FEDERAL REPUBLIC OF NIGERIA

FEDERAL MINISTRY OF WATER RESOURCES (FMWR)

THE PROJECT FOR REVIEW AND UPDATE OF NIGERIA NATIONAL WATER RESOURCES MASTER PLAN

VOLUME 8

DRAFT CATCHMENT MANAGEMENT PLAN

OGUN-OSHUN BASIN IN HA-6: WESTERN LITTORAL

JANUARY 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.
CTI ENGINEERING INTERNATIONAL CO., LTD.
SANYU CONSULTANTS INC.

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Foreign Exchange Rate

USD1.00 = NGN155.27 = JPY86.5

(31st Dec. 2012)

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Abbreviations

Abbreviation & Acronym	Explanation
ACGSF	Agricultural Credit Guarantee Scheme Fund
ADP	Agricultural Development Project
AEPB	Abuja Environmental Protection Board
AfDB	African Development Bank
BADC	British Atmospheric Data Centre
BCM	Billion Cubicmeter
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
CCU	Climate Change Unit
CD	Capacity Development
CITES	Convention on International Trade in Endangered Species
CMCC	Catchment Management Coordinating Committee
CMO	Catchment Management Office
CMP	Catchment Management Plan
CPI	Consumer Price Index
CWIQS	Core Welfare Indicators Questionnaire Survey
DDRO	Department of Dam and Reservoir Operations
DEM	Digital Elevation Model
DFID	Department for International Development in UK (UKAID)
DID	Department of Irrigation and Drainage
DO	Disolved Oxygen
DPRS	Department of Planning and Research and Statistics
DRBOI	Department of River Basin Operation and Inspectorate
DWQ&S	Department of Water Quality Control and Sanitation
DWS	Department of Water Supply
EA	Environmental Assessment
EC	European Commission
ECN	Energy Commission of Nigeria
EIA	Environment Impact Assessment
EL	Elevation
EMSS	Environmental Management Support System
ERICA	European Rivers and Catchment
ET	Evapotranspiration
EU	European Union
FAO	Food and Agriculture Organization
FCA	Fadama Association Committee
FCT	Federal Capital Territory
FEPA	Federal Environmental Protection Agency
FEWS	Flood Early Warning System
FGN	Federal Government of Nigeria
FIWD	Federal Inland Waterways Department
FMANR	Federal Ministry of Agriculture and Natural Resources
FMARD	Federal Ministry of Agriculture and Rural Development
FME(d)	Federal Ministry of Education
FME(n)	Federal Ministry of Environment
FMH	Federal Ministry of Health
FMP	Federal Ministry of Power
FMT	Federal Ministry of Transport
FMWA	Federal Ministry of Women’s Affairs
FMWR	Federal Ministry of Water Resources
FMWRRD	Federal Ministry of Water Resources and Rural Development
GCM	Global Climate Models
GDMA	Gurara Dam Management Authority

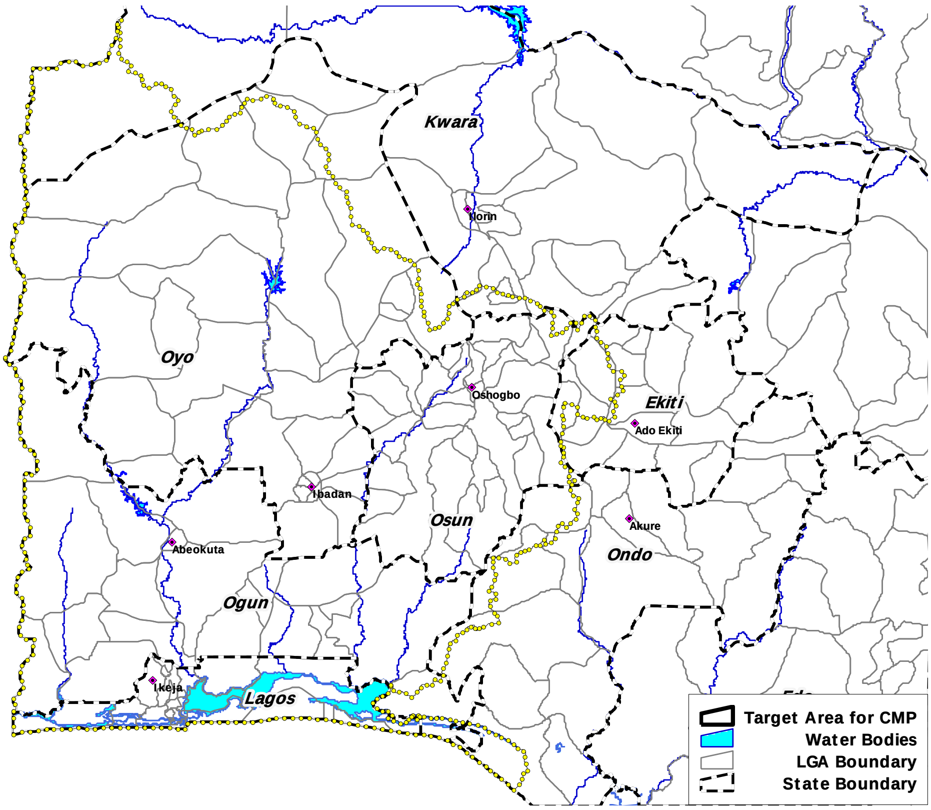
Abbreviation & Acronym	Explanation
GDP	Gross Domestic Product
GIS	Geographical Information System
GWMA	Gurara Water Management Authority
HA	Hydrological Area
HYCOS	Hydrological Cycle Observation System
ICT	Information and Communication Technology
IEE	Initial Environmental Evaluation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Programme
kW	Kilowatt
kWh	Kilowatt-Hour
LCBC	Lake Chad Basin Commission
LGA	Local Government Authority
M&E	Monitoring and Evaluation
M/P	Master Plan
MANR	Ministry of Agriculture and Natural Resources
MCM	Million Cubicmeter
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
MLIT	Ministry of Land, Infrastructure and Transport of Japan
MW	Megawatt
MWh	Megawatt-Hour
NACRDB	Nigeria Agricultural Cooperative and Rural Development Bank
NAFDAC	Nigeria Food Drag Administration and Control
NAFSS	National Agriculture and Food Security Strategy
NASRADA	Nigeria Space Research and Development Agency
NBA	Niger Basin Authority
NBN	National Bank of Nigeria
NBS	National Bureau of Statistics
NCC	Nigeria Cameroon Commission
NCWR	National Council on Water Resources
NDHS	National Demographic and Health Survey
NEED	National Economic Empowerment and Development Strategy
NEMA	National Emergency Management Agency
NERA	National Emergency Relief Agency
NESREA	National Environmental Standards and Regulations Enforcement Agency
NEWMAP	Nigerian Erosion and Watershed Management Project
NFDP	National Fadama Development Project
NFSSP	National Food Security Support Project
NGO	Non Governmental Organization
NGSA	Nigeria Geological Survey Agency
NIHSA	Nigeria Hydrological Services Agency
NIMET	Nigerian Meteorological Agency
NIS	Nigerian Industrial Standard
NIWA	National Inland Waterways Authority
NIWRMC	Nigeria Integrated Water Resources Management Commission
NNJC	Niger-Nigeria Joint Commission
NPC	National Population Commission
NPC	Nigeria Planning Commission
NRDS	National Rice Development Strategy
NRW	Non Revenue Water
NTN	National Training Network

Abbreviation & Acronym	Explanation
NWRI	National Water Resources Institute
NWSSBS	National Water Supply and Sanitation Baseline Survey
OORBDA	Ogun-Osun River Basin Development Authority
PET	Potential Evapotranspiration
PHCH	Power Holding Company of Nigeria
PPP	Public-Private Partnership
PSP	Private Sector Participation
RBDA	River Basin Development Authority
RBMC	River Bain Management Commission
RCM	Regional Climate Models
ROPSIN	Review of the Public Irrigation Sector of Nigeria
RUWASSA	Rural Water Supply and Sanitation Agency
SEA	Strategic Environmental Assessment
SHA	Sub Hydrological Area
SON	Standards Organisation of Nigeria
SRRBDA	Sokoto-Rima River Basin Development Authority
SRTM	Shuttle Radar Topography Mission
SSHA	Small Sub Hydrological Area
STWSS	Small Town Water Supply and Sanitation
STWSSA	Small Town Water Supply and Sanitation Project
STWSSP	Small Town Water Supply and Sanitation Agency
SWA	State Water Agencies
TOR	Terms of Reference
UAC	Users Association Committee
UFW	Unaccounted for Water
UNDP	United Nations Development Programme
UNEP	UN Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
VAB	Visual Basic Application
WASHCOM	Water, Sanitation and Hygiene Committee
WATSAN	Water and Sanitation
WB	World Bank
WCA	Water Consumers Association
WHO	World Health Organization
WRDP	Water Resources Development Plan
WRMP	Water Resources Management Plan
WRUP	Water Resources Utilization Plan
WSSSRP	Water Supply Sanitation Sector Reform Programme
WTP or WTW	Water Treatment Plant or Works
WUA	Water Users Association

CHAPTER 1 CURRENT SITUATION OF PROJECT AREA

1.1 Project Area

The project area of Catchment Management Plan is Ogun-Oshun Basin, the western half of Hydrological Area-6 (HA-6) which is shown in Figure 1-1. In the figure, the boundaries of hydrological area, States and LGAs are also presented.



Source: JICA Project Team

Figure 1-1 Target Area

Table 1-1 shows the States included in the project area and their share in terms of land area and population. It can be judged that the main States in the project area are Lagos, Ogun, Osun and Oyo, considering the share of area. A part of Ekiti, Kwara and Ondo are also included in the project area. The list of States and LGAs in the project area is presented in Annex-T 1-1.

Table 1-1 Area and Population of States in the Project Area

	Drainage Area (km^2)	Ratio	Remarks
1. Entire Watershed	58,315	100%	
Outside the country	917	2%	
Inside the country	57,398	98%	

	Land Area (km^2)				Population-2010 (1000 person)			
	Entire State	within project area	Share of project area	Ratio within project area	Entire State	within project area	Share of project area	Ratio within project area
2. Project Area	241,421	135,128			38,041	17,142		
Ekiti	5,782	826	1%	14%	2,696	479	2%	18%
Kwara	33,633	2,892	5%	9%	2,643	182	7%	7%
Lagos	3,635	3,609	6%	99%	10,293	10,289	41%	100%
Ogun	16,730	16,108	28%	96%	4,247	4,199	17%	99%
Ondo	14,976	1,535	3%	10%	3,875	392	2%	10%
Osun	8,550	8,421	15%	98%	3,854	3,819	15%	99%
Oyo	27,678	24,007	42%	87%	6,328	5,906	23%	93%

Source: JICA Project Team

1.2 Socio-economy

1.2.1 Population

(1) Census Population of Year 1991 and 2006

The comprehensive population census was carried out in 1991 and 2006. The result of the census revealed that the total population of the project area in1991 and 2006 was respectively 13.7 million and 21.9 million as shown in Table 1-2. Around 16% of Nigerian people live in the project area. The population growth between the above 2 census was 3.33 % annually.

(2) Estimated Population of Year 2010

None of the official population estimate of the years after the census 2006 exists in Nigeria. Meanwhile, "The World Population Progress: the 2010 Revision" by the United Nations estimated the year 2010 population of Nigeria at 158.4 million. Accordingly, this estimated population is considered as a base data for the project area, the population of which is shown in Table 1-2. Incidentally, Nigeria population of 2010 estimated by the United Nations is distributed to the states by JICA Project Team based on the state-wise growth rate between two population censuses.

Table 1-2 State-wise Land Area and Population of 4 States

Area	Land Area (km^2)	Number of LGA	Population (.000)				
			1991 Census	2006 Census	Growth (%)	Person/ km^2	2010 Estimate
1.Nigeria	909,890	775	88,992	140,432	3.18	154	158,423
2.Total of 4 States	55,597	103	13,670	21,863	3.33	1,599	24,722
: % in Nigeria	6.1%	13.2%	15.4%	15.6%	-	-	15.6%
: Lagos State	3,671	20	5,725	9,114	3.24	2,483	10,293
: Ogun State	16,400	20	2,334	3,751	3.31	229	4,247
: Osun State	9,026	30	2,158	3,417	3.21	379	3,854
: Oyo State	26,500	33	3,453	5,581	3.35	211	6,328

Source: Annual Abstract of Statistics 2009 by NBS, data provided by NPC, and "The World Population Progress - the 2010 Revision" by the United Nations.

(3) Population of Lagos States

The Lagos Bureau of Statistics estimated the state population of year 2006 by itself based on "Social Security Experiences 2006 Census" as follows:

- Population of year 2006: 17,553,000
- Population density: 3,577 persons/km^2

This figure reaches almost double the above national census. However, it should be noted that Lagos Water Corporation utilized this figure as base data in formulating the future water demand projection for "Lagos Water Supply Mater Plan (LWSMP)" formulated in 2010 and revised in 2012. Accordingly, in formulation of the CMP, a particular consideration is given to this "LWSMP".

1.2.2 Economic and Financial Conditions

(1) Gross Regional Domestic Product (GDP)

Table 1-3 presents the Gross Regional Domestic Product (GRDP) of the four states by each that were generated in year 2005. The GRDP of four states shared 24.7% in Nigeria. The economic activities in four states are dominated extremely by the primary sector in the states of Osun and Oyo; meanwhile, by the tertiary sector in the state of Lagos and Ogun (principally hotel/restaurant and wholesale/retail sale industries). The secondary sector can be seen also active in Lagos State and Ogun States, particularly in the manufacturing sectors.

Table 1-3 Gross Regional Domestic Product (GRDP) of 4 States

	Lagos	Ogun	Osun	Oyo	Total
1.GRDP by State (Naira in billion)	4,198.4	215.8	208.4	510.4	5,133.0
: Share in Nigeria	20.2%	1.0%	1.0%	2.5%	24.7%
: Share in 4 States	81.8%	4.2%	4.1%	9.9%	100.0%
2. Distribution by Sector (%)	100.0%	100.0%	100.0%	100.0%	100.0%
: Primary	1.6%	14.5%	73.8%	75.5%	12.4%
: Secondary	6.7%	17.4%	0.5%	1.3%	6.4%
: Tertiary	91.7%	68.1%	25.7%	23.2%	81.3%

Source: Information from NBS

(2) State Government Budget

Table 1-4 shows the summary of budget of the four states by each in Ogun-Oshun basin. The table reveals that the figures of Lagos State are extremely larger than those of other three states. The internal own revenues of both Lagos State and Ogun State were figured up beyond other revenues such as Federal Government allocation. This is due to the dynamic economic activities generated from the secondary and tertiary sector in these states. The capital expenditures for water supply development in Lagos State averaged 10.9billion Naira in two years of 2011 and 2012 (15.5billion Naira only in 2012).

It should be noted that Lagos State is the only state in Nigeria being awarded a credit rates from the international credit-rating agencies and issued the medium-term state bonds of 50billion Naira (equivalent to around 20% of the total own revenues) in the Nigerian capital market for the first time in 2009 for growing needs of infrastructures.

Table 1-4 Budget Summary of 4 State Governments (Naira in billion)

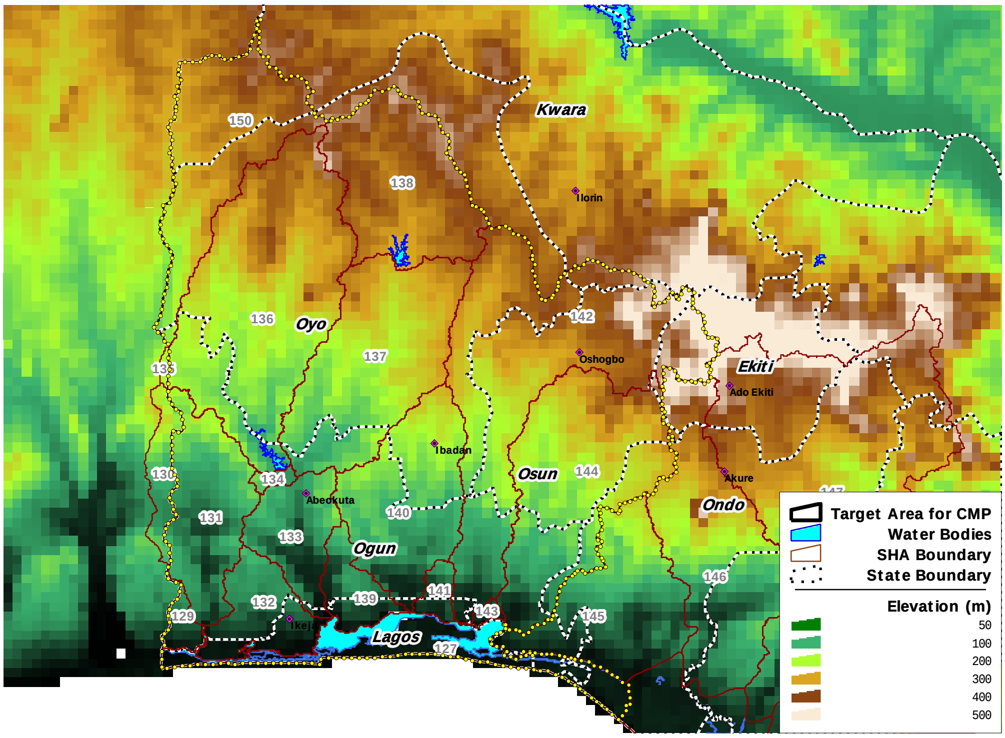
Budget Items		Lagos	Ogun	Osun	Oyo	Total
		Av. of 2 years 2011-2012	Av. of 3 years 2009-2011	Av. of 3 years 2009-2011	Av. of 3 years 2009-2011	
1. Revenues	Internal own revenue	276.2	44.8	10.1	32.4	363.5
	FGN Allocation etc.	99.9	31.3	56.2	70.1	257.5
	Total	376.1	76.1	66.3	102.5	621.0
2. Expenditures	Recurrent	215.9	55.7	40.3	58.6	370.5
	Capital	255.5	47.6	64.8	81.1	449.0
	Total	471.4	103.3	105.1	139.7	819.5
3. Balance		-95.3	-27.2	-38.8	-37.2	-198.5
4. Capital Exp. for Water Supply Dev.		10.9	1.1	2.7	2.4	17.1
Its ratio to total capital exp.		4.2%	2.4%	4.2%	2.9%	3.8%

Note: Negative balances were generally set off with such as previous years' surplus carried forward, FNG grants and loans.
Source: Budget book of 4 states

1.3 Natural Condition

(1) Topography

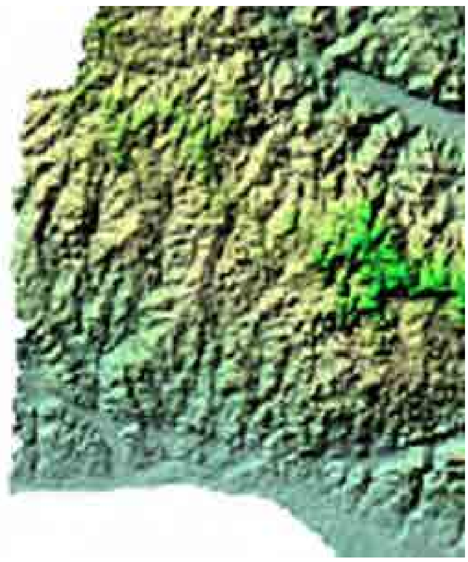
As shown in Figure 1-2, there is relatively high elevation area with about 400-500m in the northern part of Ogun-Oshun Basin. The area whose elevation is less than 200m widely extends in the remaining part of Ogun-Oshun Basin. The low land area and lagoons extends along the coastal area.



Source: JICA Project Team

Figure 1-2 Topography in Ogun-Oshun Basin

The central to the northern part of Ogun-Oshun is classified into high land area called “Western Plateau”. On the other hand the lowland, which is called as “West Nigeria Inland Low Area”, is distributed in the south of above area. The coastal area is distributed in the southern end of Ogun-Oshun Basin area with elevation of less than 100m. Top of the Plateau is flat by erosion, showing impressive feature of Isenberg’s with steep slope of various size, which abruptly stand form plain. On the other hand, lowland is distributed along the coast, facing Guinean Gulf in the southern end of Ogun-Oshun Basin. Parget area of CMP belongs to Ogun-Oshun Basin area.



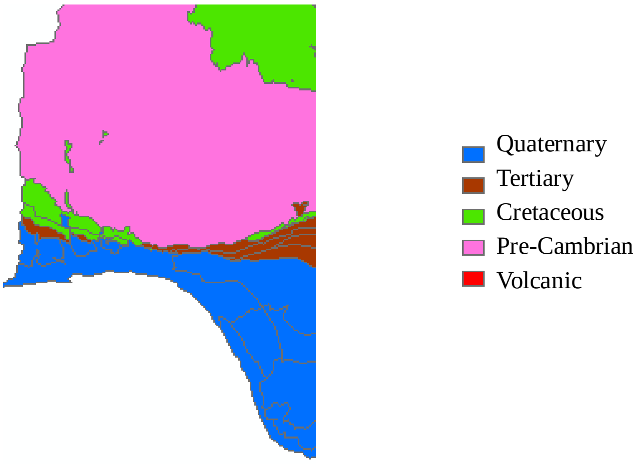
Source: JICA Project Team

Figure 1-3 Topographical Features of Ogun-Oshun Basin

(2) Geology

Geology of Ogun-Oshun Basin is classified into Basement Complex and sedimentary rocks. Basement rocks constitute plateau and high land of Ogun-Oshun Basin. Basement Complex is classified into three types below:

- Gneiss and Migmatite Complex
  Gneiss and Migmatite Complex consist of those of Pre-Cambrian era.
- Schist belts
  The Schist Belts consist of low-grade metamorphic sedimentary rocks such as schist, phyllite, marble, dolomites and amphibolite. They are enclosed within the Gneiss and Migmatite Complex in the western half of Nigeria.
- Younger Granite
  The Younger Granite consists of rhyolite, quart-diorite and granite of Jurassic period and is distributed in SSW-NNE direction in the central part of Nigeria. They are ring-dike intrusion into the older Basement Complex.



Source: JICA Project Team

Figure 1-4 Geology of Ogun-Oshun Basin

On the other hand, sedimentary rocks of after Cretaceous Age are distributed in southern part of Ogun-Oshun Basin.

- **Quaternary**
  - ✓ Alluvium
  - ✓ Deltaic Formation
  - ✓ Benin Formation
- **Tertiary**
  - ✓ Ilaro and Ameki Formation
  - ✓ Ewekoro/Imo shake and Oshuosun Formation
- **Cretaceous**
  - ✓ Abeokuta Formation
- **Pre-Cambrian**
  - ✓ Basement Complex

Sedimentary rock is distributed only along narrow belt expanding from the east to the west along the coast facing Guinean Gulf. Layers of the formation dip south, so that older formation is distributed in the northward, and younger formation is distributed in the southward respectively. For example, Basement rocks are distributed in Abeokuta, and sedimentary rocks are distributed in south of Abeokuta. Then Tertiary and Quaternary formations are distributed in the southward of above formation in this order.

(3) Hydrogeology

Characteristics of aquifer of Ogun-Oshun Basin are as follows in view points of hydrogeology.

Pre-Cambrian Basement Rocks

Pre-Cambrian rocks of Ogun-Oshun Basin consist of granite, shists and gneiss. Those rocks were weathered in depth of 30m to 100m, showing sand/gravel-like materials which form unconfined aquifer. This aquifer is distributed in small scale in the eastern half of Ogun-Oshun Basin, and suitable for water sources of rural water supply. In addition to above, fractured zone of Basement Complex also forms aquifer, though distribution of fractured aquifer is limited compared with weathered aquifer.

Sedimentary rock area

Sedimentary rocks of Ogun-Oshun Basin consist of sandstone and shale (mudstone) of Cretaceosu to Tertiasry age. Abeokuta formation of the Cretaceous age consists of sandstone, which forms excellent aquifer. Ewekoro/Imo shale and Oshuosun Formation are mudstone covering Abeokuta Formation. Covering above formations, Ilaro and Ameki Formation consist of mainly sandstone and forms aquifer.

Quaterrnary sedimentary area

There is coastal plain in the south end of Ogun-Oshun Basin, and Quaternary Formation (Alluvial Formation) is distributed in small to large scale. Quaternary formation consists of unconsolidated and half-consolidated sand and clay with high permeability forming aquifer.

Benin Formation consists of sand and sandstone forming excellent aquifer. Delta deposit and alluvial deposit are also excellent aquifer including sand layers.

(4) Vegetation

Except the southern part belonging to tropical rainforest, vegetation in Ogun-Oshun basin can be classified into Guinea-Savanna, which is the secondary vegetation due to past large-scale agricultural and productive activities.

(5) Land Use

The land use condition in Ogun-Oshun Basin is summarized in Table 1-5. The typical land use in Ogun-Oshun Basin is agricultural which covers 65.8%. The forest land shares 22.5%, which is the second largest land use type.

Table 1-5 Land Use in Ogun-Oshun Basin

	Total	Forest	Grassland/ Shrub	Agriculture	Wetland	Water body	Urban Area	Others
Area (km^2)	57,398	12,886	2,018	37,786	1,854	1,110	1,427	316
Ratio (%)	100.0	22.5	3.5	65.8	3.2	1.9	2.5	0.6

Source: JICA Project Team based on "FME, Land Degradation Mapping and Assessment for the Prevention and Control of Potential Erosion Hazard in Nigeria, Final Report, 2010".

(6) Meteorology

The climate condition in Ogun-Oshun Basin is Guinea savanna. The average precipitation and air temperature in Ogun-Oshun Basin in the last 40 years (1970-2009) are estimated at 1,289mm/year and 26.7 degree Celsius, respectively, based on the analysis by JICA Project Team. The annual precipitation varies from 1,600mm/year in the southeastern part of Ogun-Oshun Basin to 1,00mm/year in the northern part of Ogun-Oshun Basin. There are clear dry and rainy seasons. The duration of rainy season is 5months with two peaks in Jun to July and September. The detail of meteorological condition is described in Section 4.2 of Chapter 4.

(7) Hydrology

On the basis of the analysis by JICA Project Team on the meteorological and hydrological data during the last 40 years (1970-2009), it is estimated that about 16% of the total precipitation are runoff while the remaining is lost though evapotranspiration and others. The water resources potential within the territory of Nigeria is estimated at 13.0BCM/year. Adding water resources flows into Nigeria from outside the country, the total water resources potential would become 13.1BCM/year. The groundwater resources potential as renewable resources is estimated at 4.9BCM/year. The detail of hydrological condition is described in Section 4.3 - 4.5 of Chapter 4.

1.4 Water Use and Water Resources Development

1.4.1 Current Condition of Water Use

The total volume of water use in Ogun-Oshun Basin in 2010 is estimated at 1,111MCM/year. The share among municipal, irrigation and other agriculture (livestock and freshwater aquaculture) is 81%, 5% and 14%, respectively. The volume of surface water source and groundwater source is estimated at 267MCM/year (24%) and 844MCM/year (76%), respectively.

The current (2010) volume of water for municipal use is estimated at 905MCM/year. The coverage of municipal water supply is about 80%. The share of surface and ground water source is 24:76; the rate of groundwater use is much higher.

