance even at the conceptualization of the project.

After decommissioning, there are various restoration options as it relates to the environment where the project once existed. These options include:

- Remediation to pre-project state or condition.
- Partial remediation.
- Remediation to acceptable alternative condition. i.e.
    - To assess the environment to allowable baseline conditions and monitor the abandoned environment in line with legislative and regulatory requirements and best industry standards.
    - To assess, if any, the residual impacts that the project may have on the environment;
- No remediation.

For the proposed project, IUFMP proposes to adopt a combination of both the partial remediation and remediation to acceptable state.

7.2 DECOMMISSIONING PLAN/ACTIVITIES

Eleyele dam has proven to be a viable source of municipal water supply to the people of Ibadan In addition, prior to the collapse in 2011; it has also function as a useful tool for flood control in the city. It is on this background that the proponent proposes to carry out an emergency rehabilitation of the dam. Given the good history, Eleyele dam and its appurtenances after rehabilitation, is expected to have a life expectancy of not less than 50 years. Until this time, the dam is not expected to be decommissioned. The operation and maintenance procedure of the dam shall provide for monitoring the performance and integrity of the dam components. However, when the performance of the dam scales to diminishing returns and all best internationally acceptable standards to resuscitate it fail to yield desired result, strict legislative requirements and international best procedures for decommissioning shall be invoked. The goal of IUFMP should be that the contractor vacates the site in a safe and environmentally acceptable condition. To achieve this, the following shall be carried out:

- the embankment, weir walls, channels etc shall be carefully removed from ground surface;
- all equipment will be removed from site; and
- adequate check shall be carried out to ensure that no significant obstacles remain.

The recommended remediation measures are expected to mitigate the possible resultant negative impacts of this decommissioning phase on the environment.

7.2.1 Potential Impacts of Decommissioning

Potential impacts from decommissioning activities are presented by the type of affected environmental resource as follows:

- **Noise**

Sources of noise during decommissioning would be similar to those during construction/rehabilitation and would be generated primarily by decommissioning equipment and vehicular traffic. Noise levels could exceed regulatory limits but is expected to be intermittent and only for a limited time.

- **Air Quality**

Emissions generated by activities during the decommissioning phase include vehicle emissions; diesel emissions from large construction equipment and dust from many sources such as land clearing, structure removal, cement mixing, backfilling, dumping, reclamation of disturbed areas (grading, seeding, planting), and truck and equipment traffic. These emissions would not be expected to cause an exceedance of air quality standards.

- **Ecological Resources**

Impacts to ecological resources from decommissioning activities would be similar in nature to the impacts that would occur during construction, but at a reduced magnitude. There would be a temporary increase in noise and visual disturbance associated with the removal of dam facilities. Negligible to no reduction in wildlife habitat would be expected, and injury and mortality rates of vegetation and wildlife would be much lower than they would be during construction.

- **Socio-economics**

Direct impacts would include the creation of new jobs for workers during decommissioning activities and the associated income and taxes paid. Indirect impacts are those impacts that would occur as a result of the new economic development and would include things such as new jobs at businesses that support the workforce or that provide project materials, and associated income and taxes. No adverse effect to property values is anticipated as a result of decommissioning.

If significant impacts were to occur in any of the resource areas during decommissioning and these were to disproportionately affect low-income populations or women trading groups, then there could also be a negative socioeconomic impact. Issues that could be of concern during decommissioning however, are noise, dust, and visual impacts; as well as distortion of fish and wildlife habitats, which could have been of benefit to subsistence users. Others include; potential loss of portable water around the metropolis, loss of jobs etc.

- **Hazardous Materials and Waste Management**

Substantial amounts of solid waste may be generated during the decommissioning and dismantling of the Eleyele dam facilities. Some of the solid material can be recycled and sold as scrap or used for other projects; the remaining nonhazardous waste would be sent to government authorized waste disposal facilities. This will be transported by licensed waste handlers or OYSSWMA to an appropriate and permitted off-site disposal facility. Negative

impacts could result if these wastes are not properly handled. There are no hazardous expected to be generated from possible decommissioning.

- **Health and Safety**

Potential impacts to worker and public health and safety during decommissioning would be similar to the accidents during construction and rehabilitation; and relate to earthmoving, use of large equipment, dismantling of dam components, falling objects and transportation of overweight and oversized materials. Improperly closed sites can be a safety hazard. Increased or reckless driving by construction/dismantling workers would also create safety hazards

- **Transportation**

Short-term increases in the use of local roadways may occur during decommissioning and reclamation. Overweight and oversized loads could cause temporary disruptions to local traffic.

- **Surface Water and Groundwater**

The greatest potential impact to water resources resulting from the demolishing of a dam structure and other civil works will be increase in surface water turbidity and alteration of the river bed composition. Deterioraion of surface water will also make it unfit for some riparian use e.g. fufu processing women downstream.

7.2.2 Abandonment Plan

All activities related to decommissioning or abandonment will be initiated ahead of time. Considerations will be given to ensuring the safety of movement and water navigation, bearing in mind the fact that abandoned dams can pose as potential hazards to humans and wildlife after project decommissioning. All appropriate regulatory and IUFMP requirements will thus be taken into cognizance. In addition, removal of all structures will be carried out with due regard to fishing and protection of the reservoir environment and the rights and duties of the government.

Before decommissioning, IUFMP will develop plans that include the following:

- Identify the components of the dam facilities that will be abandoned and/or removed;
- Propose method(s) for abandonment/removal, disposal or re-use of any equipment/material if applicable;
- Identify and implement mitigation measures to minimize any identified potential environmental impacts associated with the decommissioning/abandonment process and
- Conduct site rehabilitation/restoration where necessary.