The irrigation scheme can be divided into public scheme and small private scheme. The former mainly uses surface water source. The planned public irrigation area is 41,600ha. However, the developed area is 4,300ha and the actual irrigated area is only 1,800ha. The total water use for irrigation is estimated at 60MCM/year.

The water use for livestock and freshwater aquaculture is estimated at 146MCM/year. It should be noted that the water use in freshwater aquaculture is increasing rapidly.

1.4.2 Surface Water Resources Facilities

The number of existing dams in Ogun-Oshun Basin confirmed in the present project is 37, and their total storage capacity is 1,160MCM. This is equivalent to about 8% of the total water resources potential in Ogun-Oshun Basin. The average effective storage is about 78% of the total storage capacity.

The water purification plant currently has capacity of 439MCM/year in total. Its operation rate is, however, only 46%.

1.4.3 Groundwater Development Facilities

Groundwater is developed through boreholes and shallow wells. Groundwater development is outlined below.

Standard yield of borehole

Standard yield of boreholes are shown in Table1-6. This yield should be considered experimental values because there are not statistical values with enough accuracy. It is commonly recognized that there is clear difference in yield between sand and shale.

Table 1-6 Standard Yield from Borehole by Aquifer Type

Type of aquifer		Standard Yield of borehole
Sedimentary rock and layer	Sand and gravels	20～500m^3/day
	Sandstone	20～500m^3/day
	Clayey rock	Less than 20m^3/day
Basement rocks		Less than 20m^3/day

Source: JICA Project Team

Depth of borehole

Relation between type of aquifer and depth of aquifer of Ogun-Oshun Basin is shown in Table 1-7. Only weathered part of rocks will form aquifer in the Basement Rock. Consequently, depth of boreholes usually corresponds to depth of weathered zone.

On the other hand, thickness of aquifer is different region by region in case of sedimentary rocks. Depth of boreholes depends on depth of aquifer in case of confined aquifer which is usually located deeper in the ground. Depth of aquifer becomes lager toward south because aquifers are dipping toward the south, causing distribution of aquifer to be deeper toward the south in Ogun-Oshun Basin. As mentioned above, depth of borehole has local characteristics. Depth of boreholes in Ogun-Oshun Basin is outlined as shown in Table 1-7.

Table 1-7 Aquifer Type and Borehole Depth

Aquifer type		Depth of borehole
Sedimenatry rock and layer	Sand and gravels	10～50m
	Sandstone	50～300m
	Clsy stone	30～50m
Basement complex		30～50m

Source: JICA Project Team

<u>Borehole operation rate</u>

According to survey by FMWR on water supply facilities in 2006, 37% of boreholes are non-operational. Breakdown of hand pumps and motorized pumps is main reason of low operation rate of boreholes. Water user's committees are in charge of operation and maintenance of boreholes in semi-urban and rural water supply. Boreholes are usually left without repairing pumps after breakdown.

On the other hand, yield of borehole might decrease due to aging deterioration of boreholes. However, there is no data showing it. Borehole operation rate is closely related to breakdown of boreholes. Especially, breakdown of boreholes cause low operation rate of boreholes more than effect of aging deterioration of boreholes, because yield of boreholes are small in rural water supply showing little aging effect.

1.5 Organizations and Institutional Responsibilities in Water Resources Sector

1.5.1 Institutions in Ogun-Oshun Basin and its Role and Responsibility

(1) Federal Institutions

There are numerous Federal Government Ministries, Departments and Agencies (MDAs) involved in water sector. The nature of their involvement ranges from policy and legal formulation and implementation, through regulatory to services provision. The major federal institutions including regulatory authorities in the basin are:

- National Council on Water Resources (NCWR)
- Federal Ministry of Water Resources (FMWR)
- Nigeria Integrated Water Resources Management Commission (NIWRMC)
- Ogun-Osun Catchment Management Office (CMO) of NIWRMC
- Nigeria Hydrological Services Agency (NIHSA)
- Ogun-Osun River Basin Development Authority (OORBDA)
- Federal Ministry of Environment (FMEnv)
- National Environmental Standards and Regulations Enforcement Agency (NESREA)
- Federal Ministry of Agriculture and Rural Development (FMA&RD)
- Federal Ministry of Transport (FMT)
- Nigeria Inland Waterways Authority (NIWA)
- Federal Ministry of Power (FMP)
- Power Holding Company of Nigeria (PHCN)
- Federal Ministry of Mining and Steel Development (FMM&SD)
- Nigeria Geological Services Agency (NGSA)
- Federal Ministry of Aviation (FMA)
- Nigeria Meteorological Services Agency (NIMET)
- Federal Ministry of Health (FMH)

(2) State Institutions

The major institutions in four states of Ogun-Oshun basin responsible for water supply for domestic and industrial uses, irrigation, hydropower generation, flood and erosion control, inland navigation, inland fishery, livestock, farming, water quality conservation, etc. are shown in Table 1-8.

Table 1-8 State Institutions in Water Sector in 4 States of Ogun-Oshun Basin

State	Major Institutions
Lagos	● State Ministry of Environment ● Lagos State Environmental Protection Agency (LASEPA) ● State Ministry of Agriculture and Cooperative ● State Ministry of Rural Development ● State Water Corporation ● State Agriculture Development Programs/Projects (ADPs)
Ogun	● State Ministry of Environment ● Ogun State Environmental Protection Agency (OSEPA) ● State Ministry of Agriculture ● State Ministry of Rural Development ● State Water Corporation ● State Rural Water Supply and Sanitation Agency (RUWASSA) ● State Agriculture Development Programs/Projects (ADPs)
Osun	● State Ministry of Water Resources ● State Ministry of Environment and Sanitation ● State Ministry of Agriculture ● State Water Corporation ● State Rural Water Supply and Sanitation Agency (RUWASSA) ● State Agriculture Development Programs/Projects(ADPs)
Oyo	● State Ministry of Water Resources ● State Ministry of Environment ● State Ministry of Agriculture ● State Water Corporation ● State Rural Water Supply and Sanitation Agency (RUWASSA) ● State Agriculture Development Programs/Projects (ADPs)

Source: FMWR

(3) Institutions at LGA Level

LGAs are responsible for:

- Provision of services to the communities in the areas of water supply, sanitation, and other rural infrastructure
- Assistance to the Water Corporation in water supply in the LGA jurisdiction
- Provision of maintenance of public conveniences, sewerage and refuse disposal
- Assistance to RUWASSA in coordination with Community-Based Organizations such as WASHCOM(Water and Sanitation Hygiene Committee)/WASCOM (Water and Sanitation Committee) or WESCOM (Water and Environmental Sanitation Committee) activities

(4) Other Stakeholders

Other stakeholders in Ogun-Oshun basin shall include:

- Academic and research institutes including the National Water Resources Institute (NWRI) of FMWR, universities, polytechnics and other research institutions, etc.
- Community-Based Organization (CBOs) such as WASHCOM/WASCOM in the case of UNICEF assisted programs, or WECOM in the case of Water Aid Programs.
- Private sector – various commerce and industries such as mining companies, sugar companies, cement companies, bottling companies, breweries which provide various services such as investment, consultancy and construction.
- Farmers, industries utilizing water resources for different purposes. It includes Water Users' Associations (WUAs).
- Non-Government Organizations (NGOs) that include those support federal and state MDAs, and LGAs on public awareness and mobilization of stakeholders to manage water supply and sanitation in their areas.
- External Support Agencies (ESAs) which support government projects and programs such as UNICEF, UNDP, EC, World Bank, ADB, JICA, etc.

Annex-Table 1

Annex-Table 1-1 List of State and LGA located in Project Area (1/2)

State	Code_State	LGA	Code_LGA	Total Area (km2)	Area in Ogun-Oshun Basin (km2)	Ratio (%)
Ekiti	13	Efon	23558	231.3	168.4	72.8
Ekiti	13	Ekiti South-West	23560	344.6	4.6	1.3
Ekiti	13	Ekiti West	23561	364.7	206.9	56.7
Ekiti	13	Ido-Osi	23564	230.9	19.4	8.4
Ekiti	13	Ijero	23565	389.6	373.7	95.9
Ekiti	13	Irepodun/Ifelodun	23569	355.3	31.1	8.8
Ekiti	13	Moba	23571	198.9	21.3	10.7
Kwara	23	Asa	23804	1,280.4	16.9	1.3
Kwara	23	Baruten	23805	9,677.9	2,528.2	26.1
Kwara	23	Irepodun	23812	734.3	49.2	6.7
Kwara	23	Offa	23816	95.0	52.1	54.8
Kwara	23	Oyun	23818	474.5	245.8	51.8
Lagos	24	Agege	23820	11.1	11.1	100.0
Lagos	24	Ajeromi/Ifelodun	23821	12.2	12.2	100.0
Lagos	24	Alimosho	23822	183.8	183.8	100.0
Lagos	24	Amuwo Odofin	23823	133.5	133.5	100.0
Lagos	24	Apapa	23824	26.5	26.5	100.0
Lagos	24	Badagry	23825	437.5	437.5	100.0
Lagos	24	Epe	23826	1,178.8	1,153.1	97.8
Lagos	24	Eti Osa	23827	191.0	191.0	100.0
Lagos	24	Ibeju Lekki	23828	452.0	452.0	100.0
Lagos	24	Ifako/Ijaye	23829	26.4	26.4	100.0
Lagos	24	Ikeja	23830	45.8	45.8	100.0
Lagos	24	Ikorodu	23831	391.3	391.3	100.0
Lagos	24	Kosofe	23832	80.8	80.8	100.0
Lagos	24	Lagos Island	23833	8.6	8.6	100.0
Lagos	24	Lagos Mainland	23834	19.3	19.3	100.0
Lagos	24	Mushin	23835	17.4	17.4	100.0
Lagos	24	Ojo	23836	156.9	156.9	100.0
Lagos	24	Oshodi/Isolo	23837	44.4	44.4	100.0
Lagos	24	Shomolu	23838	11.5	11.5	100.0
Lagos	24	Surulere	23839	22.8	22.8	100.0
Ogun	27	Abeokuta North	23879	801.2	801.2	100.0
Ogun	27	Abeokuta South	23878	70.8	70.8	100.0
Ogun	27	Ado Odo/Ota	23880	870.3	870.3	100.0
Ogun	27	Egbado North	23881	2,068.1	2,068.1	100.0
Ogun	27	Egbado South	23882	623.1	623.1	100.0
Ogun	27	Ewekoro	23883	589.4	589.4	100.0
Ogun	27	Ifo	23884	517.1	517.1	100.0
Ogun	27	Ijebu East	23886	2,223.3	2,223.3	100.0
Ogun	27	Ijebu North	23887	961.4	961.4	100.0
Ogun	27	Ijebu North East	23885	117.4	117.4	100.0
Ogun	27	Ijebu ode	23888	190.6	190.6	100.0
Ogun	27	Ikenne	23889	142.8	142.8	100.0
Ogun	27	Imeko Afon	23890	1,640.2	1,640.2	100.0
Ogun	27	Ipokia	23891	623.6	623.6	100.0
Ogun	27	Obafemi Owode	23892	1,399.9	1,399.9	100.0
Ogun	27	Odeda	23893	1,549.3	1,549.3	100.0
Ogun	27	Odogbolu	23894	537.7	537.7	100.0
Ogun	27	Ogun waterside	23895	996.0	374.2	37.6
Ogun	27	Remo North	23896	198.1	198.1	100.0
Ogun	27	Shagamu	23897	609.8	609.8	100.0
Ondo	28	Ilaje	23907	1,313.3	434.1	33.1
Ondo	28	Ile Oluji/Okeigbo	23908	695.2	527.4	75.9
Ondo	28	Odigbo	23910	1,811.6	237.7	13.1
Ondo	28	Ondo East	23912	352.8	16.0	4.5
Ondo	28	Ondo West	23913	966.8	319.7	33.1

Source: JICA Project Team

Annex-Table 1-1 List of State and LGA located in Project Area (2/2)

State	Code_State	LGA	Code_LGA	Total Area (km2)	Area in Ogun-Oshun Basin (km2)	Ratio (%)
Osun	29	Aiyedade	23918	1,107.8	1,107.8	100.0
Osun	29	Aiyedire	23919	261.2	261.2	100.0
Osun	29	Atakunmosa East	23916	237.2	237.2	100.0
Osun	29	Atakunmosa West	23917	574.7	574.7	100.0
Osun	29	Boluwaduro	23920	143.1	143.1	100.0
Osun	29	Boripe	23921	131.4	131.4	100.0
Osun	29	Ede North	23922	110.4	110.4	100.0
Osun	29	Ede South	23923	217.7	217.7	100.0
Osun	29	Egbedore	23924	269.3	269.3	100.0
Osun	29	Ejigbo	23925	371.3	371.3	100.0
Osun	29	Ife Central	23929	110.4	110.4	100.0
Osun	29	Ife East	23926	171.2	171.2	100.0
Osun	29	Ife North	23927	885.6	885.6	100.0
Osun	29	Ife South	23928	727.0	727.0	100.0
Osun	29	Ifedayo	23930	127.8	119.5	93.5
Osun	29	Ifelodun	23931	114.0	114.0	100.0
Osun	29	Ila	23932	301.7	221.5	73.4
Osun	29	Ilesha East	23933	70.3	70.3	100.0
Osun	29	Ilesha West	23934	62.6	62.6	100.0
Osun	29	Irepodun	23935	63.9	63.9	100.0
Osun	29	Irewole	23936	269.4	269.4	100.0
Osun	29	Isokan	23937	178.3	178.3	100.0
Osun	29	Iwo	23938	213.4	213.4	100.0
Osun	29	Obokun	23939	524.9	524.9	100.0
Osun	29	Odo Otin	23940	293.3	293.3	100.0
Osun	29	Ola oluwa	23941	326.1	326.1	100.0
Osun	29	Olorunda	23942	96.3	96.3	100.0
Osun	29	Oriade	23943	463.8	422.8	91.2
Osun	29	Orolu	23944	79.3	79.3	100.0
Osun	29	Osogbo	23945	46.4	46.4	100.0
Oyo	30	Afijio	23946	717.6	717.6	100.0
Oyo	30	Akinyele	23947	515.3	515.3	100.0
Oyo	30	Atiba	23948	1,746.5	1,746.5	100.0
Oyo	30	Atisbo	23949	2,974.0	2,974.0	100.0
Oyo	30	Egbeda	23950	189.6	189.6	100.0
Oyo	30	Ibadan North	23952	27.1	27.1	100.0
Oyo	30	Ibadan North East	23951	17.8	17.8	100.0
Oyo	30	Ibadan North West	23953	25.8	25.8	100.0
Oyo	30	Ibadan South East	23954	16.8	16.8	100.0
Oyo	30	Ibadan South West	23955	40.1	40.1	100.0
Oyo	30	Ibarapa Central	23956	436.7	436.7	100.0
Oyo	30	Ibarapa East	23957	831.9	831.9	100.0
Oyo	30	Ibarapa North	23958	1,208.2	1,208.2	100.0
Oyo	30	Ido	23959	979.9	979.9	100.0
Oyo	30	Iseyin	23961	1,339.1	1,339.1	100.0
Oyo	30	Itesiwaju	23962	1,503.2	1,503.2	100.0
Oyo	30	Iwajowa	23963	2,507.9	2,507.9	100.0
Oyo	30	Kajola	23964	604.3	604.3	100.0
Oyo	30	Lagelu	23965	336.5	336.5	100.0
Oyo	30	Ogbomosho North	23966	183.6	183.6	100.0
Oyo	30	Ogbomosho South	23967	67.9	67.9	100.0
Oyo	30	Ogo Oluwa	23968	366.8	366.8	100.0
Oyo	30	Olorunsogo	23969	1,063.4	139.6	13.1
Oyo	30	Oluyole	23970	625.1	625.1	100.0
Oyo	30	Ona ara	23971	288.0	288.0	100.0
Oyo	30	Orelope	23972	911.7	667.1	73.2
Oyo	30	Ori Ire	23973	2,105.4	1,199.9	57.0
Oyo	30	Oyo East	23974	143.1	143.1	100.0
Oyo	30	Oyo West	23975	522.6	522.6	100.0
Oyo	30	Saki East	23976	1,559.1	1,340.4	86.0
Oyo	30	Saki West	23977	1,997.6	1,985.2	99.4
Oyo	30	Surulere	23978	847.2	459.8	54.3

Source: JICA Project Team

CHAPTER 2 FRAMEWORK OF CATCHMENT MANAGEMENT PLAN

2.1 Objective of Catchment Management Plan

Objective of Catchment Management Plan (CMP) for Ogun-Oshun basin in HA-6 is to realize water resources management in HA-1 as a guideline and also a project implementation programme.

Water resources management is the approach of proper delivery of water services meeting water user's needs on the basis of 3Ss and 2Es (efficiency, equity) by using the facilities and operation systems prepared by governments and private sector.

- 3S Sufficiency, Sustainability, and Safety
- 2E Efficiency and Equity

Water user's needs on water resources are water use, mitigation of disaster on water resources and conservation of water quality and includes the followings:

- Municipal and industrial water supply
- Irrigation water
- Hydropower generation
- Flood and erosion control
- Inland navigation
- Inland fishery
- Livestock
- Water quality conservation
- Others

2.2 Basic Concepts of Catchment Management Plan

(1) Target Year of Catchment Management Plan

The target year of the CMP is year 2030 as well as National Water Resources Master Plan (M/P2013).

(2) Upper Level Plan

The upper level plan is the M/P2013 based on the following important policies and strategies for water resources development and management. If any policies, master plans or equivalent at state level, they should be included here. In case of discrepancy between national one and state's one, coordination and consensus are essential among stakeholders on water resources.

The M/P2013 was formulated in accordance with the followings:

- Nigeria Vision 20:2020
- The Nigeria Water Sector Roadmap
- Millennium Development Goals, 2000
- The Africa Water Vision
- National Water Resources Policy (Revised 2009)

(3) Concepts of Integrated Water Resources Management

As well as the M/P2013, the CMP is based on Integrated Water Resources Management (IWRM), which is being recognized internationally as an effective method on the development and management of water resources. IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment. IWRM is targeting the following three integrations (see Figure 2-1):

- Integrated consideration on natural world: To consider, in an integrated manner, any form and stage of water in natural water cycle such as water resources & land resources, water quantity & quality, surface water & groundwater and so on, that is, "Evaluation of Water Resources".
- Integrated consideration on various sectors related to water: To consider, in an integrated manner, various sectors which conventionally have been managed separately. (water for ideal rivers, flood control, water supply and sewerage, irrigation, industry and environment), that is, "Clarification and Projection of Water Demand".
- Participation of various stakeholders: To employ participatory approach to stakeholders at all levels including central government, local government, private sectors, NGO and residents, that is, "Consensus of Stakeholders".

In formulation of the CMP, the Project corresponds to the above three integration as follows:

<u>Evaluation of Water Resources Potential</u>

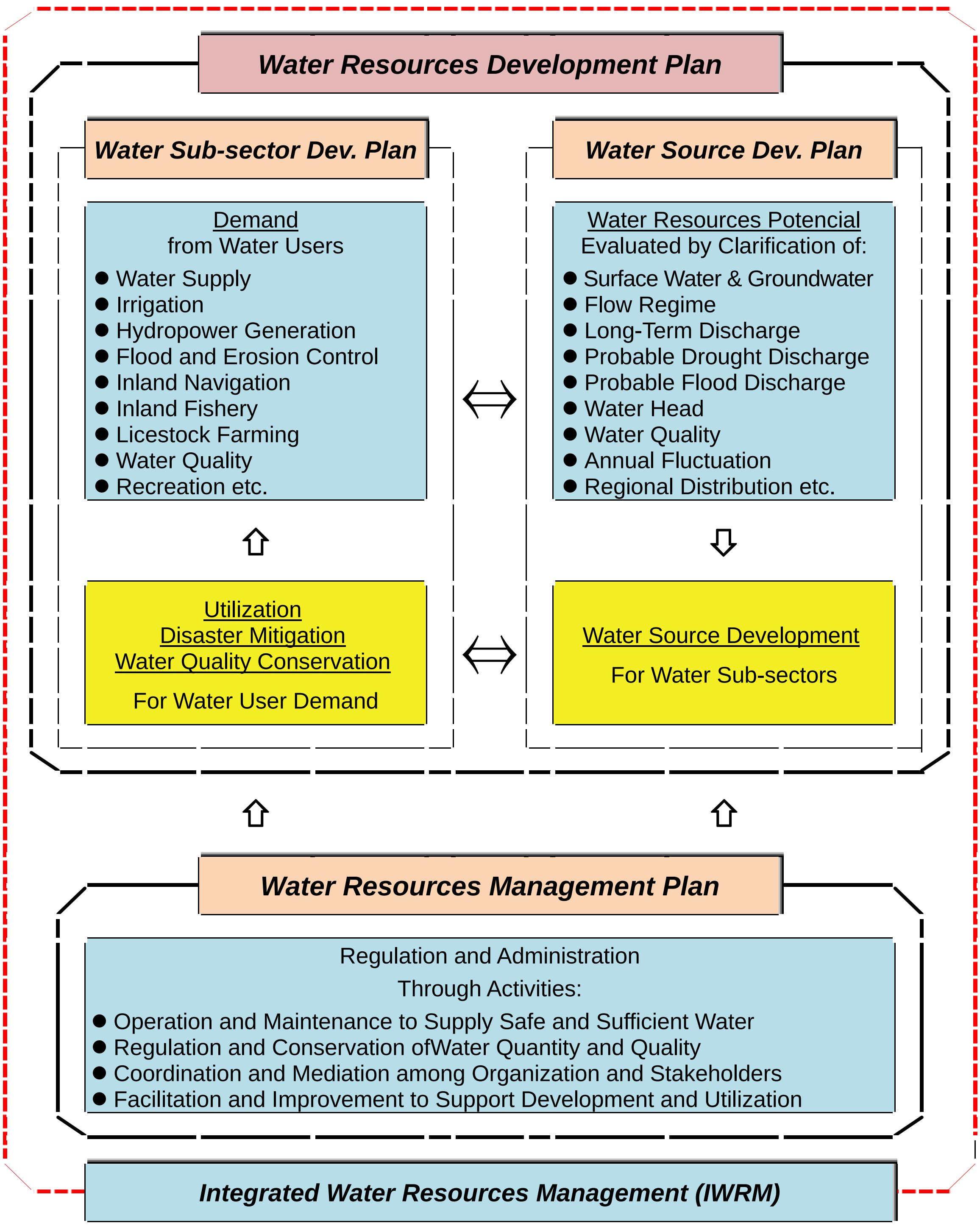
The water resources potential in HA-1 evaluated in M/P2013 is the latest one, so the Project utilizes it for the CMP.

<u>Water Demand Projection</u>

The M/P2013 projected water demand of the states located in HA-1 until 2030. If any discrepancy between this projection and state's own projection, the Project builds consensus on the projection in stakeholder meetings in parallel with water source development and sub-sector development plans.

<u>Participation of Stakeholders</u>

In order to realize the water resources development meeting the above 3S&2E, the Project invites stakeholders as many as possible and creates agreements for problem solution among various sectors or between upper and lower basins.



Source: JICA Project Team

Figure 2-1 Component of CMP based on IWRM

(4) Planning Conditions

In principle, the planning conditions shown in Table 2-1 are applied in the formulation of CMP.

Table 2-1 Planning Conditions

Item	Planning Condition
Flow and Climate Condition	1) Future climate condition is still uncertain. Therefore, the planning will be based on the existing climate and runoff conditions. 2) As a basic condition of the climate, the existing climate condition (40years: 1970-2009) is applied. Based on the existing runoff condition as well as the existing climate condition, the alternative options for water demands and water resources development will be examined.
Climate Change Impact	1) The possible climate change impact on water resources and water demand will be treated as a risk factor which we cannot control as is the case of uncertainty associated with trans-boundary water. The sensitivity of the risk factor may be analyzed. 2) For the climate change scenario, the scenario based on the output of GCM would be applied.
Trans-boundary Water	1) There are large amount of inflow through the Niger River, Benue Rivers and its tributaries, and Cross River. These inflows may be affected by the water resources development and use in the neighboring countries, which is a risk factor that is not basically controlled. The risk factor may be examined by sensitivity analysis, if necessary. 2) Especially, i) Operation of Lagdo dam in the Benue River, ii) Operation of Kandaji dam (under construction) in the upper Niger River will be carefully treated. The regulated water by these dams is not considered as a usable water source unless the minimum flow is set, by the assumption that the regulated water is basically utilized in the upstream countries.
Target Safety Level for Surface Water Development	1) The following target safety level for surface water development will be basically applied. a) Municipal Water Supply= 90% yearly dependable (1/10 years safety level: Lack of water at once in 10years can be accepted.) b) Irrigation Water Supply= 80% yearly dependable (1/5 years safety level: Lack of water at once in 5years can be accepted.) c) Other Water Supply = 80% yearly dependable (1/5 years safety level: Lack of water at once in 5years can be accepted.) It is noted that municipal water supply includes domestic, industrial and commercial through water supply system.
Priority of Water Use	1) The following principles are considered, when the surface water resources development is planned. a) The highest priority is given to domestic water use, without compromising against deterioration of environment. b) The second priority is given to irrigation water use in order to keep food security. 2) Based upon the above-mentioned principles, the following priority order of consumptive water use will be basically applied, when the surface water resources development is planned. 1st priority: Minimum stream flow requirement 2nd priority: Municipal water supply 3rd priority: Irrigation water supply 4th priority : Other water supply, if any When the hydropower component that is non-consumptive water use is included in the water resources development, the optimum use of hydropower will be considered, under the above-mentioned priority order. 3) For actual operation during extreme event such as drought and flood conditions, the priority should be discussed among stakeholders case by case. This is a part of risk management of water resources. To do so, the master plan may recommend the establishment of the committee of water use in each HA.
Minimum Stream Flow Requirement	1) Q_{97DS}90%Y (90% yearly dependable 97 percentaile daily flow for a single year), which has been estimated in the present project and may represent the drought condition according to the flow regime in each area in Nigeria, will be applied as the minimum stream flow requirement, when the surface water resources development is planned in the present project. 2) In the future, when more data for river discharge and as well as river conditions will be accumulated, more details to set appropriate minimum stream flow requirement should be discussed among stakeholders.
Groundwater Development	1) Basically, the groundwater use that exceeds safe yield should not be planned.