7.2.3 Regulatory Engagement & Approval Request

Aside from any regular/periodic engagement IUFMP may have with the regulators, World Bank and FMEnv will be engaged early to discuss and approve the comprehensive plan for the decommissioning of the dam. IUFMP shall invoke a pre-written standard decommissioning and abandonment program and submit a decommissioning notification letter along with a detailed decommissioning plan to the Bank for approval.

7.3 SITE REMEDIATION PLANS

Site remediation plans depend on the environmental characterization of the project area as well as the significance of the associated impacts. The goal of the proponent is to leave the decommissioned site in a safe and environmentally acceptable condition. To achieve this, good

waste management plan shall be put in place during decommissioning and the following measures shall be planned for implementation after de-commissioning:

- All equipment and debris shall be removed from the environment and disposed off in an environmentally friendly manner. The mode of disposal of these shall include the following:
    - Valves and pipes shall be decoupled and sold off as spared parts to artisans, scrap buyers or industries.
    - Excess laterite/fill/concrete materials from excavated and demolished portions shall be used to fill other failed portions around the project area or sold off as inputs in the building industry.
    - Plant debris shall be cut into pieces and carted away by accredited waste management consultant or used as organic manure.
    - Administrative/operational buildings could be leased out or used for other purposes.
- Reinstatement of all excavated portions to their original status to minimise negative impacts.
- Good waste management plan shall be put in place.
- Appropriate pension schemes shall be put in place for project workers for their up keep after eventual project closure or decommissioning.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

This ESIA has been undertaken to identify and predict the potential impacts (environmental and social) of the proposed dam rehabilitation project at Eleyele.

The economic gains to the host communities, the Local Government Authority, the Oyo State Government and the Federal Government from the project outweigh the adverse impacts. IUFMP is determined to implement the project in an environmentally sound manner that will reduce to the barest minimum the associated potential negative impacts. Given the description of the project's environmental characteristics, impact assessment, mitigations and ESMP that has been presented in preceding chapters of this report, it is therefore concluded that:

a. The Eleyele dam project has been in existence but collapsed in 2011. The proposed emergency rehabilitation works shall be on the same eleyele dam and in same location. Therefore, associated negative potential impacts to the rehabilitation works are expected to be largely minor especially when recommended mitigation measures are implemented.

b. The propsed dam rehabilitation is generally believed to be long overdue and a very welcomed development even by residents of host communities.

c. Some of the negative impacts identified include: potential pollution of ambient air, water and soil, increase in noise, pressure on limited infrastructures, potential proliferation of STDs, potential drop out of school for quick income especially during construction/rehabilitation, etc.;

d. The public/social perception is that there are overwhelming positive impacts of the rehabilitation on the lives and livelihoods of the dwellers of Ibadan city in general and stakeholders within Eleyele dam area in particular;

e. There will be no displacement of any community by the proposed dam rehabilitation project.

f. The technology, equipment and facilities that will be employed shall be within the category of Best Available Technology (BAT) and will be environmental friendly.

g. The project is not expected to engender any significant negative impacts that cannot be mitigated in view of choice of dam, equipment and facilities that will be deployed.

h. In the event of a worst-case scenario i.e. dam failure, adequate contingency measures as contained in the IUFMP Emergency Preparedness Plan shall be activated to contend with such eventual occurrence.

The proposed dam rehabilitation project is justifiable and will have a number of significant positive values including:

- Establishment of early warning and flood response actions;
- Development of a long-term flood risk management framework;
- Restoration of the flood damaged Eleyele dam;
- Improvement in environmental health through provision of clean water and sanitation;
- Boost in water supply to Ibadan metropolis;
- Enhancement of the living condition amongst Ibadan city dwellers.
- Increase in employment opportunity for qualified Nigerians, especially those residents within the project area – project affected people, and others.

8.2 RECOMMENDATIONS

IUFMP is poised to implement this dam rehabilitation project using the best available and environmentally friendly technology that will reduce associated negative impacts. The existing good relationship of the project proponent (IUFMP) with the host communities, and the general acceptability of the proposed project will no doubt enhance the successful implementation of the planned rehabilitation exercise. Based on the foregoing, it is recommended that:

- IUFMP maintains continuous consultations and cordial relationship with all relevant stakeholders including the host communities throughout the duration of the project.
- IUFMP should ensure that the prescribed ESMP is fully implemented.
- All dam rehabilitation and reservoir activities are carried out under the overall monitoring of the Environmental and Social safeguard specialists and relevant environmental regulatory agencies.
- IUFMP and FMEnv should ensure strict adherence to all specifications and standards for design, construction and mitigation measures in the implementation of this dam rehabilitation project.
- IUMFP should maintain encroachment restriction zone around the dam and resevior to forestall possible encroachment by property developers and farmers.

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APPENDICES

Appendix 1.1: Terms of Reference and Scope of Work

Appendix 1.2: Detailed Relevant Regulatory Provisions

Appendix 2.1: Dam Safety Asessment Site Visit Pictures

Appendix 3.1: Sampling and Laboratory Analytical Methods

Appendix 3.2: Pictures of Vegetation Composition in the Project Area

Appendix 4.1: Individual/Household Interview Schedule Questionnaire

Appendix 4.2: Business Operators Interview Schedule Questionnaire

Appendix 4.3: Business Operators Interview Schedule Questionnaire

Appendix 4.4: Focus Group Discussion Guide

Appendix 4.5: Photos of training and interview sessions of various groups of respondents

Appendix 4.6: List of Attendance at the Focus Group Discussion Sessions with Various Groups

Appendix 4.7: Profile of Focus Group Discussants

Appendix 5.1: General Environmental Management Conditions for Construction Contracts

Appendix 5.2: Road Signs and Marks

Appendix 6.1: Waste Management Plan

Appendix 7 : List of ESIA Contributors