Source: JICA Project Team

(5) Strategic Socio-Environmental Consideration

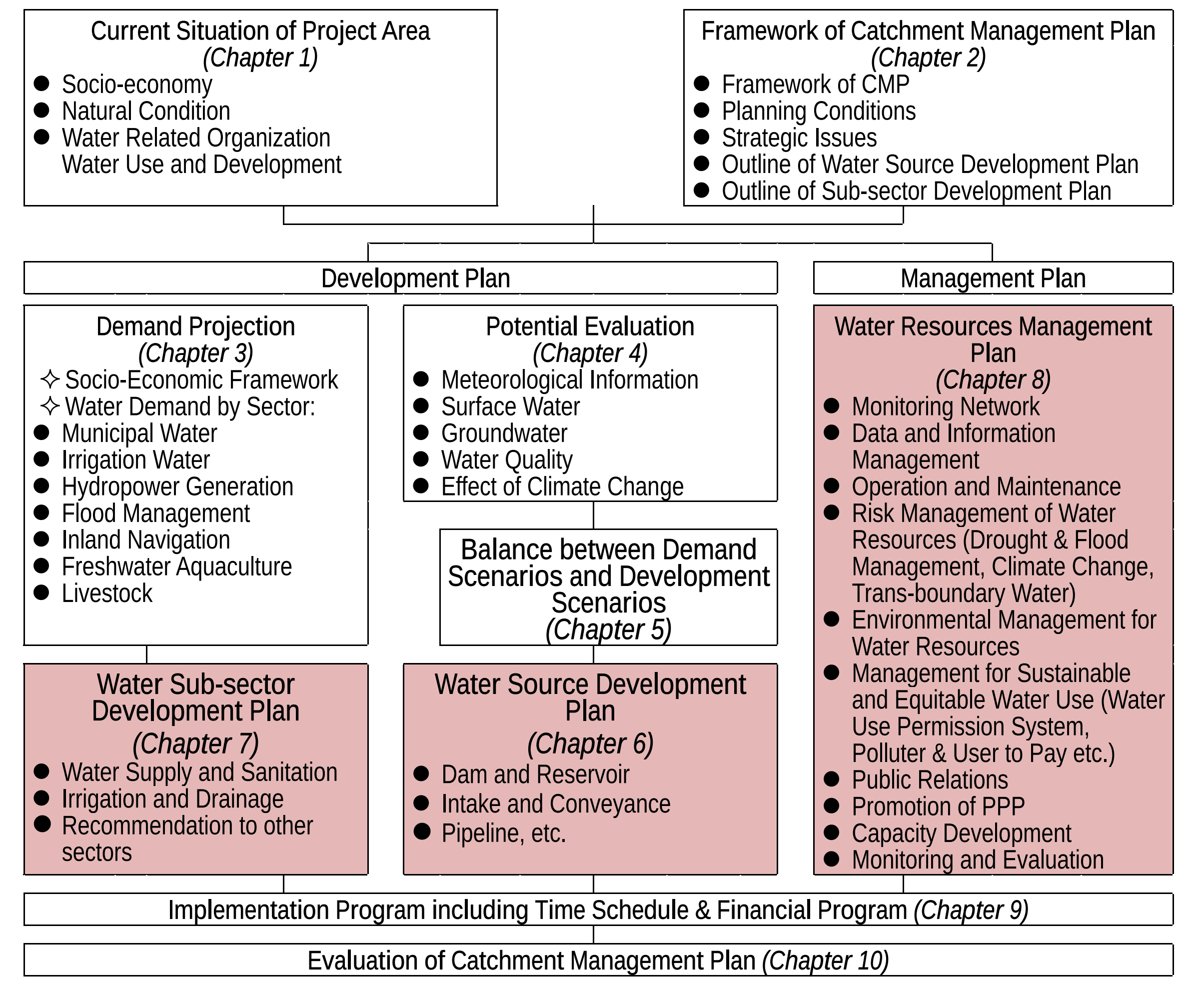
In order to avoid significant negative socio-environmental impacts, the followings are strategically considered for formulating CMP.

- Water Source Development
  - Groundwater development is to be less than safe yield so as to secure sustainable usage of groundwater.
  - Necessary new dam sites would be proposed on the basis of water balance study utilizing currently available information and data. The potential dam and reservoir sites where large town could be inundated would not be selected even though they are economically efficient sites, in order to avoid significant social impact of resettlement.
- Water Supply and Sanitation
  - New development of water supply facilities would be minimized, by promoting effective use of the existing water supply facilities by means of rehabilitation of the facilities.
  - Considering the expected increase in waste water according to the increase of municipal water demand and use, sanitation and waste water management would be more highlighted compared to M/P1995, in order to secure clean and safe water.
- Irrigation and Drainage
  - Standard cropping pattern for each hydrological area would be proposed, in consideration with precipitation and flow pattern for each hydrological area, so that water resources are efficiently utilized.
  - In general, new irrigation scheme would not be proposed in the existing Fadama area, so that the existing small private famers in Fadama area could secure their current practical life style.

2.3 Contents of Catchment Management Plan

Contents of the CMP are as follows:

- Current Situation of Project Area
- Framework of Catchment Management Plan
- Projection of Future Water Demand
- Water Resources Potential
- Water Balance between Demand and Supply
- Water Sources Development Plan
- Water Resources Sub-Sector Development Plan
- Water Resources Management Plan
- Implementation Program
- Evaluation of Catchment Management Plan
- Recommendations



[Note] (Chapter XX): Contents are discussed in this Chapter (Chapter XX).
Source: JICA Project Team

Figure 2-2 Contents of Catchment Management Plan (CMP)

The boundary of target area of CMP does not coincide with State boundaries. The followings are considered for formulating CMP.

- As for the sectors for municipal water supply and sanitation, the projects for the major four States are mainly discussed because the project proponent for these sectors is usually state government. The evaluation of the proposed projects is conducted by unit of state.
- The project in the remaining states in the target area is referred from the M/P2013.
- The municipal water demand for the major four states is reviewed in detail. The total municipal water demand is also estimated by referring the water demand in the remaining state by the M/P2013.
- As for the sectors for irrigation, all projects in the target area are shown because project proponent for this sector is mainly RBDA.
- All irrigation water demand in the target area is reviewed in detail.
- The other agricultural water demands for the major four states are shown. The total agricultural water demand is also estimated by referring the water demand in the remaining state by the M/P2013.
- The water balance is examined by the entire target area.

Dual Scenario

It was pointed out that Lagos State prepared water supply master plan based on its own population and water demand projection, which cannot be ignored, in stakeholder meetings and workshops during the formulation of CMP. In the present CMP, the following two scenarios are shown parallel.

- Scenario-A: The socio-economic framework and methodology of water demand projection in the target area is same as that applied in MP2013.
- Scenario-B: The socio-economic framework and water demand projection by States (if it exists)

Table 2-2 Basic Concept of Two Scenarios

	Scenario-A	Scenario-B
Basic Strategy	Follow the M/P2013	Respect more on State Water Supply Master Plan, if exists.
Water Demand	Follow the M/P2013	Apply water demand projection by State, if exists.
Water Supply Plan	Follow the M/P2013. However, additional information from state government is taken into account.	Follow water supply master plan by State, if exists.
Water Source Development Plan	Follow the M/P2013. However, additional information from state government is taken into account.	Water balance is examined, and necessary water source development as well as water allocation is explored.

Source: JJICA Project Team

As for the water demand projection by States, the JICA Project Team asked the State Water Corporation and the other relevant agencies to submit their own water demand projection up to 2030, if it is available, by the beginning of August, according to the agreement in the stakeholder meeting hold on 26th June, 2013. The JICA Project Team received the information on water demand projection from Lagos State. However, there was no information submitted from the other states. Ogun State Water Corporation informed that the water demand projection used in Scenario-A can be applied to Scenario-B too. For the water demand projection in Scenario-B, it is decided to use the water demand projection applied in Scenario-A for other states and that submitted by Lagos State for Lagos. It should be noted that the present CMP is formulated on the basis of the information obtained by the beginning of August, 2013.

2.4 Strategic Issues of Water Resources Development and Management in the Project Area

Issues on water resources management and development in the target area are examined in view of the nine strategic issues taken up in the M/P2013 and are summarized in Table 2-3.

Table 2-3 Strategic Issues of Water Resources Management and Development in HA-1

Strategic Issue		Issues in HA-1	Chapter/Section the topics are discussed
1	Water Resources Management and Development in Consideration of Unevenly Distributed Water Resources and Demand	Water resources potential per person is small in Ogun-Oshun Basin due to large population in the basin. The water resources potential per person in 2030 (only internal generation) is 70m^3/year/person in Logos State, which is much smaller than that in other states in Ogun-Oshun Basin, 300-500 m^3/year/person. Lagos can utilize the water that comes from upstream watershed, which means it has to rely on the resources generated in the upstream states. The water resources development and management plan has to be prepared in consideration of such locally distributed water resources potential and local water balance between demand and supply capacity.	Chapter 4 Chapter 5
2	Addressing Increasing Municipal Water Demand on the Premise of Current Low Operation Rate of Water Supply Facilities	The operation rate in the major four states in Ogun-Oshun Basin is 40.3%, which is slightly lower than the national average. In order to improve the coverage of municipal water supply, it is necessary to increase the operation rate of existing facilities as well as secure high operation rate for newly installed facilities.	Section 7.1
3	Promotion of Sound and Self-reliant Irrigation Development	In Ogun-Oshun Basin, although there are irrigation schemes whose planned area is more than 1,000ha, these have not yet fully developed and operated. Many schemes are small irrigation system currently. It is necessary to promote sound irrigation system, considering the current situation as well as the expected increase in water municipal water demand in the basin.	Section 7.2
4	Effective Utilization of Existing Water Source Facilities in View of Contemporary Needs	As a result of water balance study, it has been confirmed that there could be excess storage in Oyan and Ikere-Gorge Dams even if the expected water demand in 2030 according to the scenario based on M/P 2013 is taken into account. However, the excess storage volume may be utilized for fulfilling the municipal water demand by Lagos, if one considers the future water demand project by Lagos State. It is necessary to discuss how to use the excess storage volume by stakeholders.	Section 5.4 Section 8.4.1
5	Enhancement of Water-related Data/Information and Its Uniform Management	Water-related data/information such as dams, water purification plants, irrigation schemes and production wells are not uniformly managed in HA-1. This makes it difficult to grasp rapidly and correctly existing condition of water resources facilities. It is necessary to enhance the water related data/information and to manage them uniformly, in order to implement CMP.	Section 8.4.3
6	Consideration of Increasing Risk on Water Resources	The expected decrease in runoff due to the climate change is almost same as the national average. Since the trans-boundary water is minimal in Yewa river basin, the risk associated with it could not be significant.	Chapter 4 Chapter 5 Section 8.4.4
7	Active Involvement of Water Resources Administrator in Management of	Since the water use in Ogun and Oshun Rievrs has been very active, the flood plain area in these rivers is expected to be used more intensively in future. The management of flood plain along Ogun and Oshun Rivers in consideration of dam operation in the upstream	Section 7.3.2

	Important Rivers and Flood Plains	should be enhanced.	
8	Water Quality Monitoring to Secure Clean and Safe Water	The monitoring for water quality in Ogun-Oshun Basin is not sufficient to grasp the current condition of water quality in surface water body. In order to discuss the water source conservation scientifically, it is indispensable to enhance the water quality monitoring. Although it is pointed out that there are problems on pollution in water bodies and presence of E-coli in raw water source, the actual conditions have not yet been investigated well. Almost all of pollution in Ogun-Oshun Basin finally reaches to the lagoon along coastal area. It is recommended to implement a comprehensive research of the water quality and quantity of the lagoon to decide its potentiality and proper alternatives of water source.	Section 4.3.4 Section 4.4.3 Section 6.3 Section 8.4.6
9	Institutional Development & Strengthening of Water Resources Management	In the M/P2013, the basic principles of institutional development and strengthening of water resources management are; Cooperative institutional arrangement, Participatory management administration, Fair regulatory institutional framework, and Decentralization and coordination. The Project recognizes participatory management administration as a component to be strengthened for water resources management in HA level. Participatory approach means all stakeholders in HA participate in formulation and implementation of the CMP. The comprehensive organization governing the whole area of HA is supposedly composed of Catchment Management Coordinating Committee (CMCC), Technical Advisory Committee (TAC) and State IWRM Committee. It is necessary to advance organization planning through workshops by stakeholders.	Section 8.2

Source: JICA Project Team

CHAPTER 3 PROJECTION OF FUTURE WATER DEMAND

In the present chapter, water demand in the target area is described. In Section 3.1, socio-economic framework is presented. In Section 3.2 and 3.3, the methodology and results of water demand projection on municipal water supply and irrigation water supply. The water demand of other sectors is also discussed in Section 3.4. Finally, in Section 3.5, water demand structure is summarized.

The socio-economic framework and methodology of water demand projection in the target area is same as that applied in the National Water Resources Mater Plan (M/P2013). However, as shown in Chapter 2, it was pointed out that Lagos State prepared water supply master plan based on its own population and water demand projection, which cannot be ignored, in stakeholder meetings and workshops during the formulation of CMP. In the present CMP, the following two scenarios are parallel shown.

- Scenario-A: The socio-economic framework and methodology of water demand projection in the target area is same as that applied in M/P2013.
- Scenario-B: The socio-economic framework and water demand projection by States (if it exists)

It should be noted that even in Scenario-A, the additional information obtained through stakeholder meetings and workshops during the formulation of CMP has been reflected in the municipal water supply plan and irrigation development plan, and subsequently in the water demand projection. The municipal water supply plan and irrigation development plan are described in Chapter 7.

The water demand projection should be revised when the plan for water use will be modified. In the present CMP, the projection is on the basis of the available information of water use plan before August 2013. It should be noted that the water demand projection might be further revised when the CMP will be finalized.

3.1 Future Socio-Economic Framework

3.1.1 Population

Table 3-1 presents the projected population of the target area.

Table 3-1 Census and Projected Population of HA-6, Basin and 4 States (nos. in thousands)

Area	Census[1)]		Estimate[2)]	Projection[3)]			
	1991	2006	2010		1991	2006	2010
1. Nigeria	88,992	140,432	158,423	179,791	203,869	229,796	257,815
: Growth Rate	-	3.18%	3.06%	2.56%	2.55%	2.42%	2.33%
< Scenario A >							
A-1. HA-6	20,216	31,860	35,910	40,690	46,036	51,735	57,821
: Growth Rate	-	3.08%	3.04%	2.53%	2.50%	2.36%	2.25%
A-2. Ogun-Oshun Basin	14,017	22,355	25,267	28,710	32,569	36,687	41,094
: Growth Rate	-	3.16%	2.87%	2.39%	2.36%	2.22%	2.11%
A-3. 4 States	13,670	21,863	24,722	28,106	31,899	35,949	40,282
: Growth Rate	-	3.33%	3.12%	2.60%	2.56%	2.42%	2.30%
: Lagos	5,725	9,114	10,293	11,687	13,247	14,912	16,690
: Ogun	2,334	3,751	4,247	4,835	5,495	6,200	6,955
: Osun	2,158	3,417	3,854	4,369	4,946	5,559	6,214
: Oyo	3,453	5,581	6,328	7,215	8,211	9,278	10,423
< Scenario B >							
B-1. HA-6	-		43,617	51,976	62,109	70,813	80,535
: Growth Rate			8.17%	3.57%	3.63%	2.66%	2.61%
B-2 Ogun-Oshun R.Basin	-		32,971	39,993	48,637	55,760	63,803
: Growth Rate			10.20%	3.94%	3.99%	2.77%	2.73%
A-3. 4 States	-		32,429	39,392	47,972	55,027	62,996
: Growth Rate			10.36%	3.97%	4.02%	2.78%	2.74%
: Lagos			18,000	22,973	29,320	33,990	39,404
: Other 3 State			14,429	16,419	18,652	21,037	23,592

Source: Scenario A: 1) NPC - Census, 2) & 3) United Nations - estimate and projection on Nigeria, and 3) JICA Project Team - Sate-wise and HA-wise projection on the basis of the projection on Nigeria by the United Nations/
Scenario B: JICA Project Team based on the population projected by the Lagos Water Corporation

3.1.2 Economic Growth of Industry

An annual growth rate of 8.5% is applied for the manufacturing sector GDP in terms of industrial water demand projection based on the following criteria:

- The real growth rate of the manufacturing sector was 8.4% on average over the period between 2006 and 2011.
- The GDP growth rate of the manufacturing sector has generally recorded higher than that of the nation GDP.
- NBS estimates the averaged GDP growth rate of 7.3% in “Revised Economic Outlook for 2012 – 2015, September 2012”.

3.2 Municipal Water

The Project calculates municipal water demand of main four states and each state located in Ogun-Oshun basin because water supply is under the jurisdiction of state government, while, the Project also calculates demand of the entire area of Ogun-Oshun basin including the other related states located partially, in reference to Volume 4, the M/P2013.

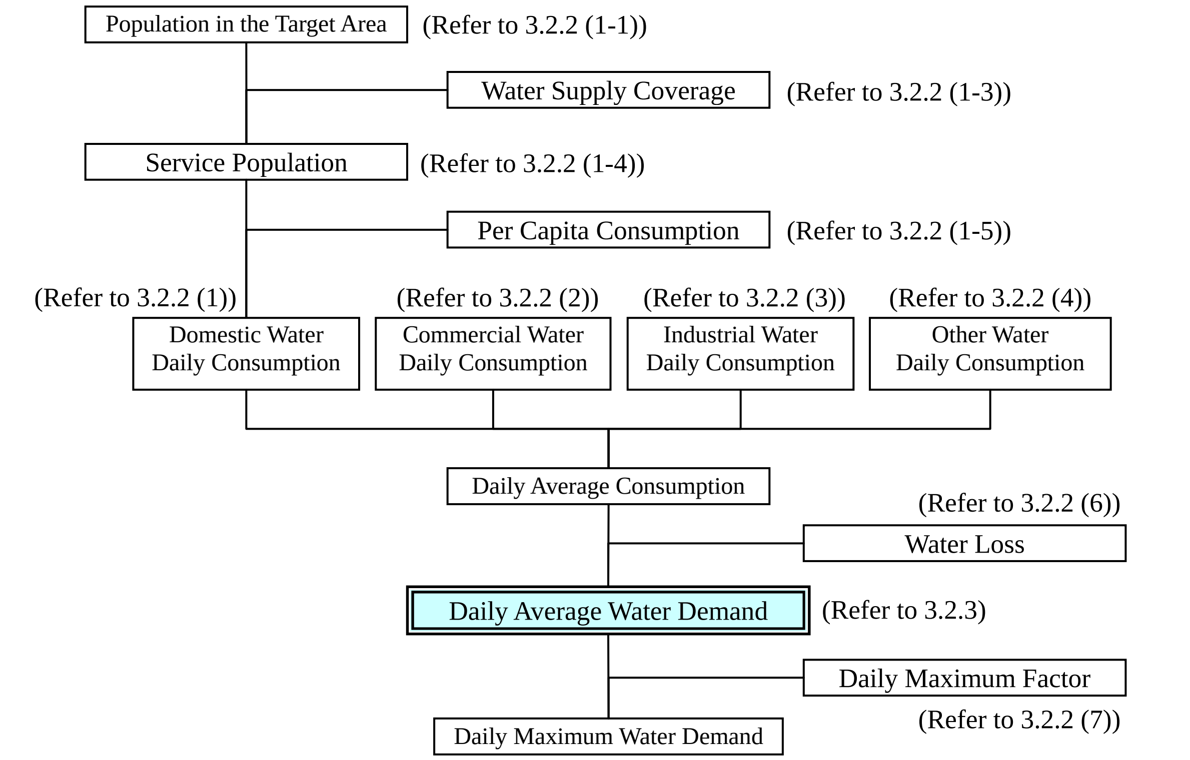
3.2.1 Method of Water Demand Projection

(1) Basic Concept

Future water demand projection is of importance for not only examination of balance between water demand and water resources potential, but also adequate water supply and appropriate development of water supply infrastructure. This Project gives a priority to improvement of water supply coverage, and conducts a sensitivity analysis by several scenarios of the projection for comparison.

(2) Flowchart of Water Demand Projection

Figure 3-1 shows flowchart of water demand projection.



Source: JICA Project Team

Figure 3-1 Flowchart of Water Demand Projection

3.2.2 Basic Conditions and Framework for Water Demand Projection

The Project estimates water demand according to the following basic conditions and frame.

(1) Domestic Water

Domestic water consists of drinking, cooking, bathing, flushing and washing water, and also other water usage in our daily lives. It typically grows by not only increase in population served but also lifestyle change and improvement in living standards.

Daily average domestic water consumption is calculated by multiplying population served by per capita consumption (lit/cap/day).

(1-1) Population

The Project estimates population as described in the above 3.1.1 (see Table 3-1).

(1-2) Categorization of Settlement and Categorization on Water Demand Projection

Categorization of settlement by population size, consisting of three categories for water supply planning; urban, semi-urban or small town and rural, has been defined by the Federal Ministry of Water Resources (FMWR). This Project, in principle, conforms to this categorization shown in the Table 3-2. In addition, per capita consumption of domestic water is applied to this categorization in water demand projection of the Project, as described in the below 3.2.2 (1-5).

However, water demand projection only by settlement category based on the population size may cause inaccuracy because there is mixture of various water supply schemes, various living or water usage situations, and various income groups on the ground in settlement. In the process of water demand projection, the Project puts additional category shown in Table 3-2 and allocates population based on referenced indicators.

Table 3-2 Categorization of Settlement on Water Demand Projection

Population Size		Settlement Category	Typical Water Supply Scheme	Category on Water Demand Projection
1	More than 20,000	Urban	Surface water, piped supply, house or yard connection	Urbanized water usage (referenced indicator: number of household using flush toilet, Census 2006)
2	5,000 to 20,000	Semi-Urban or Small Town	Surface or groundwater, small scale piped supply, communal standpipes, house or yard connection	Semi-urbanized water usage (except the above 1 and the below 3)
3	Less than 5,000	Rural	Ground water, 250m radius, 250-500 persons per point	Rural water usage (referenced indicator: number of household using handpump, Census 2006)

Source: JICA Project Team

(1-3) Water Supply Coverage

National water supply coverage of 75% in 2015 as the midterm goal and 100% in 2025 as the long-term goal specified in the Sector Roadmap 2011 by FMWR are considered as guidepost. Water supply coverage in each target year should be practically set by the above settlement categories based on population size, because the necessity of water supply infrastructure development is dependent on socioeconomic activities.

The Project uses the water supply coverage of each state by settlement category; the results of Core Welfare Indicators Questionnaire Survey (CWIQS), 2006, to estimate the present water demand, and then applies them respectively as average of the local government areas across the board for each State.

Summation of water consumption based on the above supply coverage and 100% attainment in 2025 with constant improvement of supply coverage result in water supply coverage of four states of 79% in 2010, 86% in 2015 and 93% in 2020, as coverage of each target year shown on the Table 3-3.

On the assumption that development and improvement are not carried out as planned, sensitivity analysis which adopts water supply coverage of four States as a variable is conducted.

Table 3-3 Water Supply Coverage of 4 States by Settlement Category in Target Years

Target Year	Water Supply Coverage of 4 States			
	All	Urban	Semi-Urban, Small Town	Rural
2010 (Current) Estimated by the Project	79%	88%	72%	59%
2015	86%	92%	82%	73%
2020	93%	96%	91%	86%
2025	100%	100%	100%	100%
2030	100%	100%	100%	100%

Source: JICA Project Team

(1-4) Population Served

Based on the above coverage, the Project estimates population served as shown in Table 3-4:

Table 3-4 Population Served by State

National, State and HA-1		Population Served (1,000 persons)				
		2010	2015	2020	2025	2030
National		79,848	120,287	170,100	229,796	257,815
Ogun-Oshun Basin		18,611	23,662	29,702	36,688	41,094
4 States		18,369	23,284	29,158	35,949	40,282
State-wise						
24	Lagos	7,961	9,921	12,246	14,912	16,690
27	Ogun	2,838	3,767	4,889	6,200	6,955
29	Osun	2,892	3,641	4,534	5,559	6,214
30	Oyo	4,678	5,954	7,490	9,278	10,423

Source: JICA Project Team

(1-5) Per Capita Consumption of Domestic Water

In view of the present water supply coverage and high growth of water demand by increase in population, improvement of water supply coverage should be above everything else although in the future the per capita consumption needs review by improvement of living standards, progress of the coverage and so on. So, this Project applies current standard per capita consumption set by FMWR as shown in Table 3-5 until 2030, the target year.

Table 3-5 Per Capita Consumption of Domestic Water

Settlement (Water Supply) Category		Category on Water Demand Projection	Per Capita Consumption
1	Urban	Urbanized water usage	120 lit/cap/day
2	Semi-Urban or Small Town	Semi-urbanized water usage	60 lit/cap/day
3	Rural	Rural water usage	30 lit/cap/day

Source: Federal Ministry of Water Resources (FMWR)

(2) Commercial Water

Commercial water is defined as water for public and private institutions, stores and shops, accommodation facilities, hospitals and clinics, educational institutions, urban greening, et al. It typically grows by not only development of urbanized activities but also improvement in facilities and equipment of institutions.

Daily average commercial water consumption is calculated by the average of 10% (20% in Lagos) of daily domestic water consumption at each state except rural settlement.

These ratios are referred to instances from Japan, the Philippines (Manila), Colombia (Bogota), Indonesia (Bali) and Brazil (Sergipe), because useful reference data in Nigeria have not been confirmed. See Section SR1.2.1, Volume-5 Supporting Report.

(3) Industrial Water

Industrial water is defined as water for raw material of commodity and production, treatment, coolant, cleaning, et al. It typically grows by development of socioeconomic activities.

Daily average consumption of industrial water in 2010 is calculated as 2.5% (5.0% in Lagos) of average of the total daily domestic water consumption at each state. Daily average consumption of industrial water increases at an annual rate of 8.5% (GDP growth rate).

As well as commercial water, these ratios for calculation of the water consumption in 2010 are referred to data of Japan, the Philippines (Manila), Colombia (Bogota), Indonesia (Bali) and Brazil (Sergipe) from “GRDP Contribution of Manufacture Sector” and “The percentage of Industrial Water Consumption to Domestic Consumption”, because useful reference data in Nigeria have not been confirmed. See Section SR1.2.1, Volume-5 Supporting Report.

(4) Other Water

Other water is, for example, in-house usage water for water supply services by State Water Agencies and insensible water caused by metering inaccuracies and so on. It has normally a very little proportion of total water consumption, so it can be regarded as being included in commercial water or water loss described below.

(5) Recycled Wastewater

Although utilization of recycled wastewater in industry should be taken in into water demand projection in consideration of the current status, popularization and advancement, the Project assumes recycled wastewater is not utilized because of unfamiliarity, lack of statistical information, high cost and difficulty in realization.

(6) Water Loss

Water loss is defined as total volume of water leakage from pumping equipment, reservoirs and pipelines, and also missing water by illegal connections, that is, synonymously unaccounted for water (UFW). Most of State Water Agencies can not figure out water loss ratio accurately because no installing meters to most household and flat rate tariff is much more common in urban, semi-urban and small town water supplies in Nigeria. Furthermore, poor data management of existing facilities causes difficulty of status analysis. In view of these facts and hearings from State Water Agencies, 30% of water loss ratio is applied except rural water supply.

Replacement of aged or damaged pipes and improvement of revenue water through water demand management reduce water loss, so the sensitivity analysis adopts water loss rate as a variable.

(7) Daily Maximum Factor

Daily maximum factor normally used for water supply planning and designing, is not applied to water demand projection in this Chapter, because main objective is evaluation of water resources potential and hydrological balance. The factor is supposed to be incorporated in the process of water supply development plan, but this Project does not apply it in consideration of additional production efficiency.

3.2.3 Result of Water Demand Projection

Table 3-6 shows the estimates of water demand projection by State, based on the above basic conditions and frame. Table 3-7 shows them by each water usage category such as domestic, commercial and industrial water.

The estimated water demand will nearly double from 2010 to 2030 in Ogun-Oshun basin as well as four States and also each state as shown below (see Figure 3-2).

Table 3-6 Water Demand Projection

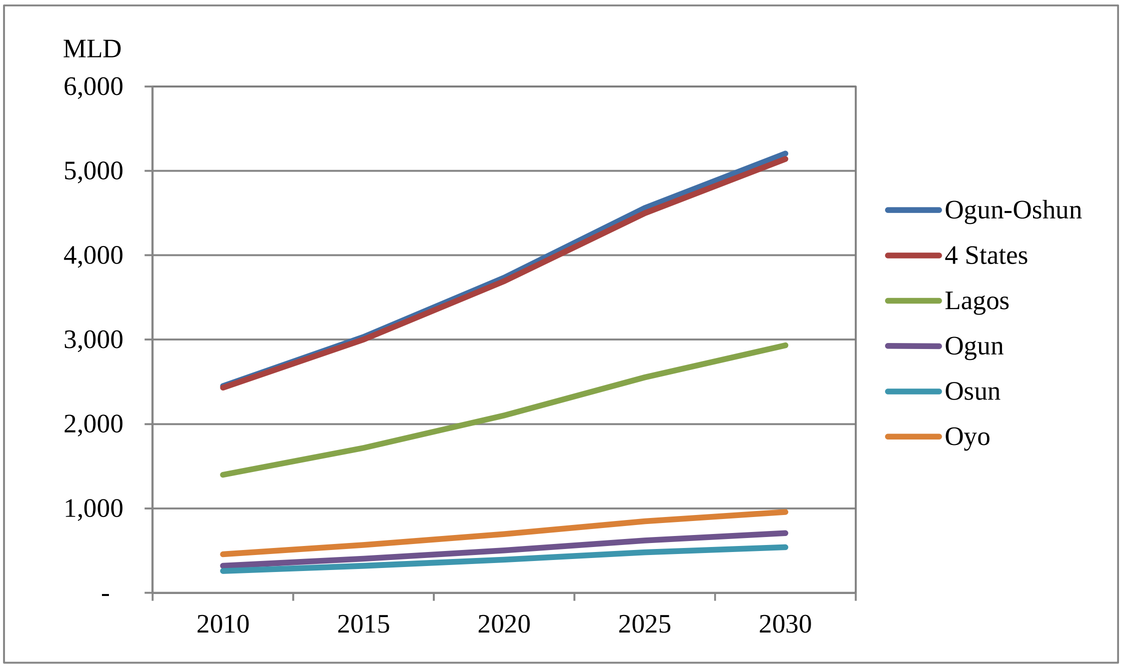
National, State or HA		Water Demand (Million Liter per Day : MLD)					2030/2010
		2010	2015	2020	2025	2030	Ratio
National		8,254	11,666	15,890	20,994	23,876	2.9
Ogun-Oshun R. Basin		2,452	3,034	3,735	4,558	5,205	2.1
4 States		2,432	3,004	3,692	4,500	5,140	2.1
State-wise							
24	Lagos	1,397	1,716	2,102	2,555	2,934	2.1
27	Ogun	319	402	502	620	707	2.2
29	Osun	258	319	392	478	541	2.1
30	Oyo	458	566	696	848	959	2.1

Source: JICA Project Team

Table 3-7 Water Demand Projection of Each State by Water Usage Category

State	Water Usage Category	Water Demand (Million Liter per Day : MLD)				
		2010	2015	2020	2025	2030
24 Lagos	State Total	1,397	1,716	2,102	2,555	2,934
	Urban	813	955	1,118	1,298	1,446
	Semi-Urban/Small Town	253	341	449	577	654
	Rural	8	11	15	18	19
	Commercial	267	324	392	469	525
	Industrial	57	85	128	193	290
27 Ogun	State Total	319	402	502	620	707
	Urban	134	163	196	234	266
	Semi-Urban/Small Town	132	165	204	249	278
	Rural	15	27	41	58	65
	Commercial	30	36	44	54	60
	Industrial	7	11	17	25	38
29 Osun	State Total	258	319	392	478	541
	Urban	86	105	127	151	168
	Semi-Urban/Small Town	110	134	162	194	217
	Rural	33	44	57	72	81
	Commercial	22	27	32	38	43
	Industrial	6	9	14	21	32
30 Oyo	State Total	458	566	696	848	959
	Urban	179	211	248	289	320
	Semi-Urban/Small Town	182	227	281	343	382
	Rural	45	62	83	108	123
	Commercial	40	49	59	70	78
	Industrial	11	16	25	37	56

Source: JICA Project Team



Source: JICA Project Team

Figure 3-2 Water Demand Projection from 2010 to 2030

3.2.4 Sensitivity Analysis on Water Demand Projection

(1) Conditions of Scenarios

In consideration of change of water demand through water demand management and realistic aspect of future water supply coverage, the Project compares the water demand projection based on the basic conditions described in the above 3.2.2 with other alternative projections in the following three scenarios.

Basic Scenario : **Water demand projection based on the basic conditions**

This scenario based on the basic conditions described in the above 3.2.2 is positioned as "Basic Scenario".

Scenario-1 : **Water demand projection based on the basic conditions with the exception that 100 percent of water supply coverage in 2025 can not be attained.**

On the assumption that infrastructure development does not progress as planned, this scenario sets water supply coverage at 89% in 2025 and 100% in 2030, the target year.

Scenario-2 : **Water demand projection based on the basic conditions with the exception that water loss ratio is reduced from 30% to 10% by 2030**

On the assumption that water demand management and measures against non revenue water are carried out effectively, this scenario sets water loss ratio reduce from 30% to 10% in stages by 2030.

Scenario-3 : **Water demand projection based on the same basic conditions as Scenario-1, with the exception that 100 percent of water supply coverage in 2025 can not be attained and water loss ratio improves from 30% to 10% by 2030**

This scenario is combination of Scenario-1 and Scenario-2.

Table 3-8 shows the conditions of the above four scenarios.

Table 3-8 Condition Setting for Sensitivity Analysis

Items		Basic Scenario	Scenario-1	Scenario-2	Scenario-3
Domestic Water (lit/cap/day)					
Urban		120 lit/cap/day	120 lit/cap/day	120 lit/cap/day	120 lit/cap/day
Semi-Urban and Small Town		60 lit/cap/day	60 lit/cap/day	60 lit/cap/day	60 lit/cap/day
Rural		30 lit/cap/day	30 lit/cap/day	30 lit/cap/day	30 lit/cap/day
Commercial Water (Ratio to Domestic)		10%, 20%	10%, 20%	10%, 20%	10%, 20%
Industrial Water (Ratio to Domestic)		2.5%, 5.0%	2.5%, 5.0%	2.5%, 5.0%	2.5%, 5.0%
Water Supply Coverage					
All	2010	50%	50%	50%	50%
	2015	66%	62%	66%	62%
	2020	83%	74%	83%	74%
	2025	100%	87%	100%	87%
	2030	100%	100%	100%	100%
Urban	2010	69%	69%	69%	69%
	2015	79%	76%	79%	76%
	2020	89%	84%	89%	84%
	2025	100%	92%	100%	92%
	2030	100%	100%	100%	100%
Semi-Urban and Small Town	2010	47%	47%	47%	47%
	2015	64%	60%	64%	60%
	2020	82%	73%	82%	73%
	2025	100%	86%	100%	86%
	2030	100%	100%	100%	100%
Rural	2010	40%	40%	40%	40%
	2015	60%	55%	60%	55%
	2020	80%	70%	80%	70%
	2025	100%	85%	100%	85%
	2030	100%	100%	100%	100%
Water Loss * Except Rural Water Supply	2010	30%	30%	30%	30%
	2015	30%	30%	25%	25%
	2020	30%	30%	20%	20%
	2025	30%	30%	15%	15%
	2030	30%	30%	10%	10%

Source: JICA Project Team

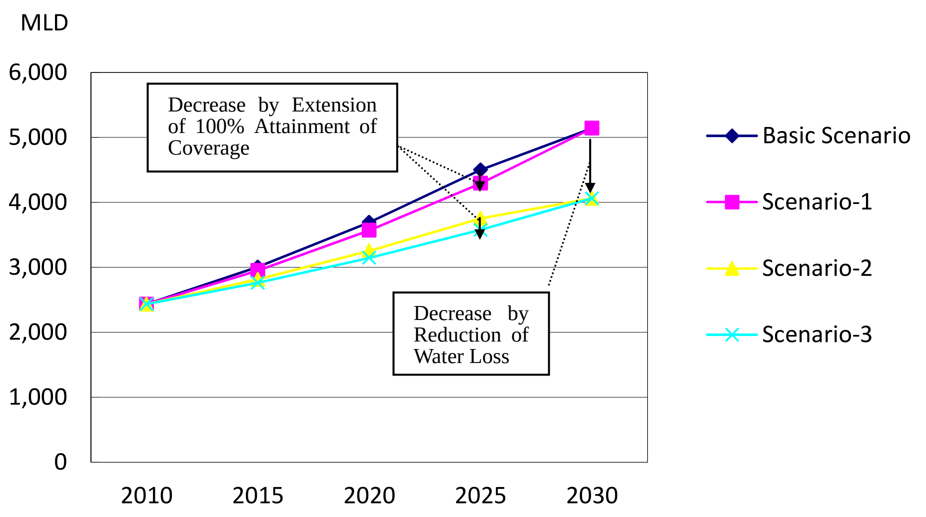
(2) Results of Sensitivity Analysis and Comparison of Scenarios

Table 3-9 and Figure 3-3 show results of sensitivity analysis of water demand projections of four states, based on the conditions in the above Table 3-8, and also the ratio of each scenario to the Basic Scenario.

Table 3-9 Results of Sensitivity Analysis of Water Demand Projection of 4 States

Scenarios	Estimated Water Demand (MLD) and Ratio (%)				
	2010	2015	2020	2025	2030
(I) Basic Scenario Water Demand	2,432	3,004	3,692	4,500	5,140
(2) Scenario-1 Water Demand	2,432	2,949	3,569	4,291	5,140
Ratio to Basic Scenario (2)/(1)	100.0%	98.2%	96.7%	95.4%	100.0%
(3) Scenario-2 Water Demand	2,432	2,813	3,255	3,751	4,062
Ratio to Basic Scenario (3)/(1)	100.0%	93.7%	88.2%	83.4%	79.0%
(4) Scenario-3 Water Demand	2,432	2,762	3,145	3,575	4,062
Ratio to Basic Scenario (4)/(1)	100.0%	91.9%	85.2%	79.4%	79.0%

Source: JICA Project Team



Source: JICA Project Team

Figure 3-3 Result of Sensitivity Analysis of Water Demand Projections of 4 States

- **Comparison of Scenario-1 with the Basic Scenario**

  Differences are water supply coverage of each year and target year of 100% attainment, but water demand of 2030 is same. Compared with the Basic Scenario, decrease in water demand is respectively 1.8% in 2015, 3.3% in 2020 and 4.6% 2025.

- **Comparison of Scenario-2 with the Basic Scenario**

  Difference is reduction of water loss rate. Compared with the Basic Scenario, water demand decreases gradually since 2011 and finally about 21% of scale-down is possible in 2030.

- **Comparison of Scenario-3 with the Basic Scenario**

  Differences are water supply coverage of each year and target year of 100% attainment, and reduction of water loss rate. Although about 21% of scale-down of water demand in 2030 is same as Scenario-2, water demand between 2010 and 2030 is the lowest in all scenarios.

These indicate that set up of water supply coverage and target year of 100% attainment has an effect on water supply development plan especially for studying the feasibility and the reasonability of the plan. Reduction of water loss rate can decrease water demand by water demand management including measures against non revenue water.

The Project adopts the basic scenario for analysis of hydrological balance because of 100% attainment of water supply coverage to be prioritized by water supply development plan. This is because of uncertainty of current water loss as well as lack of information on water leakage, illegal use and existing distribution network, which are addressed in operation and maintenance.

Table 3-10 shows the results of sensitivity analysis of water demand projection by each state.

Table 3-10 Results of Sensitivity Analysis of Water Demand Projection by Each State

	State	Scenarios	Estimated Water Demand (MLD)				
			2010	2015	2020	2025	2030
24	Lagos	Basic	1,397	1,716	2,102	2,555	2,934
		1	1,397	1,689	2,039	2,449	2,934
		2	1,397	1,603	1,841	2,108	2,286
		3	1,397	1,577	1,785	2,020	2,286
27	Ogun	Basic	319	402	502	620	707
		1	319	393	483	586	707
		2	319	377	445	521	564
		3	319	369	427	491	564
29	Osun	Basic	258	319	392	478	541
		1	258	313	378	453	541
		2	258	301	350	406	439
		3	258	295	338	385	439
30	Oyo	Basic	458	566	696	848	959
		1	458	554	669	803	959
		2	458	532	619	717	773
		3	458	521	595	679	773

Source: JICA Project Team

3.2.5 Water Demand Projection by Lagos State

In Ogun-Oshun basin, Lagos State has state water demand projection based on state's own population census 2006 and Lagos Water Supply Master Plan prepared by Lagos Water Corporation.

The Project prepares two scenarios for water balance study and formulation of development plans in Catchment Management Plan as follows:

Scenario-A: Water demand projection based on national population census, same as M/P2013

Scenario-B: Water demand projection based on state population census or equivalent

Table 3-11 shows the population and the water demand projected by Lagos State (Lagos Water Corporation).

Table 3-11 Population and Water Demand projected by Lagos State

	State	Scenario	Upper : Population (thousand), Lower: Water Demand (MLD)				
			2010	2015	2020	2025	2030
24	Lagos	Lagos	18,000	22,973	29,320	33,990	39,404
		Water Corp.	2,452	3,129	3,328	3,858	4,472
Conditions Annual Population Growth: 5% (2010-2020), 3% (2020-2030) Per Capita Consumption: 136LCD (2010-2017), 114LCD(2018-2030)							

Source: Lagos Water Supply Master Plan, Lagos Water Corporation

3.3 Irrigation Water

3.3.1 Agriculture and Irrigation Policies

(1) Agriculture of Target Region

The climate of target region is tropical rain forest in south region and guinea savanna in north region. Mean annual rainfall here ranges from 1,000-1,500 mm. The rein-fed farming is predominant in Nigeria. Major rain fed crops planted in the area is cassava and yam. The other crops are rice, maize, groundnut, vegetables, beans, fruits, cacao, palm oil, and rubber.

Table 3-12 Production of Crops (,000ton)

State	Cassava	Yam	Rice	Maize
Ogun	1,118	99	14	80
Osun	751	246	14	72
Oyo	1,320	1,144	2	246
Lagos	375	22	3	1

Note: Above-cited figure is average between 1994/95 to 2005/06.
Source: NBS, Agricultural Survey Report 1994/95-2005/06

(2)Irrigation Scheme

Major crops produced in Nigeria are rice, cassava, yam, maize, sorghum, millet, groundnut, etc. The country is self-sufficient in most basic staples such as cassava, yam, etc, but the country is still heavily dependent on import of agricultural commodities and processed products, particularly rice, wheat and sugar. Rice and are specially identified as strategic significant crops in the nation at present.

The country's annual rice demand is estimated to be about 5 million tonnes, while production is about 2.2 million tonnes in average. The national rice supply demand gap of 2.8 million tonnes is bridged by importation. It is estimated that 4.6 million hectares in Nigeria is suitable for rice production and 1.8 million hectares of this land is rain-fed rice. Irrigated rice is estimated merely 50,000 ha.

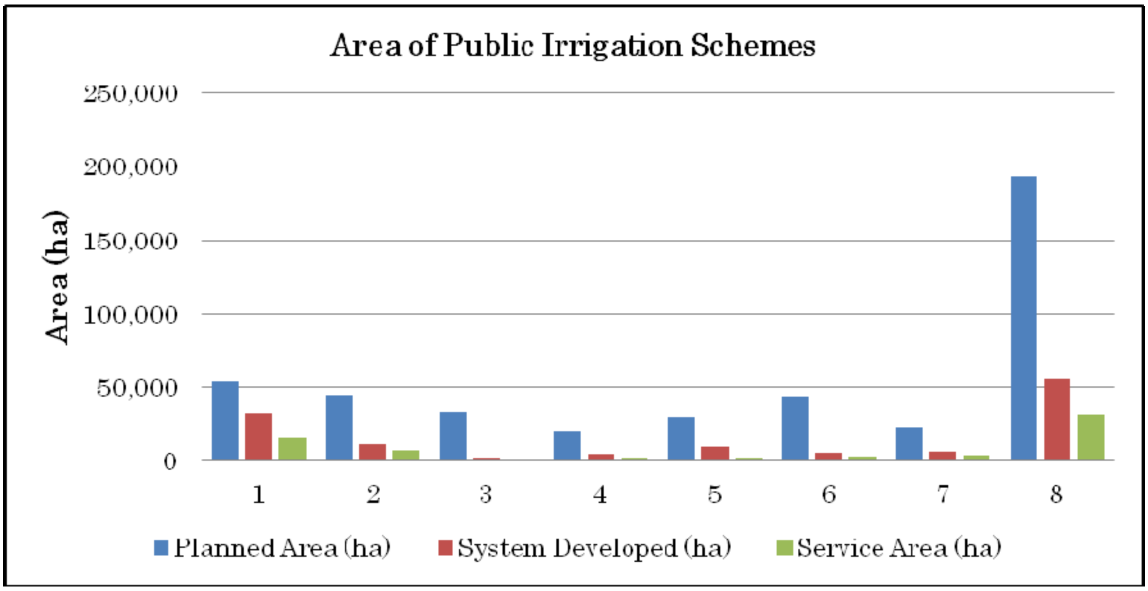
The irrigation scheme in Nigeria is generally classified into two types. One is the public irrigation scheme operated federal government or state government, another is the private irrigation scheme or farming. The private irrigation farming operated by individual farmer is generally small scale.

The development of irrigation schemed is very slow in south reason in Nigeria rather than the north region. A part of system developed area is already irrigated and cropped rice during rainy season, and cropped maize, wheat and vegetables, etc during dry season. It is necessary to sustain irrigation development for food security in future.

Table 3-13 Area of Public Irrigation Scheme by HA (,000ha)

	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
Planned area	53.9	44.2	33.0	20.3	29.3	43.7	23.0	193.4	440.9
Developed area	32.1	11.3	2.5	5.0	10.0	5.7	6.1	55.3	128.1
Irrigated area	15.5	7.6	1.0	2.3	2.4	2.7	4.1	31.5	67.1

Source: JICA Project Team



Source: JICA Project Team

Figure 3-4 Area of Public Irrigation Scheme by HA

(3) Policy of Irrigation Development

Keys of Nigerian agricultural and irrigation policies are (a) enhanced agricultural productivity, (b) expanded irrigated farmland, and (c) internal reform of irrigated farming. It is imperative to boost three under-mentioned matters for Nigerian development policies of agricultural and irrigation sectors.

- Completion of ongoing schemes for irrigation development and rehabilitation,
- Development of new irrigated farmland,
- Increased rice production

3.3.2 Proposed Cropping Pattern

Typical cropping calendar and cropping pattern of target region are set up for estimation of water demand as follows.

(1) Cropping Calendar

The following table shows cropping seasons in the three large hydrological basins of Nigeria, which are gained from various materials and interview surveys.

Crop (Area, season)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice (Central, South)												
Grain & vegetable												

Figure 3-5 Cropping Calendar

(2) Current Cropping pattern

The following table shows the current cropping rate set based on RBDA's materials and cropping acreages of large-scale irrigation schemes. Also, vegetables and grain are major crops in small-scale private irrigation schemes.

Table 3-14 Current Cropping Pattern

HA	Irrigation scheme (%)				Small-scale private irrigation (%)			
	Wet Season		Dry Season		Wet Season		Dry Season	
	Paddy	Upland	Paddy	Upland	Paddy	Upland	Paddy	Upland
6	35	25	0	35	20	50	0	70

Source：JICA Project Team

(3) Proposed Cropping Pattern

The following table shows the proposed cropping rate set based on current cropping rate and agricultural policies that emphasize rice product.

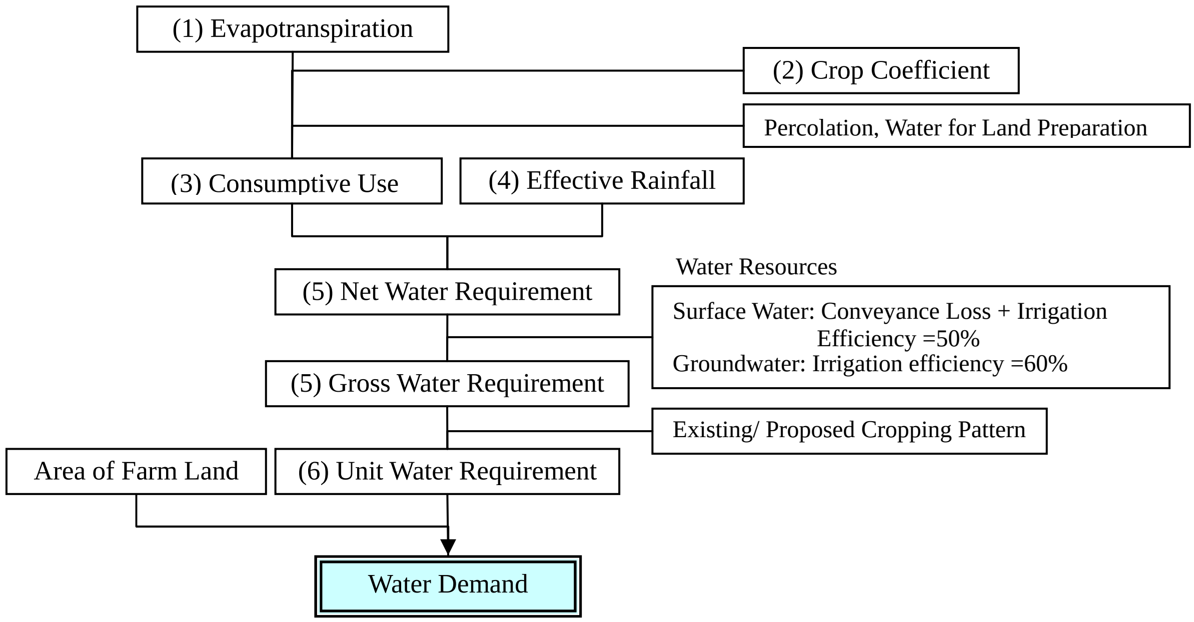
Table 3-15 Proposed Cropping Pattern

HA	Irrigation scheme (%)				Small-scale private irrigation (%)			
	Wet Season		Dry Season				Wet Season	
	Paddy	Upland		Paddy	Upland		Paddy	Upland
6	60	30	40	40	20	70	0	80

Source：JICA Project Team

3.3.3 Projection of Future Water Demand

The Calculation flow to estimate the water demand is shown as follows:



Remarks: Number in ( ) corresponds to the section number below.
Source: JICA Project Team

Figure 3-6 Calculation Flow of Water Demand Projection

(1) Reference Evapotranspiration

Calculation of the reference evapotranspiration (ETo) is applied Hamon method[1].

Table 3-16 Reference Evapotranspiration (mm)

HA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6	106	107	125	121	122	111	106	102	100	105	105	105

Source: JICA Project Team

(2) Crop Coefficient

The crop coefficient is applied based on FAO technical note as follows;

Table 3-17 Crop Coefficient

HA	Crop	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6	Rice	1.10	0.66	0.16	-	0.17	0.69	1.04	0.99	0.61	0.32	0.69	1.11
	Others	0.81	0.87	0.54	0.14	0.13	0.46	0.79	0.86	0.54	0.14	0.14	0.48

Source: JICA Project Team

(3) Consumptive Use of Water

The consumptive use of water is estimated using reference evatranspiration (ETo), crop coefficient (kc), deep percolation (Per), and water for land preparation (Pre). The loss due to deep percolation is assumed to be at 2 mm/day in this calculation, and the losses of water due to land preparation are assumed to be 150mm in paddy and 60mm in upland field respectively.

- Crop Evapotranspiration (ETc) = ETo × kc
- Consumptive Use of Water = ETc + Per +Pre

---

[1] The modified Penman method requires much more data such as daily mean temperature, daily sunshine hours, daily average wind speed, daily average relative humidity, some of which are not available in the present project. Hamon method requires much less meteorological parameters.

(4) Effective Rainfall

The effective rainfall is defined as the amount of precipitation consumed by crops. As for paddy, approximately 80% of the total precipitation is often regarded as the effective rainfall if daily precipitation is 5 to 80mm. Accordingly, this M/P adopts 80% for the effective rainfall in paddies. Unlike the paddy, meanwhile, the upland field has no function to store rainfall and the effective rainfall in upland fields is calculated to be smaller than that in paddies. Therefore, this M/P adopts 70% for the effective rainfall in upland fields.

Table 3-18 Effective Rainfall (Paddy) (mm)

HA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6	3	0	37	71	112	140	116	66	154	105	15	3
6	2	0	26	50	78	98	81	46	108	74	11	2

Source: JICA Project Team

(5) Net Water Requirement, Conveyance, Application Efficiency, and Gross Water Requirement

The net water requirement is calculated by deducting the effective rainfall from the consumptive use of water. Public irrigation schemes take surface water as major water sources. Meanwhile, fadama farming and some small-scale private irrigation systems in floodplains mainly use sub-surface flows, which occur after flood recession. The other small-scale private irrigation systems outside floodplains have irrigation water mainly by extracting groundwater.

For surface water irrigation schemes, one must calculate the gross water requirement by making allowances for conveyance efficiency from the intake to fields and the application efficiency in the field. As for groundwater irrigation schemes, meanwhile, one only needs to take the application efficiency into account. The irrigation efficiency, which is the product of conveyance efficiency and the application efficiency, is generally estimated as follows.

- Surface Water: Conveyance efficiency × Application efficiency = 50%
- Groundwater: Application efficiency =60%

Hence, dividing the net water requirement by the irrigation efficiency gives gross water requirement.

(6) Diversion Water Requirement

The following diversion water requirements are calculated from gross water requirements and the cropping patterns. It is presumed that farmers in HA-1 and 8 do not grow paddy rice in the dry season because of less precipitation. Consequently, the plan shows net water requirements for paddy rice in those areas are zero in the dry season.

Table 3-19 Surface Water: Diversion Water Requirement (Current)

HA	Season	Net Water Requirement (mm)		Gross Water Requirement(m^3/ha)		Cropping Pattern (%)		Diversion Water Requirement (m^3/ha)
		Paddy	Upland	Paddy	Upland	Paddy	Upland	
6	Wet	205	45	4,100	900	35	25	1,660
	Dry	642	331	12,840	6,620	0	35	2,317

Source: JICA Project Team (Refer to Section SR1.3.4, Volume-5 Supporting Report)

Table 3-20 Groundwater: Diversion Water Requirement (Current)

HA	Season	Net Water Requirement (mm)		Gross Water Requirement (m^3/ha)		Cropping Pattern (%)		Diversion Water Requirement (m^3/ha)
		Paddy	Upland	Paddy	Upland	Paddy	Upland	
6	Wet	205	45	3,417	750	20	50	1,058
	Dry	642	331	10,700	5,517	0	70	3,862

Source: JICA Project Team (Refer to Section SR1.3.4, Volume-5 Supporting Report)

Table 3-21 Surface Water: Diversion Water Requirement (Proposed)

HA	Season	Net Water Requirement (mm)		Gross Water Requirement (m^3/ha)		Cropping Pattern (%)		Diversion Water Requirement (m^3/ha)
		Paddy	Upland	Paddy	Paddy	Upland	Paddy	
6	Wet	205	45	4,100	900	60	30	2,730
	Dry	642	331	12,840	6,620	40	40	7,784

Source: JICA Project Team (Refer to Section SR1.3.5, Volume-5 Supporting Report)

Table 3-22 Groundwater: Diversion Water Requirement (Proposed)

HA	Season	Net Water Requirement (mm)		Gross Water Requirement (m^3/ha)		Cropping Pattern (%)		Diversion Water Requirement (m^3/ha)
		Paddy	Upland	Paddy	Upland	Paddy	Upland	
6	Wet	205	45	3,417	750	20	70	1,208
	Dry	642	331	10,700	5,517	0	80	4,414

Source: JICA Project Team (Refer to Section SR1.3.5, Volume-5 Supporting Report)

(7) Monthly Variations of Diversion Water Requirement by Hydrological Area

The following table shows monthly variations of diversion water requirement in target region. As for the surface water sources, the diversion water requirement in the south region, where annual precipitation is higher, is maximum in December and January, the mid-term of dry-season irrigation. Here the diversion water requirement in the south region is required few in wet season due to much precipitation.

Table 3-23 Monthly Variations of Diversion Water Requirement

Water Source: Surface Water Bodies (mm)

HA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6	206	155	44	0	17	50	67	139	0	14	157	202

Source: JICA Project Team

In the case of small-scale private irrigation that mainly use sub-surface flows or groundwater, the diversion water requirement in the south region is maximum in December and January, the mid-term of dry-season irrigation.

Table 3-24 Monthly Variations of Diversion Water Requirement

Water Source: Sub-surface flows or groundwater (mm)

HA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6	112	124	56	0	5	14	22	81	0	0	45	104

Source: JICA Project Team

(8) Current Irrigation Water Demand

The following table shows water demands of surface water irrigation schemes, fadama irrigation systems and a part of small-scale private irrigation systems with sub-surface flow water, and small-scale private irrigation systems with groundwater irrigation

The overall water demand is 17MCM in the wet season and 45MCM in the dry season, and the total amount is 62MCM year-round. The total amount corresponds approximately to 0.14% of target region’s total water abundance 43,600MCM (internal generation only).

Table 3-25 Current Irrigation Water Demand

Water Source	Type	Area (ha)	Wet Season (MCM)	Dry Season (MCM)	Total (MCM)
Surface Water	Irrigation scheme	4,240	7	10	17
Groundwater	Small-scale private irrigation	9,111	10	35	45
Total		13,351	17	45	62

Source: JICA Project Team

(9) Proposed Irrigation Water Demand

The overall water demand is 101MCM in the wet season and 306MCM in the dry season, and the total amount is 407MCM year-round. The total amount corresponds approximately to 0.93% of target region’s total water abundance 43,600MCM (internal generation only).

Table 3-26 Proposed Irrigation Water Demand

Water Source	Type	Area (ha)	Wet Season (MCM)	Dry Season (MCM)	Total (MCM)
Surface Water	Irrigation scheme	27,991	77	218	295
Groundwater	Small-scale private irrigation	19,840	24	88	112
Total		47,831	101	306	407

Source: JICA Project Team

(10) Preliminary Consideration on Water Demand Variations of Scenarios No.1 and No.2 Due to Climate Change

We consider impacts of climate change on water demand based on the Climate Change which is set in **Section 4.3.3**. Taking projected air temperature variations into account, in this regard, we project and set the future reference PET derived from the fundamental reference PET multiplied by the coefficients of air temperature variation shown in the table below. Here, the coefficients of air temperature variation are calculated and obtained by the Hamon's equation.

Table 3-27 Coefficient of Air Temperature Variation

Items	HA-6
Air Temp. Variation (^oC)	+2.2
Coefficients of Air Temperature Variation	1.146

Source: JICA Project Team

Given the occurrence of Climate Change, it is projected that the water demand will increase by nearly 16% in total. As shown in below table, water demand will increase more in the wet season rather than in the dry season. Particularly, the groundwater demand for small-scale irrigation is projected to increase most by 19%.

Table 3-28 Variation of Water Demand due to Climate Change

Water Source	Type	Area (ha)	Wet Season	Dry Season	Total
Surface water	Irrigation schems	27,991	+24%	+11%	+14%
Groundwater	Small-scale irrigated farming	19,840	+38%	+14%	+19%
Total		47,831	+28%	+12%	+16%

Source: JICA Project Team

3.4 Other Sub-Sectors

3.4.1 Livestock

As to method of estimating, annual water demand for livestock was calculated from the text of FAO livestock guideline in African region, Annual consumption rates by livestock specie applied to the projection toward 2030 are: 7.88, 0.84, 0.73, 1.20, 8.98, 8.10, 3.07 and 0.039 m^3 for head/ fowl of adult cattle, goat, sheep, pig, camel, horse, donkey and poultry.

Water demand of major four (4) states is estimated based on Section 4.4.1, Volume 4, M/P2013. Referring to the information of other states included in Ogun-Oshun basin additionally, in accordance with each state's relative area, the projected water demand for livestock in 2030 amounts to 11.5 MCM, as against 8.4 MCM in 2010.

Table 3-29 Water Demand of Livestock

Year/ Specie	2010		2030	
	Number(,000head))	Water Demand(MCM)	Number(,000head))	Water Demand(MCM)
Cattle	501	8.4	758	11.5
Goats	2,160		2,564	
Sheep	1,254		1,297	
Pigs	1,023		1,565	
Poultry	11,288		11,447	
Camel	2.6		2.6	
Horse	2.6		2.6	
Donkey	2.6		2.6	

Note : 1) Chicken, ducks and Guinea fowls are included in poultry.
2) As to heads of camels, horses and donkeys data of 2010 are only available in recent term, so the data are also used for 2030 projection due to unpredictability.
3) Water demand is referred to Section 4.4.1, Volume 4, M/P2013.
Source: JICA Project Team

Table 3-30 Number and Water Demand of Livestock as of 2010

State	Number of Livestock in 2010								Total
	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses	(head)
Lagos	3,300	203,814	230,111	584,908	3,320,472	0	0	0	
Ogun	41,828	301,002	251,109	78,500	568,613	2,551	2,551	2,551	
Osun	9,073	408,555	98,368	103,300	1,222,429	0	0	0	
Oyo	446,320	1,246,587	674,891	256,274	6,175,998	0	0	0	
Total	500,521	2,159,958	1,254,479	1,022,982	11,287,512	2,551	2,551	2,551	
State	Annual Water Requirement (m^3) in 2010								Total
	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses	(m3)
Lagos	26,004	171,204	167,981	701,890	129,498	0	0	0	1,196,577
Ogun	329,605	252,842	183,310	94,200	22,176	7,832	22,908	20,663	933,534
Osun	71,495	343,186	71,809	123,960	47,675	0	0	0	658,125
Oyo	3,517,002	1,047,133	492,670	307,529	240,864	0	0	0	5,605,198
Total	3,944,105	1,814,365	915,770	1,227,578	440,213	7,832	22,908	20,663	8,393,434

Note: Number of livestock and water demand are referred to Section SR1.4.1, Volume-5 Supporting Report.
Source: JICA Project Team

Table 3-31 Number and Water Demand of Livestock as of 2030

State	Number of Livestock in 2030								Total
	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses	(head)
Lagos	4,998	241,950	237,984	894,641	3,367,507	0	0	0	
Ogun	63,355	357,323	259,701	120,069	576,667	2,551	2,551	2,551	
Osun	13,742	485,000	101,734	158,002	1,239,745	0	0	0	
Oyo	676,019	1,479,837	697,982	391,982	6,263,482	0	0	0	
Total	758,115	2,564,110	1,297,401	1,564,693	11,447,401	2,551	2,551	2,551	
State	Annual Water Requirement (m^3) in 2030								Total
	Cattle	Goats	Sheep	Pigs	Poultry	Donkeys	Camels	Horses	(m3)
Lagos	39,387	203,238	173,729	1,073,569	131,333	0	0	0	1,621,255
Ogun	499,236	300,151	189,582	144,083	22,490	7,832	22,908	20,663	1,206,945
Osun	108,290	407,400	74,266	189,602	48,350	0	0	0	827,908
Oyo	5,327,034	1,243,063	509,527	470,378	244,276	0	0	0	7,794,278
Total	5,973,947	2,153,852	947,103	1,877,632	446,449	7,832	22,908	20,663	11,450,386

Note: Number of livestock and water demand are referred to Section SR1.4.1, Volume-5 Supporting Report.
Source: JICA Project Team

3.4.2 Freshwater Aquaculture

This sub-sector has recently been growing faster than ever supported by policy orientation with the application of subsidy for private facility development, also by bullish growth of domestic demand for fish. Southern states in HA-5 and HA-6 are center of this activity because many feed mills and fingering hatcheries are available for fish farming.

Water use of freshwater aquaculture largely depends on ground water, particularly during dry season. Water demand of aquaculture is projected, based on “Inventory of Private and Government Fish Farm (2007) published by Department of Fishery in FMARD”. Projected water demand of major four (4) states is estimated based on Section 4.4.2 Volume 4, M/P2013. Referring to the information of other states included in Ogun-Oshun basin additionally, in accordance with each state’s relative area, the water demand for freshwater aquaculture will increase from 241 MCM in 2010 to 389 MCM in 2030.

Table 3-32 Water Demand of Freshwater Aquaculture

State	2010		2030	
	Fish Pond Area(ha)	Water demand(MCM)	Fish Pond Area(ha)	Water demand(MCM)
Lagos	279	8.4	447	13.4
Ogun	388	11.6	621	18.6
Oyo	1,877	67.6	3,008	108.3
Osun	2,252	56.3	3,609	90.2
4 States	4,796	143.9	7,685	230.5
Ogun-Oshun RB	8,042	241.3	12,885	386.6

Note: Fish pond area and water demand are referred to Section SR1.4.2, Volume-5 Supporting Report.
Source: JICA Project Team

3.4.3 Hydropower Generation

In Nigeria, stable supply of power is one of the key elements for national development. Hydropower generation can contribute to it, and is thereby being introduced.

Because water use by hydropower generation is basically non-consummative[2], total water quantity is not reduced by it. However, the flow regime can be altered in case of hydropower generation with storage dam. Even in case of run-of river type hydropower generation, it is possible that the reach with almost no flow can appear due to the intake flow that is introduced into the turbine off stream.

The optimum utilization of water for hydropower generation desired is on the condition that it would not inhibit other water uses such as municipal and irrigation in downstream reach.

[2] In case of hydropower generation with storage dam, there is a loss due evaporation and so on, although it is generally small compared to total water resources.

3.4.4 Flood Control

Flood generally means the phenomena of rainwater stagnation or overflow from river channels in the area where it is usually dry, and flood control means controlling of such flooding to store rainfall and river water in ponds and reservoirs and/or to let river water flow downstream safely through man-made channel.

The water demand in urban and rural water supply, agriculture, fishery sectors means the water quantity required for such uses are calculated and quantified for natural river flow or groundwater. In the case of flood control, such water intakes and consumptive uses of water are not so common, and quantitative evaluation of water demand is not conducted.

However, flood control measures such as flood storage in multipurpose dam reservoir and rain water harvesting in arid area could contribute to water resources development. They should be considered in Nigeria in the future.

3.4.5 Inland Water Navigation

Inland Water Navigation is being developed to complement road transportation in Nigerian through appropriate policy initiatives. Since Inland water navigation is under the jurisdiction of NIWA in Federal Ministry of Transport, information on this sector is so limited that the water demand and discharge in navigation route cannot be addressed adequately. However, inland water navigation is one of the multi-modal transportation system composed of road, air and waterway in terms of the latest national policy. So the operation and maintenance of major rivers having navigation routes will be significant in Nigeria. Water demand in inland water navigation should therefore be evaluated comprehensively as part of river discharge for each river section when local water demand of other sectors on rivers are studied in detail.

3.4.6 Minimum Stream Flow Requirement

Aside from the water demand shown in the previous sections, the minimum stream flow should be kept as high priority in order to protect the environment of the water body or for other specific reasons. There is no official measure to determine the minimum stream flow requirement in Nigeria at the moment.

Since the present project is to formulate the national water master plan, the hydrological method to discuss the minimum stream flow would be applied[3]. There are many criteria for determining the minimum stream flow using the hydrological method. In the Master Plan, Q_{97DS}90%Y (90% year dependable 97percentile flow for a single year), which may represent the drought condition according to the flow regime in each area in Nigeria is applied. Similar parameter has been applied in UK. In UK, Q_{95D} (95 percentile flow for long-term multi-year) is usually used for the minimum stream flow requirement[2].

It should be noted that the minimum stream flow discussed in the present project could be used as a guide for the overall water resources planning and management. It may require more detailed study before a particular project is actually implemented, however. It is desirable that more appropriate minimum stream flow requirement for each of the rivers be set by discussion among stakeholders, when more reliable data of river conditions such as river discharge will be available.

[3] IUCN: Flow-The Essentials of Environmental Flows

3.5 Water Demand Structure

The basic idea and the results of the water demand prediction are presented in the previous sections. In the present section, the water demand structure is discussed based on the following.

- For municipal water demand, which includes domestic, industrial and commercial water demand, the base case shown in Section 3.2 is applied. The demand in 2010 and 2030 are to be discussed.
- As for the municipal water demand, the demarcation between surface water and groundwater sources is estimated on the basis of existing condition and future plan for water supply facilities by state governments. The conveyance loss of 5% is additionally considered for surface water source. It is assumed that there is no conveyance loss in case of groundwater source.
- For other sub-sectors, irrigation, livestock and freshwater aquaculture in 2010 and 2030 are to be discussed.
- It is assumed that surface water source is mainly used in rainy season and groundwater source is utilized in dry season. The demarcation between surface water and groundwater sources is assumed to be 25:75.

The water demand structure for the following two scenarios are presented below.

- Scenario-A: The socio-economic framework and methodology of water demand projection in the target area is same as that applied in M/P2013.
- Scenario-B: The socio-economic framework and water demand projection by States (if it exists)

The existing total water demand in Ogun-Oshun Basin is estimated at 1,111MCM/year in 2010. It is expected to increase to 2,589MCM/year in 2030 for Scenario-A, and 3,193MCM/year in 2030 for Scenario-B. Figure 3-7 shows the share of water demand by each sector. The share of municipal water demand in 2010 is 81%, and it will slightly decrease to 76% in 2030 for Scenario-A, and 80% in 2030 for Scenario-B. The share of irrigation water demand will slightly increase from about 5% in 2010 to 16% in 2030 for Scenario-A, and 13% in 2030 for Scenario-B.

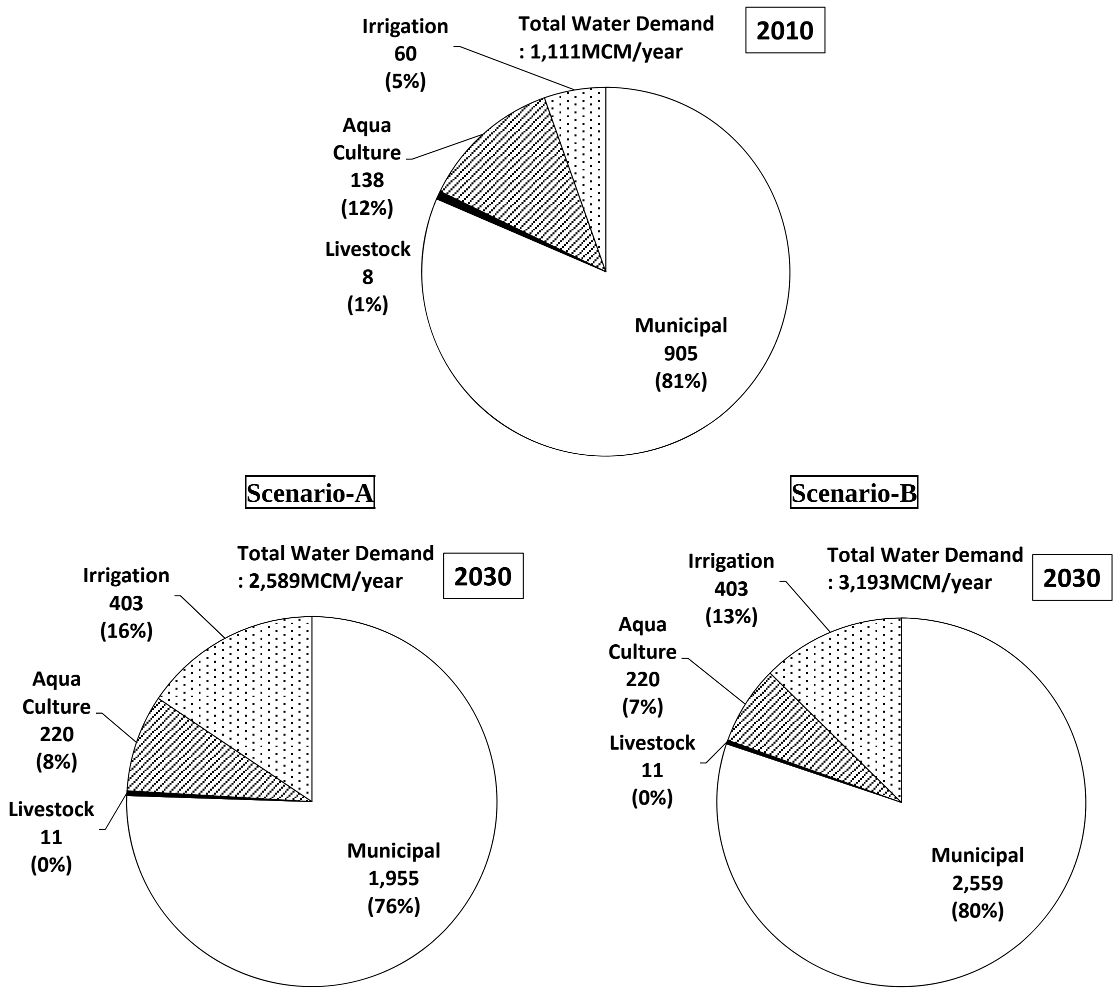
Table 3-33 shows the estimated municipal water demand and total water demand by sources. The share of surface water source in municipal water demand is 24% in 2010, it will increase to 59% in 2030 for Scenario-A, and 81% in 2030 for Scenario-B. The share of surface water source in total water demand is 24% in 2010, it will increase to 58% in 2030 for Scenario-A, and 76% in 2030 for Scenario-B.

The water demand for surface water source by each sector and that for groundwater are presented in Figure 3-8.

Table 3-33 Estimated Municipal Water Demand and Total Water Demand by Sources

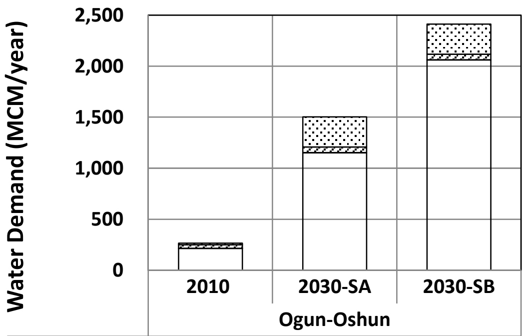
		Municipal Water Demand	Total Water Demand
Present (2010)	**Total**	**905** (100%)	**1,111** (100%)
	Surface Water	214 (24%)	267 (24%)
	Groundwater	691 (76%)	844 (76%)
Future Scenario-A (2030)	**Total**	**1,955** (100%)	**2,589** (100%)
	Surface Water	1,152 (59%)	1,504 (58%)
	Groundwater	803 (41%)	1,085 (42%)
Future Scenario-B (2030)	Total	**2,559** (100%)	**3,193** (100%)
	Surface Water	2,060 (81%)	2,412 (76%)
	Groundwater	499 (19%)	780 (24%)

Unit: MCM/year
Source: JICA Project Team



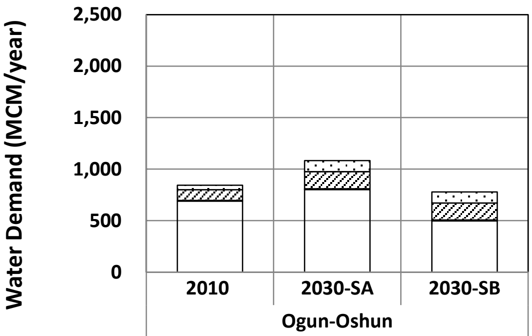
Source: JICA Project Team

Figure 3-7 Change in Share of Water Demand by Sectors



	2010	2030-SA	2030-SB
Total	267	1,504	2,412
Irrigation	17	295	295
AquaCulture	34	55	55
Livestock	2	3	3
Municipal	214	1,152	2,060

Surface Water



	2010	2030-SA	2030-SB
Total	844	1,085	780
Irrigation	44	108	108
AquaCulture	103	165	165
Livestock	6	8	8
Municipal	691	803	499

Groundwater

Source: JICA Project Team

Figure 3-8 Water Demand by Sectors and by Sources

CHAPTER 4 EVALUATION OF WATER RESOURCES POTENTIAL

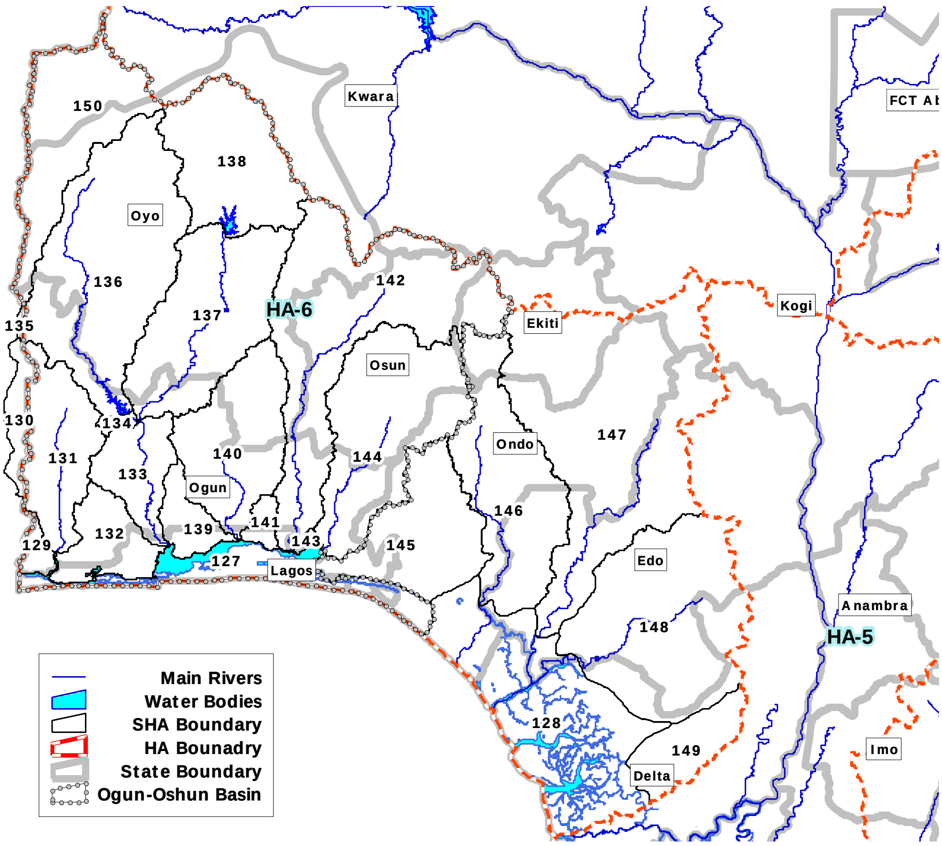
In the present chapter, water resources potential in the target area is discussed. Firstly, in Section 4.1, the updated catchment delineation in HA-6, which will be a basis for discussing the water resources, is presented. Secondly, in Section 4.2, meteorological condition as an input condition for water resources is shown. In Section 4.3, surface water resources potential in quasi-natural condition[1] is discussed on the basis of results of the rainfall-runoff model introduced in the project. The aspect of water quality is also discussed using currently available data. In Section 4.4, groundwater resources potential is evaluated. Finally, in Section 4.5, overall water resources potential is summarized.

It is judged that the evaluated water resources potential for the entire country through the formulation of the M/P2013 is the most updated results for the water resources potential. In the present draft catchment management plan, the evaluated results for Ogun-Oshun Basin are utilized as they are. Some additional analyses on the results are also shown here. As for the details on the evaluation of water resources potential, please refer to Section SR2.1, Volume-5 Supporting Report.

It should be noted that the water resources potential can be fluctuated depending on climate condition etc.. It is thus necessary to review the water resources potential periodically, on the basis of accumulated quality-assured hydrological data.

4.1 Catchment Delineation

In the M/P2013, the review on the catchment delineation has been made by joint effort of NIHSA and JICA. The number of newly delineated Sub-Hydrological Area (SHA) in HA-6 is 24, 22 of which are located inside the territory of Nigeria. The delineated SHA is shown in Figure 4-1 and Table 4-1.



Source: JICA Project Team

Figure 4-1 Delineated Boundary of Sub Hydrological Areas (SHAs) in HA-6

[1] It is not possible for us to know actual natural condition which has no influence of human activity. The quasi-natural condition is defined as the condition without influence of significant storage dams and abstraction in the present project.

Table 4-1 List of Sub Hydrological Areas (SHAs) in HA-6

SN	SHA Code	SHA Code divided by National Boundary	Area (km^2)	Inside (I) or outside(O) Nigeria	River	Remarks	Ogun-Oshun Basin
127	60001	60001	2,701.1	I		Coastal Area	x
128	60002	60002	8,252.4	I		Coastal Area	
129	601	601	391.8	I			x
130	602	602_e	844.5	O	Yewa		
131		602_i	3,311.6	I			x
132	603	603	1,965.7	I			x
133	60401	60401	2,034.9	I	Ogun		x
134	604021	604021	168.9	I	Oyan	Downstream of Oyan dam	x
135	604023	604023_e	72.9	O	Oyan	Upstream of Oyan dam	
136		604023_i	9,040.6	I			x
137	60403	60403	6,011.7	I	Ogun	Downstream of Ikere Gorge dam	x
138	60405	60405	4,704.2	I	Ogun	Upstream of Ikere Gorge dam	x
139	605	605	1,102.3	I			x
140	606	606	4,398.1	I	Oni		x
141	607	607	417.6	I			x
142	608	608	9,764.4	I	Oshun		x
143	609	609	113.5	I			x
144	610	610	6,462.0	I	Sasa		x
145	611	611	4,227.7	I			
146	612	612	5,869.5	I	Silko		
147	614	614	13,271.7	I	Osse		
148	616	616	8,417.4	I	Ossimo		
149	617	617	1,896.8	I			
150	699	699	4,809.4	I			x

SN=Serial number
Source: JICA Project Team

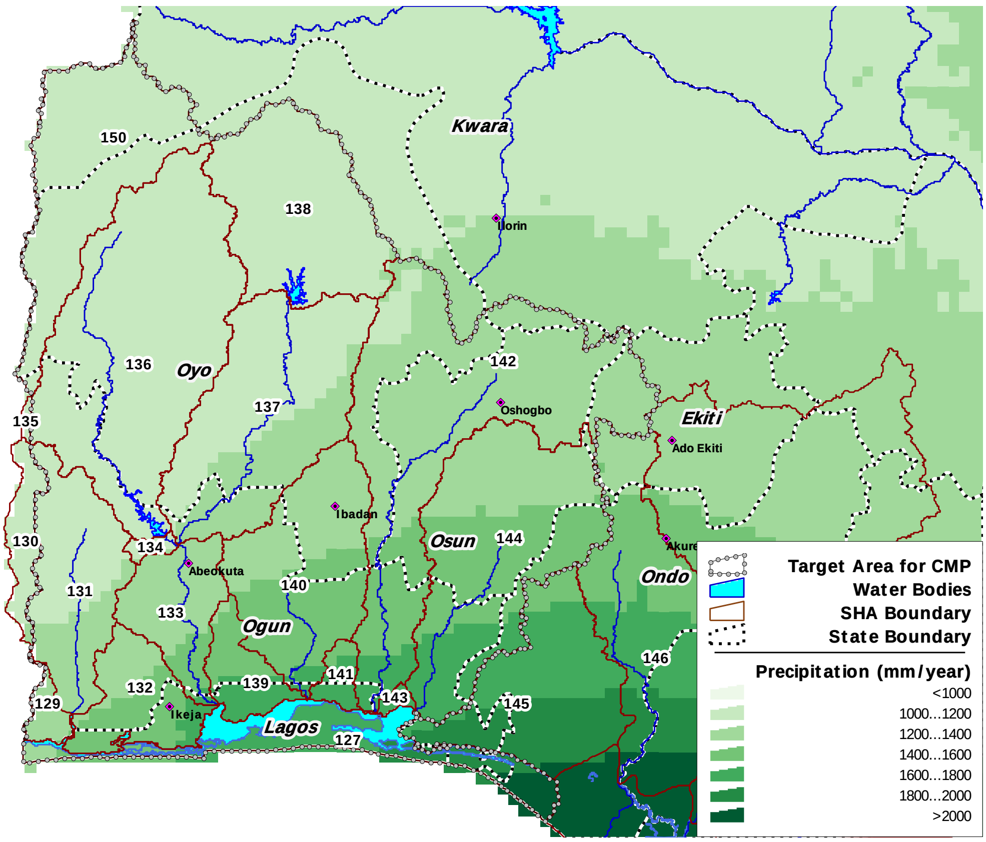
4.2 Meteorological Condition

In the M/P2013, the gridded data with 2.5minutes grid for monthly precipitation, monthly averaged air temperature and monthly potential evapotranspiration (PET) have been prepared for 1959 to 2009 (51years) for the entire country. The meteorological conditions in Ogun-Oshun Basin based on the prepared gridded data are shown below.

4.2.1 General Spatial Pattern

The annual precipitation and annual mean air temperature in Ogun-Oshun Basin in the last 40years (1970-2009)[2] are estimated at 1,274mm/year and 26.7degree Celsius in average, respectively. The estimated annual PET in the last 40years is 1,330mm/year.

Figure 4-2 and 4-3 show the spatial pattern of annual precipitation and annual PET in Ogun-Oshun Basin. The annual precipitation varies from over 1,600mm in Southeastern part of Ogun-Oshun Basin to less than 1,000mm in the most northern part of Ogun-Oshun Basin. Since the PET is estimated on the basis of Hamon equation[3], the PET is affected by air temperature. The air temperature tends to increase towards the north in the country. However, in the target area, variation of air temperature by altitude is larger than such changes from south to north. In the high elevation area along the northern border of Ogun-Oshun Basin, the annual PET becomes 1,200mm/year, whereas the PET in the remaining areas ranges between 1,300mm/year to 1,400mm/year.

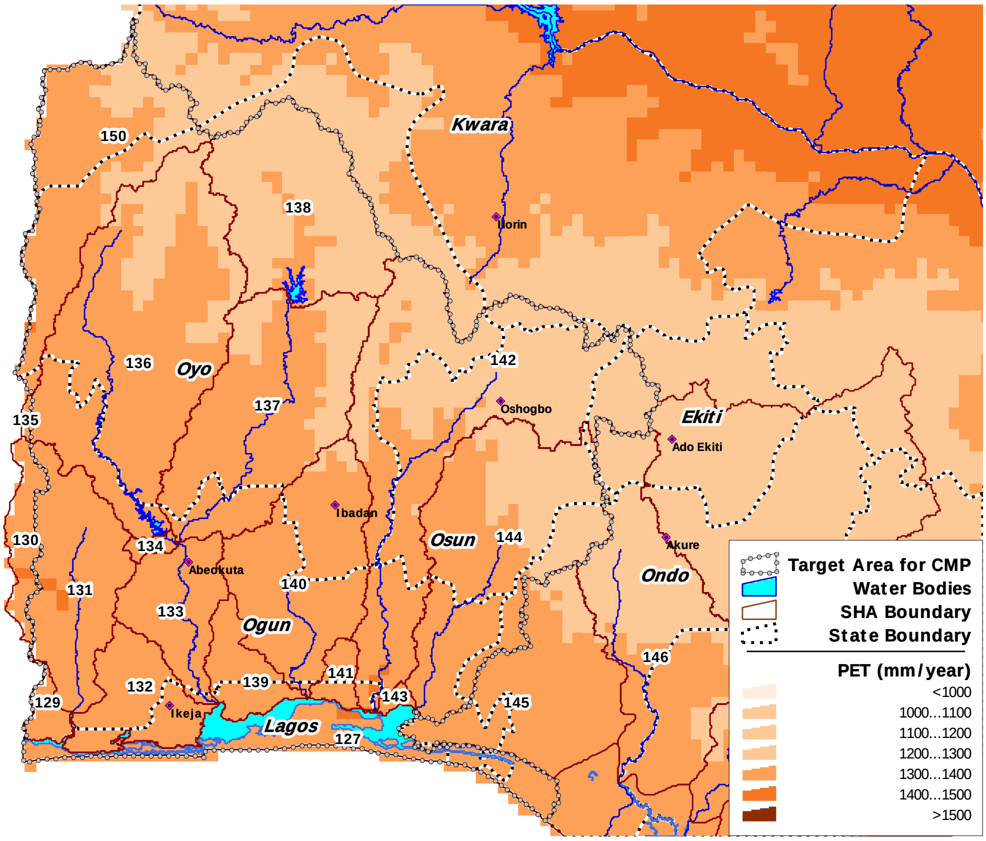


Source: JICA Project Team
Note: Average in 1970-2009 (40years)

Figure 4-2 Spatial Patterns of Annual Precipitation

2 The average values for 1970-2009 were shown, because the water resources potential is estimated using 1970-2009 data in the later section.

3 Hamon, W.R.: Estimating potential evapotranspiration, Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, v. 87, p. 107–120, 1961. There are some variations to express the Hamon equation. In the present project, the equation and coefficient shown in the following paper are utilized; G.J. McCabe and S.L. Markstrom: A Monthly Water-Balance Model Driven by a Graphical User Interface, USGS Open-File Report 2007-1088, 2007.

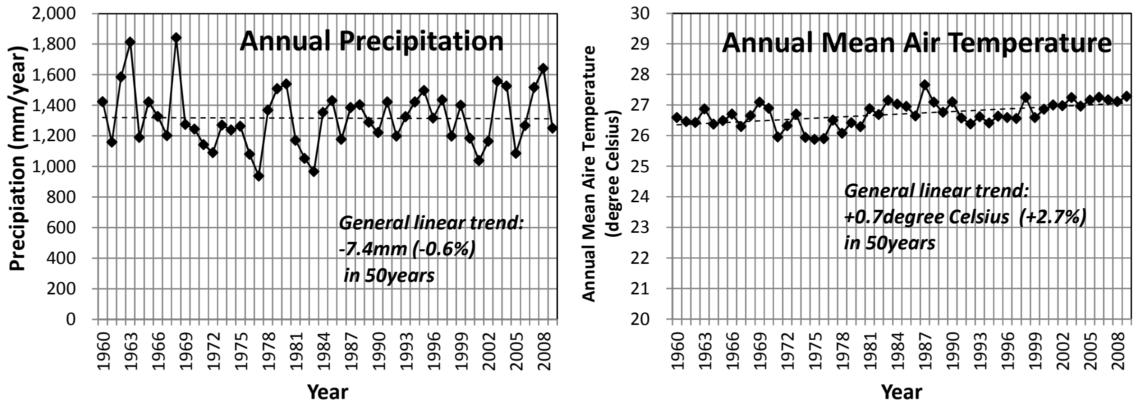


Source: JICA Project Team
Note: Average in 1970-2009 (40years)

Figure 4-3 Spatial Patterns of Annual PET

4.2.2 Long-term Trend

Figure 4-4 shows the long-term trend of annual precipitation and annual mean air temperature for Ogun-Oshun Basin.

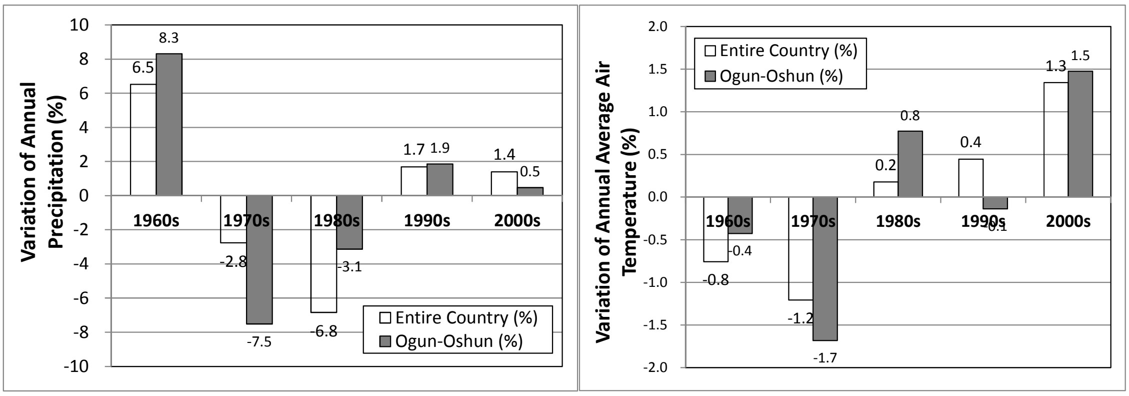


Source: JICA Project Team

Figure 4-4 Long-term Trends of Precipitation and Air Temperature for Ogun-Oshun Basin

The annual precipitation is kept almost same in the last 50years, and the rate is -0.4% in 50years. The annual mean air temperature tends to increase with +2.7% in 50years.

Figure 4-5 shows the variation of annual precipitation and annual mean air temperature by decades. One can see that 1960s was relatively wet (more precipitation) and 1970s-1980s was dry (less precipitation). 1990s-2000s became wet periods again. The magnitude of the fluctuation is much larger than the linear change rate of annual precipitation in 50years. The most driest period in Ogun-Oshun Basin appeared in 1970s, although the driest was 1980s in the national average. On the other hand, annual mean air temperature has been increasing almost constantly without large fluctuation over five (5) decades.



Source: JICA Project Team

Figure 4-5 Variation of Annual Precipitation and Annual Mean Air Temperature by Decades

The number of years with the annual precipitation less than 80% yearly dependable precipitation by each of decade is calculated and presented in Table 4-2. Four drought years appeared in 1970s. The drought years in 1970s and 1980s tend to appear continuously.

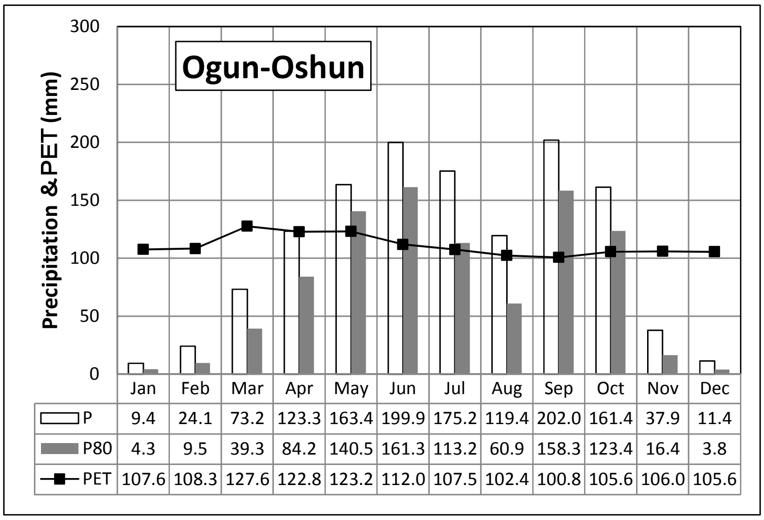
Table 4-2 Change in Number of Drought Year

	1960s	1970s	1980s	1990s	2000s
Number of Drought Year*	1	4	2	0	3
Drought Year* (Annual Precipitation (mm))	1961(1,141)	1971(1,142) 1972(1,082) 1976(1,075) 1977(927)	1982(1,041) 1983(948)		2001(1,029) 2005(1,065)

*Drought year is defined here as a year with the annual precipitation less than 80% yearly dependable precipitation
Source: JICA Project Team

4.2.3 Seasonal Pattern

The seasonal variation of precipitation and PET is presented in Figure 4-5[4]. In the figure, 80% yearly dependable precipitation for each month as well as average monthly precipitation and PET are presented. In Ogun-Oshun Basin, the peak of precipitation appears twice in a year; June and September. The average precipitation exceeds the average PET in six months, which means that there is hydrological deficit for about six months in a year.



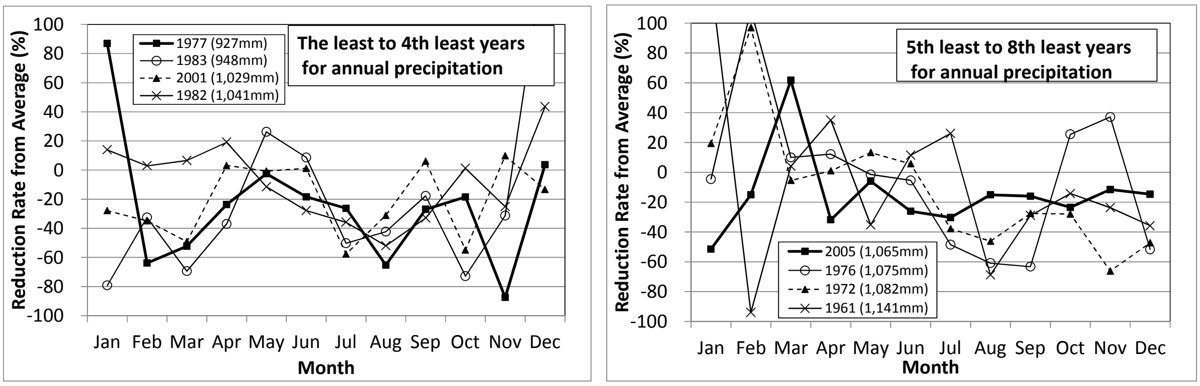
Note: P80=80% yearly dependable monthly precipitation, Duration of date used =1970-2009 (40years)
Source: JICA Project Team

Figure 4-6 Seasonal Variation of Precipitation and PET

4 The average values for 1970-2009 were shown, because the water resources potential is estimated using 1970-2009 data in the later section, in the same way in section "(1) General Spatial Pattern".

The 80% yearly dependable precipitation for each month as well as average monthly precipitation and PET for each SHA are presented in Annex-T 4-1 – 4-3.

The reduction rate of precipitation by month in the drought years is presented in Figure 4-7. One can see that the reduction of precipitation tends to occur throughout a year in the extreme drought years, whereas the reduction does not always occur throughout a year in the more frequent drought years. It is, however, difficult to find general tendency on when the reduction occurs.



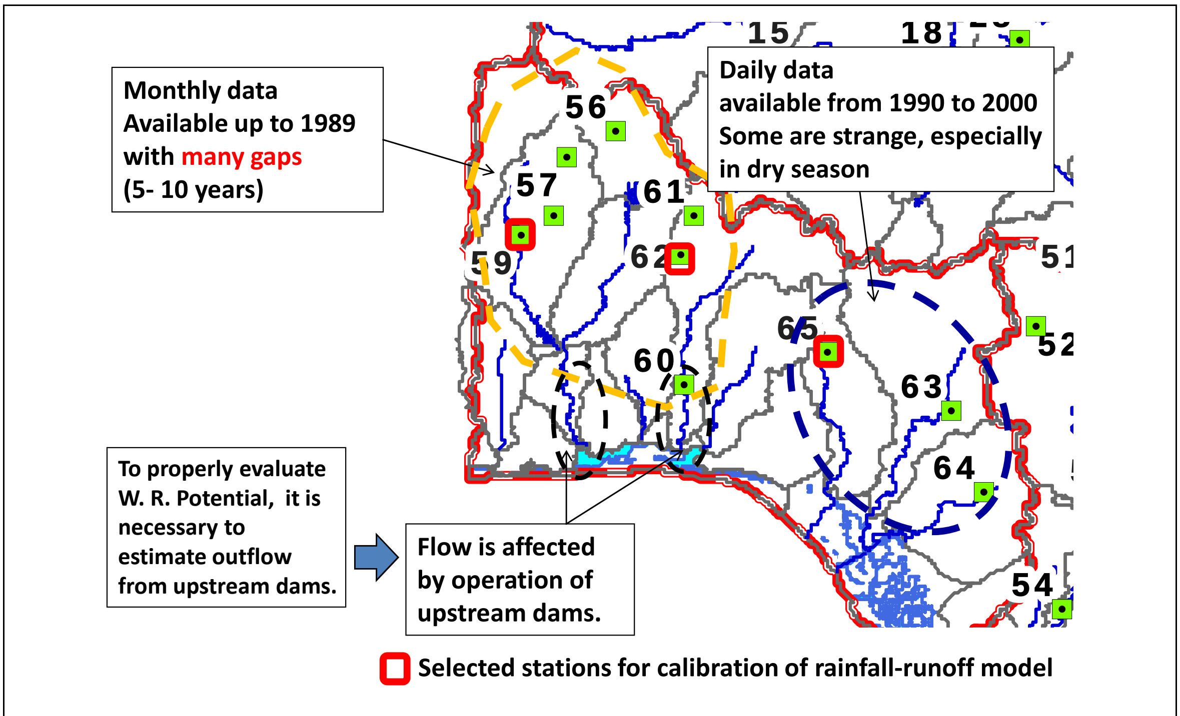
Source: JICA Project Team

Figure 4-7 Reduction Rate of Precipitation by Month in Drought Years

4.3 Surface Water Resources

4.3.1 Available Hydrological Data

In the M/P2013, available hydrological data were collected and arranged as many as possible. Monthly discharge data have been arranged for totally 101 stations in nationwide. However, available data in HA-6 are very limited as shown in Figure 4-8. The details of the available data are shown in Section SR2.3.1, Volume-5 Supporting Report.



Source: JICA Project Team

Figure 4-8 Available Hydrological Data in HA-6

4.3.2 Surface Water Resources Potential in Quasi-Natural Condition

(1) Introduction of Long-Term Rainfall-Runoff Simulation Model

It is always better to use directly observed data, if they are available and their quality is good. However, in the present project there are not enough discharge data in terms of space and time for proper assessment of water resources, as shown in Section 4.3.1. Furthermore, the observed data at many stations are disturbed by operation of large dams. In the M/P2013, a long-term rainfall-runoff model has been introduced in order to obtain supplemental information on runoff condition in space and time, especially for the quasi-natural condition without effect of the large storage dams. A monthly-basis soil-moisture accounted model, which is called the Thornthwaite monthly water balance model[5] has been selected and were applied with semi-distributed manner[6,7,8] in a catchment for the long-term rainfall-runoff model. The model parameters are calibrated against the observed discharge at the selected hydrological stations. The details of the rainfall-runoff model are shown in Section SR2.3.3, Volume-5 Supporting Report.

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5 G.J. McCabe and S.L. Markstrom: A Monthly Water-Balance Model Driven by a Graphical User Interface, USGS Open-File Report 2007-1088, 2007.

6 Moore, J.W. Trubilowicw and J.M. Buttle: Prediction of Streamflow Regime and Annual Runoff for Ungauged Basins using a Distributed Monthly Water Balance Model, J. of the American Water Resources Association, Vol.48, No.1, pp.32-42, 2012.

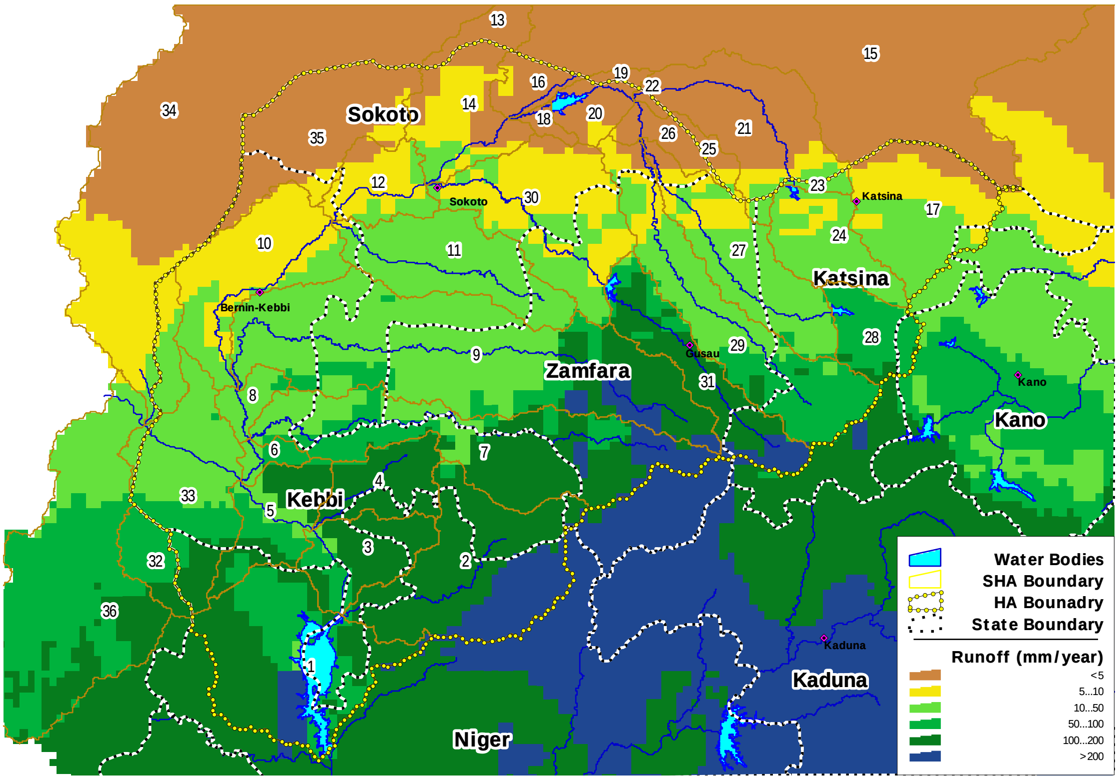
7 C. Gregory Knight, Heejun Chang, Marieta P. Staneva & DeyanKostov : A Simplified Basin Model For Simulating Runoff: The Struma River GIS,The Professional Geographer, 53:4, 533-545, 2001

8 FAO: Water Resources and irrigation in Africa, available from http://www.fao.org/nr/water/aquastat/watresafrica/index4.stm

(2) Estimated Surface Water Resources Potential in Quasi-Natural Condition

The simulated runoff from 1970 to 2009 (40years)[9] are used for estimation of surface water resources potential in quasi-natural condition. The average runoff yield and runoff rate in Ogun-Oshun Basin are estimated at 199mm/year and 15.4%, respectively.

Figure 4-9 show spatial distribution of the average annual runoff yield. In the most part of Ogun-Oshun Basin, the runoff yield is less than 200mm/year, whereas it becomes more than 300mm/year in the southeastern end. The runoff yield by SHAs is shown in Annex-T 4-4.



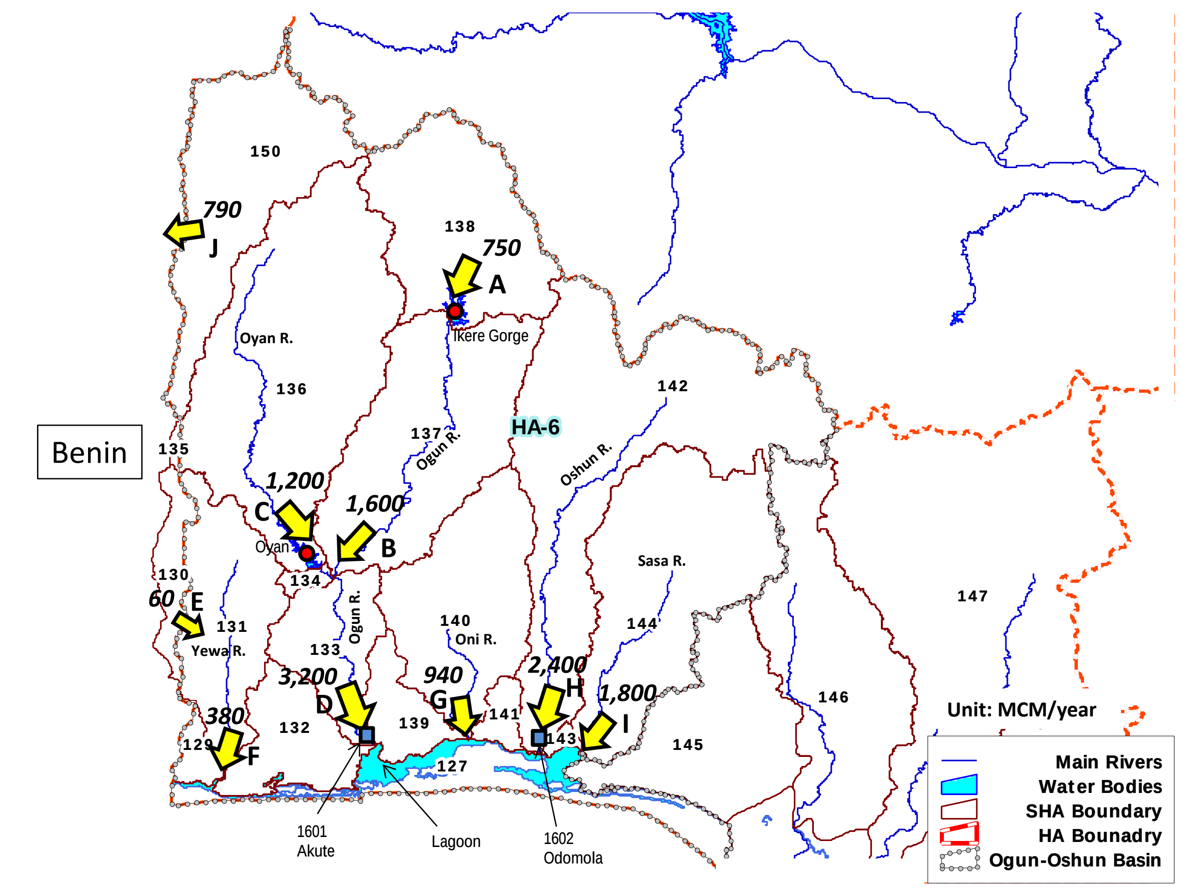
Note: Duration of data used =1970-2009 (40years)
Source: JICA Project Team

Figure 4-9 Spatial Distribution of Average Annual Runoff Yield

Figure 4-10 shows the regional water balance in terms of annual runoff in Ogun-Oshun Basin. The followings are noted.

- Almost all rivers in Ogun-Oshun Basin except the one that flows to Benin drain to the lagoon in the coastal area.
- The runoff from the catchment area of Ikere Gorge dam, which is located in the most upstream of Ogun River, is estimated at 750MCM/year (“A“ in the figure). The runoff in Ogun River increases to1,600MCM/year before the confluence of Oyan River (“B“ in the figure). The runoff from the catchment area of Oyan dam is estimated at 1,200MCM/year (“C” in the figure). The total runoff at the most downstream of Ogun River reaches to 3,200MCM/year (“D“ in the figure).
- The most upstream area of Yewa River belongs to the territory of Benin. The runoff from this area to Niger is estimated at 60MCM/year (“E“ in the figure). The total runoff at the most downstream of Yewa River is estimated at 380MCM/year (“F“ in the figure).
- The total runoff in Oni River is estimated at 940MCM/year (“G“ in the figure).
- The total runoff in Oshun River is estimated at 2,400MCM/year (“H“ in the figure).
- The total runoff in Sasa River is estimated at 1,800MCM/year (“I“ in the figure).

9 Since the inflow from Niger-Nigeria border can be estimated only after 1970 due to availability of the observed discharge, it is decided to assess the water resources potential using 1970-2009.



Note: Duration of data used =1970-2009 (40years)
Source: JICA Project Team

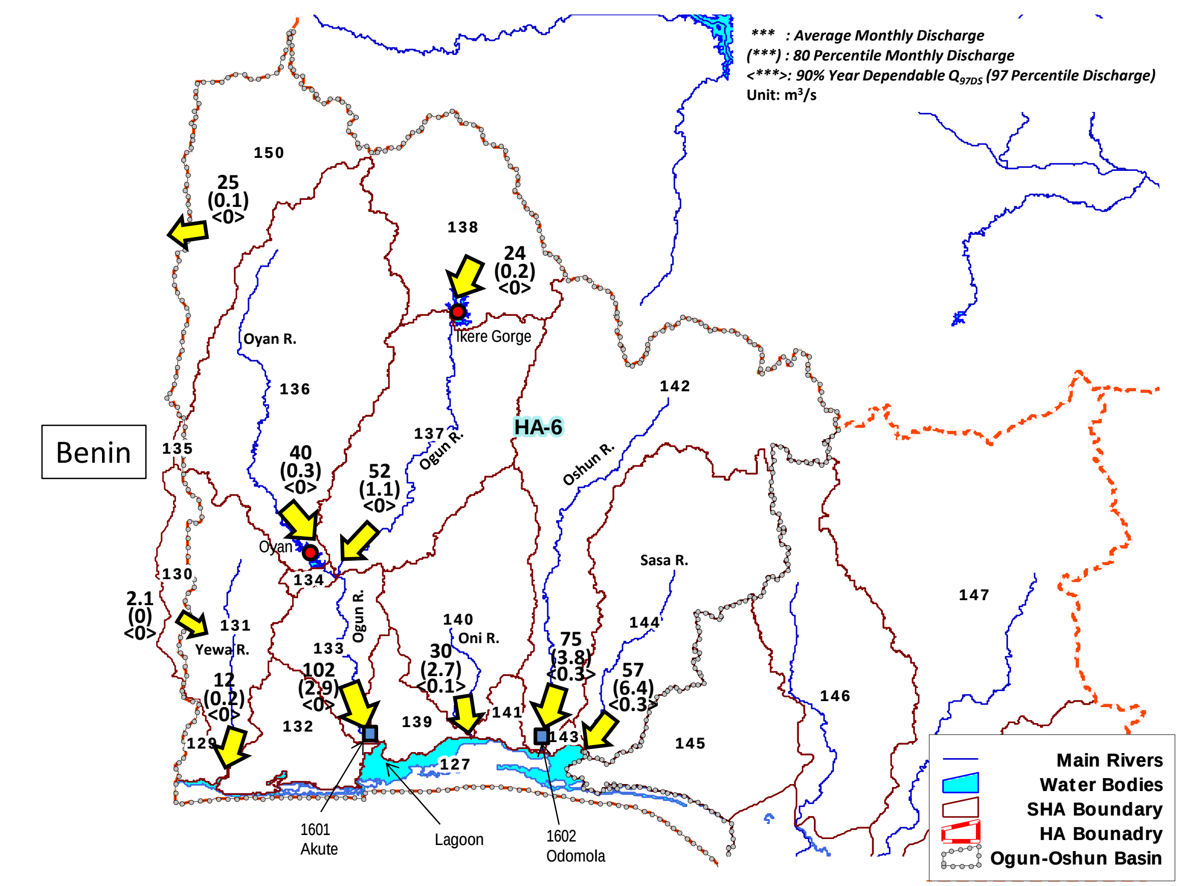
Figure 4-10 Regional Water Balance in terms of Annual Runoff in Ogun-Oshun Basin

(3) Available Surface Water Resources in Quasi-Natural Condition

There are clear dry and wet seasons in Ogun-Oshun Basin. The usable water in dry season with stable manner is much smaller than the annual average discharge in quasi-natural condition. In order to evaluate the stably usable surface water in quasi-natural condition, the following indicators were computed at the representative points. The computed these values are presented in Figure 4-11.

- Q_{80M}
  - 80% monthly discharge, [suffix M means that the value is based on monthly data].
  - This can be directly calculated from the simulated runoff.
- Q_{97DS}90%Y
  - 90% yearly dependable Q_{97DS} (Q_{97DS}: 97 percentile daily discharge for a single year, which is usually called as drought discharge, [suffix d represents daily, suffix s represents single year])
  - This indicator represents a drought condition of river flow.

The estimated Q_{80M} and Q_{97DS}90%Y as well as average monthly discharge at the downstream end of SHAs are shown in Annex-T 4-5.



Source: JICA Project Team
Note: Duration of data used =1970-2009 (40years)

Figure 4-11 Average Discharge, Q_{80M} and Q_{97DS}90%Y

(4) Estimated Flow Condition in Quasi-Natural Condition at Representative Points

The primary hydrological monitoring stations proposed in the M/P2013 as well as the significant dams whose gross storage is more than 100MCM are selected as the representative points in Ogun-Oshun Basin. The flow condition at the representative points is discussed below. There are two primary hydrological monitoring stations in Ogun-Oshun Basin; Akute and Odomola. Akute is located at downstream end of Ogun River. Odomola is located at downstream end of Oshun River. In both points, there are intakes for municipal water supply for Lagos state. These locations are shown in Figure 4-10, 4-11.

(4-1) Flow Regime

Table 4-3 shows the flow regime at representative points. At the most downstream end of Ogun and Oshun Rivers, the 80% monthly discharge is about 3-5% of average discharge. However, it reduces to about 1% at Oyan dam and Ikere Gorge dam.

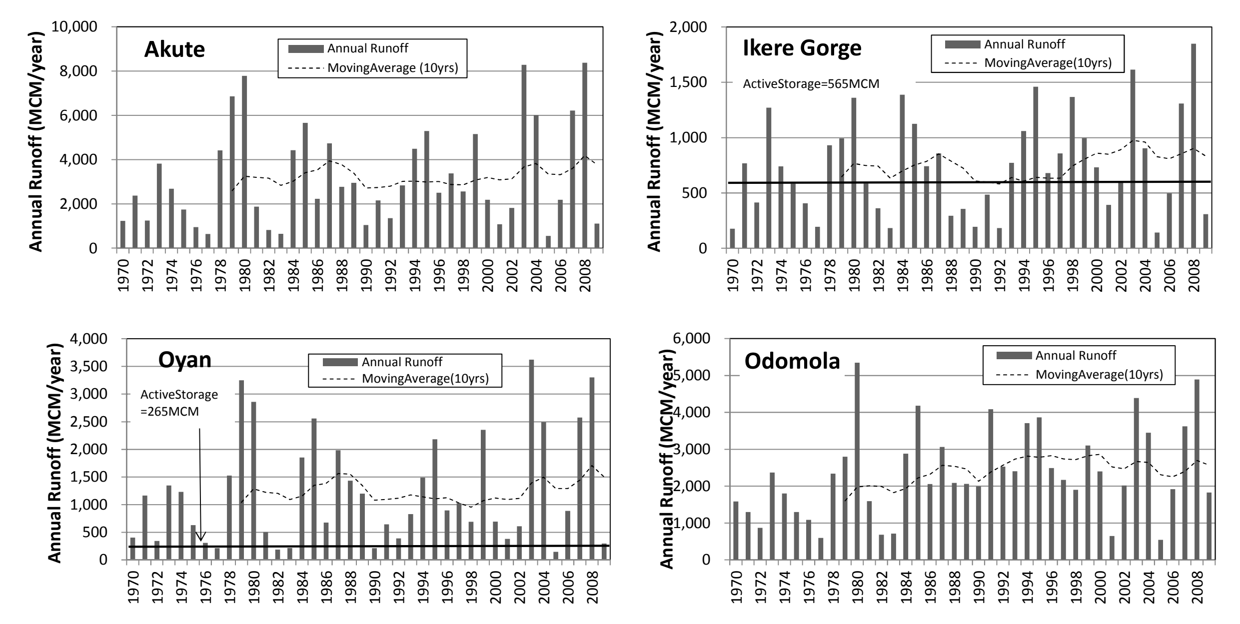
Table 4-3 Flow Regime at Representative Points

Representative Points	$Q_{average}$ (m^3/s)	Q_{20M} (m^3/s)	Q_{50M} (m^3/s)	Q_{80M} (m^3/s)	Q_{97DS}90%Y (m^3/s)
1601 Akute	101.8	139.0	31.5	2.9	0.043
Ikere Gorge	23.9	29.8	2.6	0.2	0.003
Oyan	39.3	45.6	3.5	0.3	0.000
1602 Odomola	75.0	104.2	29.2	3.8	0.257

$Q_{average}$=Average Discharge, Q_{20M}=80% monthly discharge, Q_{50M} =60% monthly discharge, Q_{80M}=20% monthly discharge [subscript M represents monthly value].
Q_{97DS}90%Y=90% yearly Q_{97DS} (Q_{97DS}: 97 percentile daily discharge for a single year, which is usually called as drought discharge, [suffix D represents daily, suffix S represents single year])
Source: JICA Project Team

(4-2) Change in Annual Runoff

Figure 4-12 shows the change in annual runoff in the representative points. The annual runoff varies year by year very much. The large fluctuation of annual runoff makes the operation of dams in these rivers difficult. In the figure, the moving average with 10years is also shown. The moving average value indicates almost no change in runoff from 1970s to 2000s.

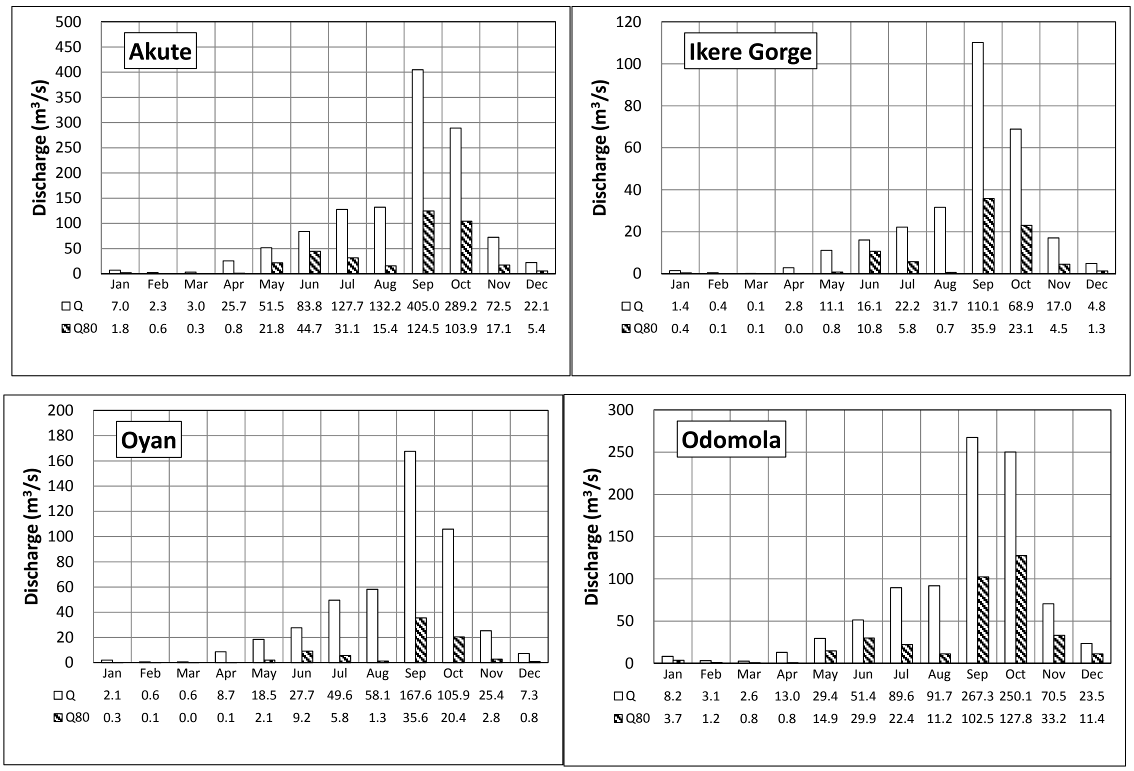


Source: JICA Project Team

Figure 4-12 Change in Annual Runoff at Representative Points

(4-3) Seasonal Variation

Figure 4-13 shows the seasonal variation of discharge at representative points. In the figure, average discharge as well as 80% yearly dependable discharge for each month is presented. There is almost no flow during December to March. Although the average discharge increases gradually from April to September. the 80% yearly dependable discharge once decreases in July and August. It indicates that the discharge in July and August is significantly affected in drought years.

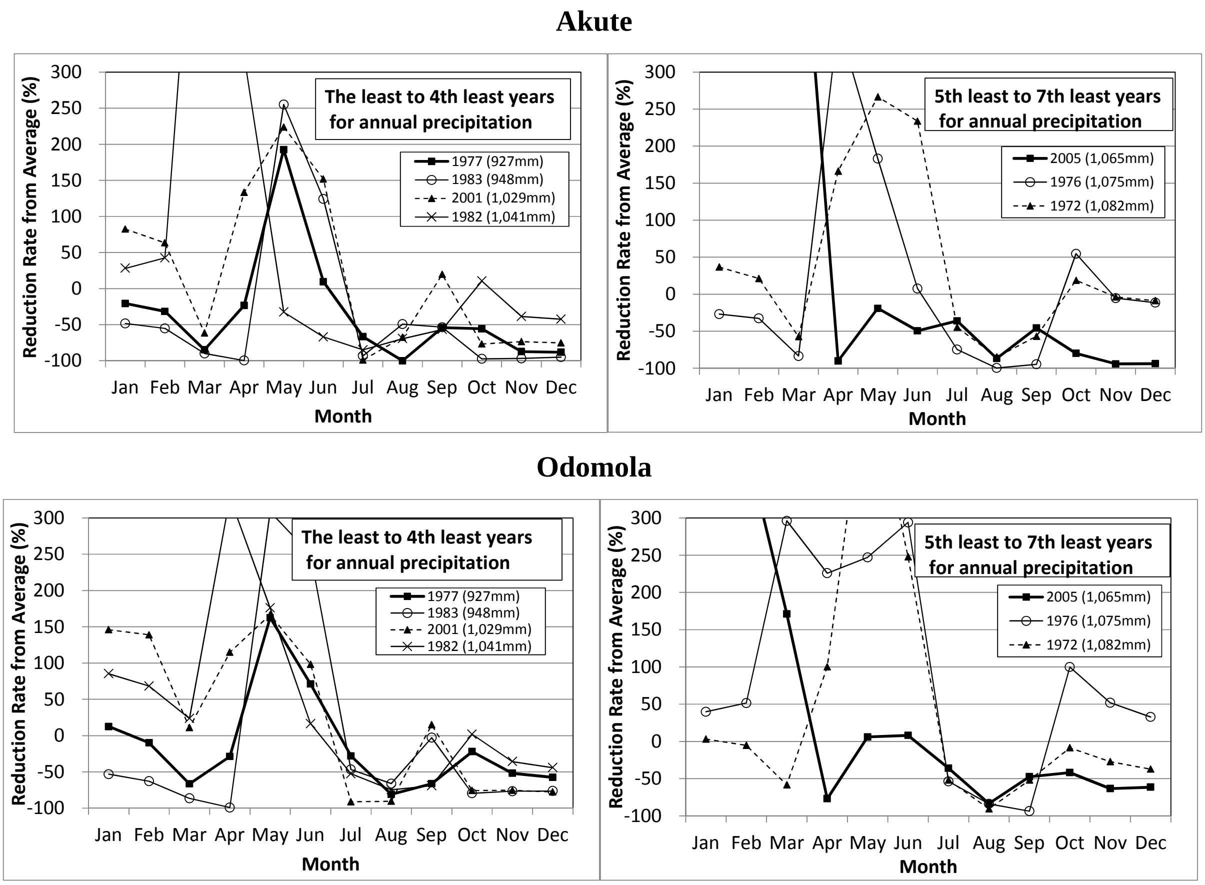


Source: JICA Project Team
Note: P80=80% yearly dependable monthly discharge, Duration of date used =1970-2009 (40years)

Figure 4-13 Seasonal Variation of Discharge at Representative Points

The reduction rate of discharge by month in the drought years at Akute and Odomola is presented in

Figure 4-14. One can see that the reduction of discharge tends to occur from July to December in drought years. It is difficult to find general tendency on the reduction from January to June.



Source: JICA Project Team

Figure 4-14 Reduction Rate of Discharge in Drought Years

4.3.3 Effect of Climate Change on Runoff

In order to explore the possible change in climate conditions in future, the statistically downscaled output of GCMs, which is provided by CCAFS[10], are analyzed. The statistical downscaling as well a bias correction was conducted utilizing the spatial distribution of parameters provided by Worldclim[11] dataset. The downscaled data for A1B scenario with grid scale of 10 minute are spatially averaged for each HA and other related catchment areas outside Nigeria for further analysis. The details are shown in Section SR2.3.5, Volume-5 Supporting Report.

Although the outputs of the GCMs for precipitation are scattered, their average and standard deviation are computed. The following is noted from the figure.

- In general, the average change among the different outputs from the GCMs is much smaller than the standard deviation. This indicates that there is a lot of uncertainty on the change in precipitation.
- For all HAs, the precipitation tends to decrease during MAM (March, April, May) and increase during JJA (June, July, August) and SON (September, October, November).
- For the southern areas such as HA-5,-6 and-7, the precipitation tends to decrease during DJF (December, January, February), whereas it tends to increase in the central and northern areas.
- These tendencies could bring about drier dry season and wetter wet season, especially in the southern area.
- The rate of change increases gradually with time in general, which amplifies the initial

[10] Ramirez, J.; Jarvis, A. 2008. High Resolution Statistically Downscaled Future Climate Surfaces. International Center for Tropical Agriculture (CIAT); CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Cali, Colombia. Data are available from web-site of CCAFS http://www.ccafs-climate.org/

[11] Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Available from http://www.worldclim.org/

direction of change.

As for the air temperature derived from outputs of the GCMs, the following is noted from the figure.

- In general, the average change among the different outputs from the GCMs is much larger than the standard deviation. This indicates that there is certain change in air temperature.
- The changes are almost same for all HAs and all seasons.
- The rate of change increases gradually with time.

In order to assess the effect of climate change on runoff, the scenarios for change in precipitation and air temperature are set as shown in Table 4-4, based on the output from the GCMs. The target year is set at 2050 and the outputs of GCMs for 30years around 2050 are utilized for setting the scenario.

Table 4-4 Scenarios for Change in Precipitation and Air Temperature

Case	Item	Season	HA-6
1	P (%)	ANN	0
	T (°C)	ANN	+2.2
2	P (%)	DJF	-3.2
		MAM	-7.5
		JJA	+1.9
		SON	+2.3
	T (°C)	ANN	+2.2

Remarks:
1) P = Precipitation, T=Air Temperature
2) HA-1e: Catchment area outside Nigeria whose runoff comes into HA-1
3) DJF= December, January, February, MAM=March, April, May, JJA=June, July, August, SON= September, October, November, ANN=Annual

Source: JICA Project Team

The long-term rainfall-runoff simulation model was utilized for estimating the effect of the change in precipitation and air temperature on runoff. In the simulation, only the precipitation and PET were modified, based on the scenarios shown in Table 4-4. The response of internal annual runoff volume, which is generated within Ogun-Oshun Basin, to the change in precipitation and air temperature, on the basis of the simulated results, are summarized as follows.

- The expected change in air temperature could bring about the reduction of annual runoff with about 20% in Ogun-Oshun Basin (Case-1), which is almost same as the national average.
- The response of runoff against the expected change in precipitation is not large in Ogun-Oshun Basin (Case-2).
- The decreasing rate of 80, 90% dependable annul runoff volume is larger than that of the average runoff volume in general, which indicates that drought condition would become severer.

4.3.4 Outline of Surface Water Quality

(1) General Condition of Surface Water Quality

It is difficult to assess the general condition of surface water quality in Nigeria, because no systematic water quality monitoring and analysis is implemented. The current water quality monitoring being implemented by the Water Quality Laboratories of FMWR is conducted poorly for proper water quality assessment of watercourses in Nigeria, due to financial constraints. A few studies performed were conducted on ad-hoc basis or on the request of some governmental institutions or in the frame of EIA of some projects.

Although it is difficult to grasp the general condition of surface water quality, based on the draft report on Data Gathering for Development of Baseline Data for Water Quality Laboratory and Monitoring, which was recently implemented by the request the FMWR, Department of Water Quality and Sanitation, the preliminary evaluation on water quality for Lagos, Ogun, Oyo and Osun States are presented in Table 4-5.

The following preliminary findings are noted.

- Generally the water quality of rivers is good both in the wet season and dry season judging from the fact that the concentration of BOD and DO are maintained within the standards to support aquatic living environment. This is attributable, among others reasons, to the higher rain pattern in the zone that helps to maintain the self-purification efficiency of the water courses.

- Some found values in some rivers needs to be confirmed to assess their quality.
- Presence of heavy metals had been detected in some rivers that call for further water monitoring research in order to understand their causes and to promote a sound management of the water quality of those affected rivers.

It should be noted that these preliminary findings are based on the monitoring data obtained only two times (one in wet season, another in dry season). Continuous monitoring is strongly recommended to assess current situation of water quality.

Table 4-5 Preliminary Evaluation of Water Quality Status of Some Rivers in Lagos, Ogun, Osun and Oyo States.

State	River Name	Code	Wet Season		Dry Season		NFA
			BOD	DO	BOD	DO	
Lagos	River Ogun at intake to Iju WTP	SW/002	0.3	12.5	0.2	13.5	Cu, Fe, Pb
	River Ogun at intake to Adiyan WTP	SW/003	1.2	29.5	1.2	3.0	Cu, Fe, Pb
Ogun	River Oyan	SW/006	0.9	28.0	0.9	15.0	Cu, Fe, Ni
	Surface water at Igbo-Ora Road by the Bridge	SW/009	0.7	33.0	0.6	5.6	Cu, Fe, Ni
	Oyan Dam	SW/007	27.9	n.a.	27.4	n.a.	Cu, Fe, Ni, Pb
	River Ogun at intake to Abeokuta WTP	SW/012	0.6	27.3	0.3	15.0	Cu, Ni
Osun	River Osun at intake to Asejire WTP	SW/001	1.4	9.7	1.3	9.6	Fe, Pb, Cd
	River Ona at intake to Eleyele WTP	SW/003	1.2	6.2	1.1	6.1	Fe Pb Cd, Ni
Oyo	Esa-Odo Dam	SW/004	0.0	6.2	0.0	6.2	Fe, Cu, Ni
	River Osun at Gbodofon Bridge	SW/006	0.1	6.5	0.1	6.6	Ni

Note: The number of sampling of water quality is only two times (one in wet season and another in dry season). This table shows only preliminary evaluation based on the results of these limited samples.
Criteria:

Good quality : BOD = < 3 and 6=<DO (based on Nigeria Standard Values for surface water- recreation & fisheries)
Moderate : 3<BOD = <6 and 4=<DO < 6 (based on Nigeria Standard Values for surface water- irrigation & reuse)
Poor : BOD > 6 or DO < 4 (proposed by JICA Project Team)
NFA: need further assessment because of the presence of higher values in the samples than the standard
Source: JICA Project Team

(2) Other Information

Ogun River

During the field observation conducted on July 16, 2013 (wet season), it was noted high turbidity on the Ogun River, water source for drinking water supply. No presence of E. coli was detected at the water intake point for the water corporation, which indicates that this river is not receiving untreated wastewater. It is recommended to take periodical samples from this river in order to assess the trend of its condition which must include physic-chemical, bacteriological and organic analysis.

Oshun River

During the field observation conducted on July 16, 2013, the Water Corporation of Oyo State had provided water quality data of Oshun River. The presence of E. coli indicates the discharge of untreated wastewater which should be controlled by responsible organizations.

Lagoons in Lagos State

During the field observation conducted on July 15, 2013, in Lagos State, it was noted that some drainage channels constructed by the State Ministry of Environment to drain storm water were converted in sewage open channel that finally discharge into the lagoons. The fact is that Water Corporation of Lagos State is planning to use the lagoon as a water source in the future; however, according to the Lagos State Ministry of Environment, no holistic study was conducted in the lagoon to determine its suitability, therefore, it is recommended to implement a comprehensive research of the water quality and quantity of the lagoon to decide its potentiality and proper alternatives of treatment for its use.

(3) Preliminary Analysis on Pollution Load

Although it is difficult to evaluate the surface water quality situation, it is also expected that further deterioration of water body due to future increase of population and so on. In order to preliminary discuss this, preliminary analysis on pollution load has been conducted.

In the present project, the pollution load is defined as the amount of pollutant that enters a water body taking into account its level of reduction by on-site, off-site treatment facilities. The pollution load is estimated in order to assess its impact on the surface water quality under the present and future condition. The parameter BOD is selected as the indicator of organic pollution for the estimation of the pollution load. The scenario on development of sanitation facilities in Section 7.1 is referred. The detailed methodology on estimating the pollution load is shown in Item (3) of Section SR2.3.6, Volume-5 Supporting Report.

As shown in Table 4-6, the estimated total pollution load in Ogun-Oshun Basin is 628x10^6kg/year for 2010 and 1,018x10^6kg/year for 2030. The domestic pollution load occupies more than 70%, and this ratio slightly increases in 2030.

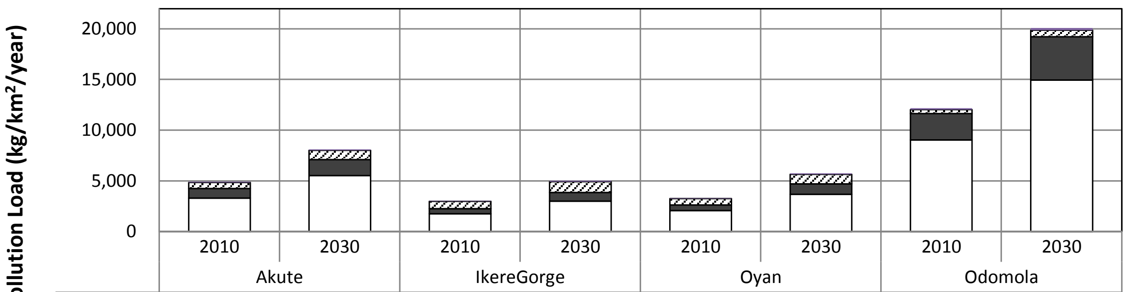
Table 4-6 Pollution Load in Ogun-Oshun Basin

	Domestic	Industrial	Livestock	Aqua Culture	Total
2010	461 (73%)	134 (21%)	28 (4%)	5 (0.7%)	628
2020	750 (74%)	219 (21%)	42 (4%)	7 (1.0%)	1,018

Unit: 10^6 kg/year
Source: JICA Project Team

The pollution load by SHA is presented in Annex-T 4-6.

The unit pollution load, total pollution load in a catchment divided by the catchment area, at representative points is shown in Figure 4-15. One can see that the unit pollution load in Oshun River is higher than that in Ogun River. In Ogun River, the unit pollution load increases toward the downstream, which means higher pollution load in downstream. Lagos state, which has much population, mainly belongs to outside the Ogun river basin, and thereby its contribution of pollution load to Ogun River that is a major source of municipal water supply of Lagos is not much. However, the pollution load generated by Lagos directly reaches to the lagoon in the coastal area.



	2010	2030	2010	2030	2010	2030	2010	2030
	Akute		IkereGorge		Oyan		Odomola	
Total	4,926	8,108	3,043	5,029	3,322	5,746	12,195	20,103
Fishpond	59	94	68	109	60	96	150	241
Livestock	613	915	715	1,070	626	935	390	635
Industrial	942	1,569	489	833	572	1,022	2,597	4,284
Domestic	3,313	5,530	1,771	3,018	2,063	3,693	9,058	14,944

Source: JICA Project Team

Figure 4-15 Unit Pollution Load at Representative Points

The domestic pollution source occupies more than 70% in the total pollution load. It is expected that its effect increase more in future due to future increase in population. As shown in Section 7.1, the target of sanitation sector is to achieve 100% access of sanitary facilities by 2030. The reduction of domestic pollution load depends on the progress of sanitation development and its maintenance such as how septage is properly treated. It is important to develop the sanitation facilities as planned and to sustain its function properly, in order to mitigate the pollution load.

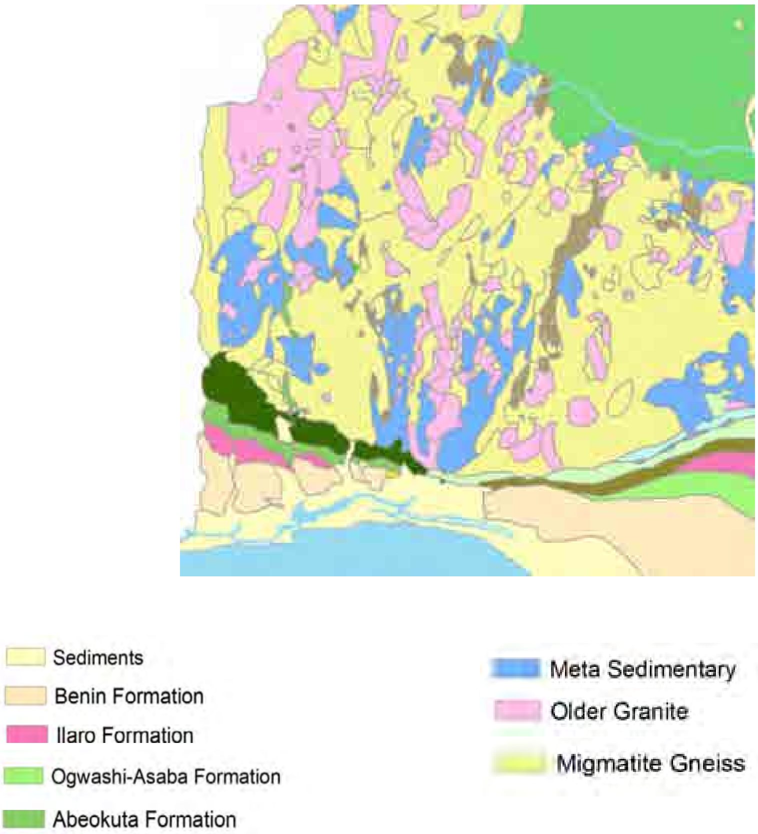
The effect of pollution load on water quality is not well understood, due to lack of data and information. It is necessary to accumulate reliable water quality data in rivers and lagoon by enhancing water quality monitoring, so as to discuss more details on water quality and water environment.

4.4 Groundwater Resources

Groundwater potential means groundwater recharge, which is equivalent to maximum amount of groundwater to be developed. On the other hand, amount of groundwater which can be practically developed depends on both groundwater potential and aquifer capacity. In this part, aquifer capacity of Ogun-Oshun Basin is mentioned at first, and groundwater potential is mention at second.

4.4.1 Aquifer type

Aquifer of Ogun-Oshun consists of Basement rocks and sedimentary rocks. Surface geology and structural geology of Ogun-Oshun is shown in Figure 4-16.



Source: Geological Map of Nigeria

Figure 4-16 Geological Map of Ogun-Oshun Basin

<u>Type of Basement rock and hydrogeological characteristics</u>

Basement Rock is classified into three types, namely a) Gneiss and Migmatite Complex, b) Schist Belts, c) Younger Granite. There is not large difference among them. However, items below should be taken into account.

- Weathered part of rock can become aquifer in case of the Basement rocks. Radius of influence of borehole is small due to low permeability of aquifer. As a result, yield of one borehole is small.
- Crystalline and coarse-grain rocks such as gneiss and migmatite will become sandy and form aquifer when they are weathered.
- Argillaceous meta-sediment rocks will become clayey and impermeable when they are weathered, and they are classified as aquiclude.
- Old granite is intruded by Younger Granite, which is usually fractured to be promising as aquifer.

Basement rock is distributed in the central and northern part of Ogun-Oshun. Abeokuta and Ibadan city and others are located on the Basement rocks. Yield from borehole of the Basement rocks cannot be expected so much. It means that the Basement rock area is not suitable for large scale groundwater development

Type of Basement rock and hydrogeological characteristics

Sedimentary rocks of Ogun-Oshun consist of sandstone (sand layer) and shale (clay layer). Sand layer with enough thickness and large extension forms large scale aquifer. Abeokuta Formation of the Cretaceous and Benin Formation of Tertiary meet above condition. Boreholes have high yield with large influence area when aquifer scale is large and permeability is high. Groundwater can be pumped up more than groundwater recharge in such area. As a result, there will be possibility that groundwater level will be decreasing gradually year by year, because groundwater storage will be consumed gradually. It is necessary that allowable groundwater extraction must be less than groundwater recharge in area of sedimentary aquifer for sustainable groundwater usage. Abeokuta Formation and Benin Formation are water sources for water supply of Lagos metropolitan area. Over pumping must be taken care in such areas.

4.4.2 Groundwater Recharge

(1) Groundwater Recharge

Groundwater recharge was analyzed as the late component of Surplus (S) of the model explained in 4.3 of this Report. Result of analysis is shown in Table 4-17. Result should be interpreted as explained below:

- The Surplus is classified into two parts. The first part is those that flow into rivers within one month, and the second part is those that will flow into river after next month. For example, groundwater flowing in weathered basement rock will flow into river earlier within one month after rainfall. On the other hand, some groundwater flowing in sedimentary rock will take more than several months to flow into river, depending on hydrological structure of aquifer.
- Groundwater will finally flow into rivers, so it is considered that groundwater recharge is part of river runoff.

Table 4-7 Groundwater recharge by Aquifer

	HA-6
Area(km2)	99,333
Average precipitation (mm/year)	1,541
Average groundwater recharge (mm/year)	236
Same (%)	15.3
Same (BCM/year)	23.4

Source: JICA Project Team

Groundwater recharge of HA-6 including Ogun-Oshun Basin is shown, and Aquifer characteristics of HA-6 are shown in Table 4-8 and 9, and groundwater recharge is shown in Figure 4-17.

Table4-8 Groundwater recharge by HA-6

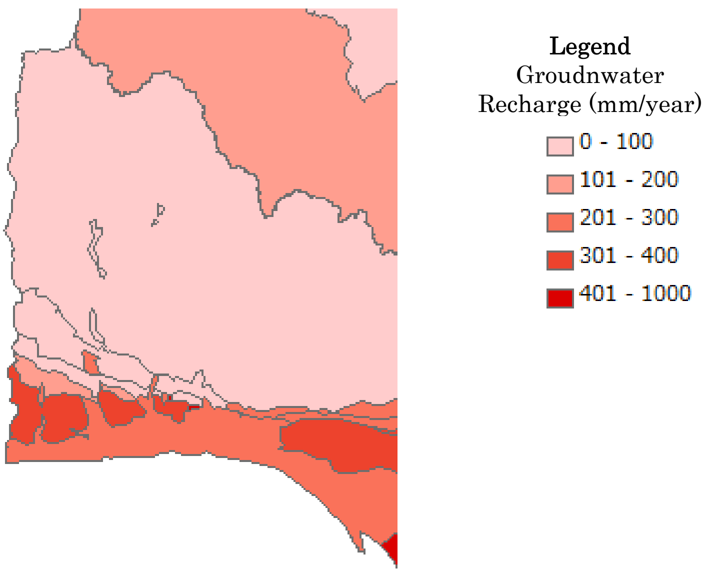
Age	Formation	Groundwater recharge(mm/year)
Quaternary	Alluvium	792
	Deltaic Formation	532
	Benin Formation	291
Tertiary	Ilaro and Ameki Formation	124
	Ewekoro/Imo shake /Oshuosun Formation	180
Cretaceous	Abeokuta Formation	86
Pre-Cambrian	Basement rock	93

Source: JICA Project Team

Table 4-9 Aquifer Characteristics in HA-6 including Ogun-Oshun Basin

Age	Formation	Lithology	Aquifer Characteristics	Groundwater recharge (mm/day)	Potential for groundwater development
Quaternary	Alluvium	Sand and clay.	Fluvial deposit forming excellent aquifer.	792	Large
	Deltaic Formation	Sand.	Sandstone has small thickness with faces changing in lateral direction. Over–pumping can cause sea-water intrusion.	532	Large
	Benin Formation	Sand with intercalated thin clay lens.	Good aquifer with good water quality.	291	Large
Tertiary	Ilaro Formation/Ameki Formation	Alternation of sandstone and shale.	Good aquifer.	124	Large
	Ewekoro/Imo Shale /Oshuosun Formation	Sandstone, shale, limestone.	Low permeability due to argillaceous rocks. Intercalated sandstone lens store groundwater.	180	small
Cretaceous	Abeokuta Formation	Sandstone.	Promising aquifer. Basal sandstone bordering Basement Complex has high permeability with thickness of 250-300m.	86	Large

Source: JICA Project Team



Source: JICA Project Team

Figure 4-17 Groundwater Recharge by Aquifer in Ogun-Oshun Basin

Groundwater recharge is around 100mm/year in the central and northern part of HA-6 including Ogun-Oshun Basin area. Groundwater recharge is more than 200mm/year in southern part of HA-6, and it becomes lager toward south to finally reach more than 700mm/year in the coastal area of the south end of HA-6.

(2) Water Balance by Groundwater Monitoring

As explained in Table 4-7, groundwater recharge was analyzed by the method that dealt with both surface and groundwater at the same time. As a result of the analysis, groundwater recharge was calculated nationwide with the unified method, and it is easy to compare groundwater recharge of each area with the same accuracy. On the other hand, single method has limitation to analyze those of the large country such as Nigeria with various natural conditions. To address this disadvantage, groundwater monitoring is to analyze groundwater recharge in Ogun-Oshun Basin, where Catchment Management Plan will be formulated in this Project.

Analysis method

Rainfall will fall on the ground and infiltrate into the soil. Then surplus soil water will drain into shallow aquifer as a result of soil water balance. Groundwater recharge, which was drained from the saturated soil, can be directly observed as the fluctuation of groundwater table of shallow aquifer. The details are shown in Section SR2.4.3, Volume-5 Supporting Report. So this can be observed in shallow hand-dug wells. For this purpose, shallow hand-dug wells were constructed as monitoring wells in this Project.

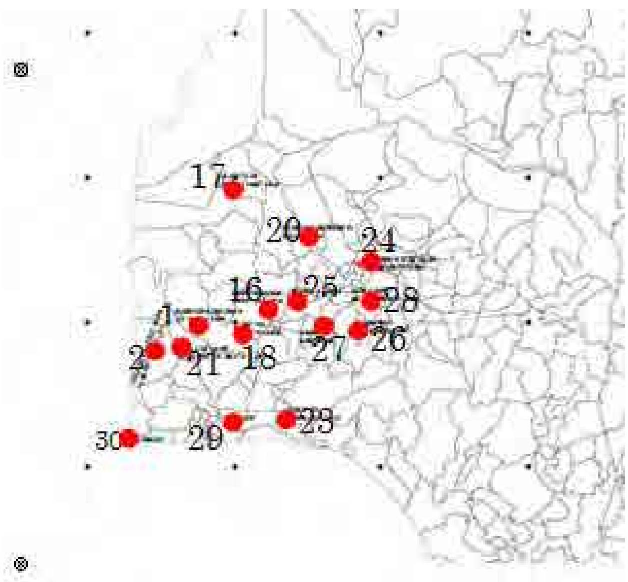
Installation of groundwater monitoring wells

Monitoring wells were selected at 15 sites in Ogun-Oshun Basin by JICA Project Team and NIHSA, considering representative geological condition of the target areas and accessibility by observers. Groundwater level was monitored by the JICA Project Team during Phase-1 of the Project. Then, NIHSA took over the monitoring work from JICA Project Team and is continuing monitoring work. Location of monitoring wells is shown in Figure 4-18.

Table 4-10 Outline of Monitoring shallow wells on HA-6

No.	site	state	geology	Depth of wells(m)
16	IBADAN	OYO	Basement	13
17	SHEPETERI	OYO	Basement	12
18	ISEYIN	OYO	Basement	15
19	IGBO ORA	OYO	Basement	10
20	OGBOMOSO	OYO	Basement	12
21	ABEOKUTA	OGUN	Basement	8
22	ILARO	OGUN	Basement	10
23	IJEBU ODE	OGUN	Basement	10
24	INISA	OSUN	Basement	10
25	IWO	OSUN	Basement	15
26	ILE IFE	OSUN	Basement	12
27	GBONGAN	OSUN	Basement	15
28	ILESA	OSUN	Basement	15
29	IKORODU	LAGOS	Sedimentary	15
30	BADAGRY	LAGOS	Sedimentary	15

Source: JICA Project Team



Source: JICA Project Team

Figure 4-18 Location of Monitoring Well

Monitoring result

Maximum groundwater level lowering of 15 monitoring sites in observation period was shown in Table 4-11.

Table 4-11 Maximum groundwater lowering

Well No	Maximum groundwater level lowering of observation period(m)	Well No	Maximum groundwater level lowering of observation period(m)
16	-1.29	24	-0.41
17	-1.59	25	-0.74
18	-0.92	26	-0.36
19	-0.5	27	-0.78
20	-2.21	28	-0.59
21	-0.65	29	-0.85
22	-0.48	30	-1.35
23	-0.48	average	-0.88

Source: JICA Project Team

Analysis method

Groundwater level of well will be expressed as below.

$$\mu \frac{\Delta Hn}{\Delta t} = W_n - Q_n$$

n : Day
P_n : Rain fall
W_n : Groundwater recharge
Q_n : Groundwater flow away
H_n : Groundwater level of day-n
μ : Effective porosity of aquifer
⊿H : Daily groundwater fluctuation

Wn=0 in dry season, then relation below will be satisfied:

$$\mu \frac{\Delta Hn}{\Delta t} = -Q_n$$

Qn will be approximated as below:

$$Q_n = a \times H_{n-1} + b$$

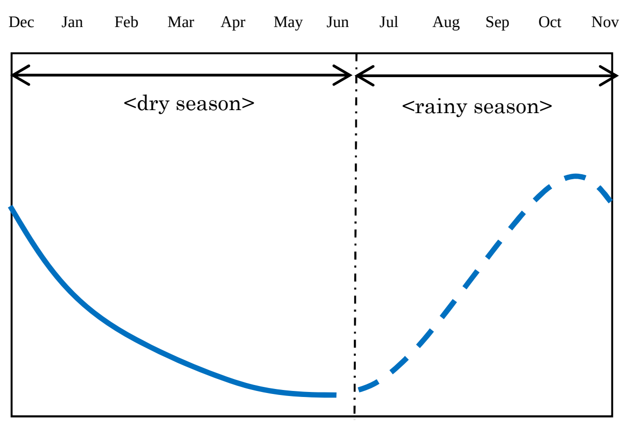
Parameters of "a" and "b" of above equation can be analyzed at each monitoring site from the observation result. Then groundwater discharge can be estimated from formula below:

$⊿H_n/⊿t = - aH_{n-1} - b$

Analysis method is explained in detail in Section SR2.4.3, Volume-5 Supporting Report.

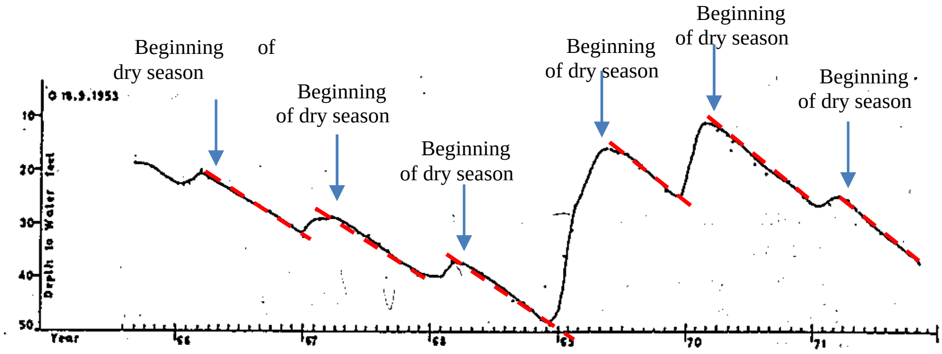
Result of analysis

Groundwater level was observed from December 2011 to May 2012. Groundwater level was declining in this period because of dry season as shown in Figure 4-19. To analyses groundwater potential the monitoring is necessary to be continued for longer period including at least one rainy and dry season.



Source: JICA Project Team

Figure 4-19 Concept of groundwater level lowering



Source: JICA Project Team

Figure 4-20 Pattern of groundwater fluctuation of the other Area with Same Climate Condition

Figure 4-20 is record showing groundwater fluctuation of shallow dug well in dry season and rainy season. Groundwater level shows effect of dry season and rainy season clearly. It should be noticed that speed of lowering of groundwater level is almost same every year so that the lowering of groundwater level is also same every year. On the other hand, speed of the rising of groundwater level is different year by year, depending on amount of rainfall. Based on fact above, it can be considered that relationship below will hold in long period of time.

Lowering of groundwater level of each year = Average rinsing of groundwater level in long period of time

Consequently, it can be concluded that groundwater discharge, which corresponds to lowering of groundwater level in dry season, is equivalent to average groundwater recharge in rainy season of long period of time, under the assumption that lowering of groundwater level is almost same every year. Based on assumption above, groundwater recharge was analyzed as shown in Table 4-12 from monitoring result of 15 sites from December 2011 to May 2012.

Table 4-12 Groundwater Recharge

Well No	Groundwater recharge (mm/year)	Well No	Groundwater recharge (mm/year)
16	300	24	260
17	201	25	163
18	255	26	167
19	285	27	178
20	205	28	220
21	177	29	342
22	256	30	246
23	134	average	226

Source: JICA Project Team

According to analysis result, groundwater recharge of HA-6 including Ogun-Oshun Basin is 228 mm/year, which is consistent with the result of discharge analysis of long period of time. Hence, groundwater recharge calculated by the discharge analysis is used as the final estimate of groundwater recharge in this Project.

<u>Groundwater monitoring from now on</u>

NIHSA continue groundwater monitoring after July 2012. They are expected to continue the monitoring work even after completion of this Project to analyze groundwater level fluctuation and groundwater recharge.

(3) Influence of Climate Change

As shown in Table 4-12, groundwater recharge seems to reduce due to influence of Climate Change. Groundwater recharge will decrease by 21% in case -1, 15% in case-2 in HA-6 including Ogun-Oshun Basin on average.

It should be noted that HA-6 has more groundwater recharge than the other area, and there will be more surplus in groundwater recharge than the other area even in case of the Climate change. However, there will be more groundwater consumption in HA-6 than the other area by growing urbanization, which will lead to threatening of water balance in large urban areas.

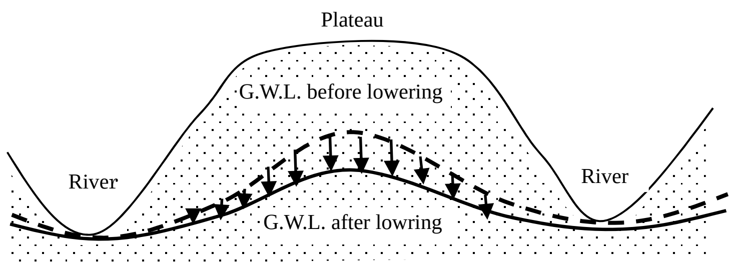
Table 4-13 Groundwater Recharge Affected by Change of Precipitation and Temperature due to the Climate Change

Item		HA-6	Nation wide
Current estimation (mm/year)		236	156
Case-1	Groundwater recharge (mm/year)	186	123
	Ratio to current recharge (%)	79%	79%
Case-2	Groundwater recharge (mm/year)	188	133
	Ration to current recharge (%)	80%	85%

Source: JICA Project Team

<u>Difference in Groundwater level place by place by effect of Climate Change</u>

Lowering of groundwater level due to reduction in groundwater recharge will be small around rivers because groundwater level will be almost constant at river beds. However, decrease in groundwater level will become larger in places far from rivers (see Figure 4-21). Therefore, inland area in the plateau far form rivers will be affected with more influence by decrease in groundwater recharge. Countermeasures against the Climate Change should take account of such a condition mentioned above. For example, Ibadan city is located in Basement rock of the central part of Plateau area of Ogun-Oshun Basin, which leads to considerable influence by Climate Change.



Source: JICA Project Team

Figure 4-21 Groundwater Level Lowering after Decrease in Groundwater Recharge

4.4.3 Groundwater Quality

Groundwater quality can be classified following aspects below.

- Geochemical aspect
- Hygienic aspect

(1) Geochemical Aspect

Main chemical elements of groundwater are: Na+, K+, Ca2+, Mg2+, $SO32^-$, $HCO3^-$, and Cl^-. Groundwater can be classified based in Ogun-Oshun Basin on elements above as listed below.

a) Calcium bicarbonate type

b) Magnesium sulphate, sodium chloride calcium bicarbonate type

c) Sodium chloride type

- Calcium bicarbonate type is most common in both Basement Complex and sedimentary rock area. Groundwater of this type is stored in unconfined aquifer in the shallow part of the ground.
- Magnesium sulphate, sodium chloride calcium bicarbonate type is common next to calcium bicarbonate type in sedimentary rock area. This type is gradually changed from calcium bicarbonate type during flowing through aquifers of sedimentary rock area.
- Sodium chloride type is found in aquifers in part of the coastal aquifer. Sea-water intrusion is cause of salty groundwater in the coastal aquifer.

Relation between water quality and geology

When groundwater is flowing within aquifer, some chemical substances will be dissolved into groundwater from minerals by chemical reaction with groundwater. Therefore, groundwater is rich in dissolved chemical substances in aquifer which consist of rocks with soluble minerals. It can be said that groundwater in sedimentary rock area is richer in dissolved chemical substances than groundwater in the Basement rock area. Groundwater in the Basement rock area is flowing within weathered zone near the ground surface for short period of time, showing unconfined condition. On the other hand, groundwater of the sedimentary rock area is flowing within deep aquifer for long period of time, showing confined condition. Such a difference in groundwater environment makes difference in groundwater quality of both aquifers.

(2) Hygienic Aspect

According to the existing survey result, water quality of groundwater of boreholes and shallow wells is summarized below in Ogun-Oshun Basin area.

- There are many cases where groundwater of both shallow wells and boreholes are contaminated with coliforms. More than half of groundwater is contaminated in shallow wells. Shallow hand dug-well will be easily contaminated by dirty surface water compared with borehole in terms of facilities structure. It is generally said that coliform cannot survive in borehole deeper than 30m if sealing of borehole is perfect. Borehole with coliform means that sealing is not perfect.
- Contamination by nitrate is detected in groundwater of both boreholes and shallow wells to the same degree.
- Arsenic contamination is not detected.
- Contamination originated form geology such as fluoride and iron was detected more from boreholes than shallow wells. Those chemical substances are dissolved from minerals of rocks comprising aquifer. Groundwater of deep aquifer flows for longer period of time within the aquifer than groundwater of shallow aquifer, which makes deep groundwater richer in chemical substance. As a result, groundwater of boreholes has more chemical substances than groundwater of shallow hand-dug wells.
- Groundwater of shallow wells is of high turbidity. This is caused by muddy surface water which infiltrates into the ground in case of heavy rainfall.
- Some groundwater has lower or higher pH value than requirement of water quality standard. Other than health hazard, groundwater with low pH will cause corrosion of metallic materials of pipes and pumps of boreholes. Therefore, it is recommended that PVC and stainless materials, which show high resistance against corrosion, should be used for borehole construction in the area of low pH. Such areas have already been identified, and it should be taken into account for new groundwater development.

Generally speaking, groundwater is better than surface water in raw water quality. However, it is recognized that even groundwater is contaminated by coliform and does not comply with water quality standard. Cause of groundwater contamination is as follows:

- Shallow wells will collect groundwater near the ground surface which is subject to contamination by dirty/muddy surface water around the wells.
- Borehole is not completely sealed to prevent surface water from entering into borehole, so that dirty surface water will easily infiltrate into borehole through casing pipe of borehole.
- Borehole is located in the center of community and subject to contamination by domestic waste water around boreholes.

(3) Other groundwater problems

There is local groundwater contamination for further examination in Ogun-Oshun Basin as mentioned below:

High pH groundwater is detected in Basement Rock area of the central to northern art of Ogun-Oshun Basin. Low pH groundwater will cause early corrosion of casings and pumps of boreholes. Moreover, groundwater has high concentration of iron (Fe), which needs treatment of groundwater to meet domestic use.

4.5 Summary of Water Resources Potential

In this section, the water resources potential in Ogun-Oshun Basin is summarized based on the results shown in the previous sections.

<u>Basis for Estimating Water Resources Potential</u>

The followings are the basis for estimating the water resources potential.

- The output of long-term rainfall-runoff model with the input data of precipitation and air temperature for 40years from 1970 to 2009 is used.
- The long-term rainfall-runoff model is setup based on the available observed discharge data at main hydrological stations, which covers the catchment area of rivers flowing into Nigeria except the upper Niger River as well as the territory of Nigeria.

<u>Estimated Water Resources Potential</u>

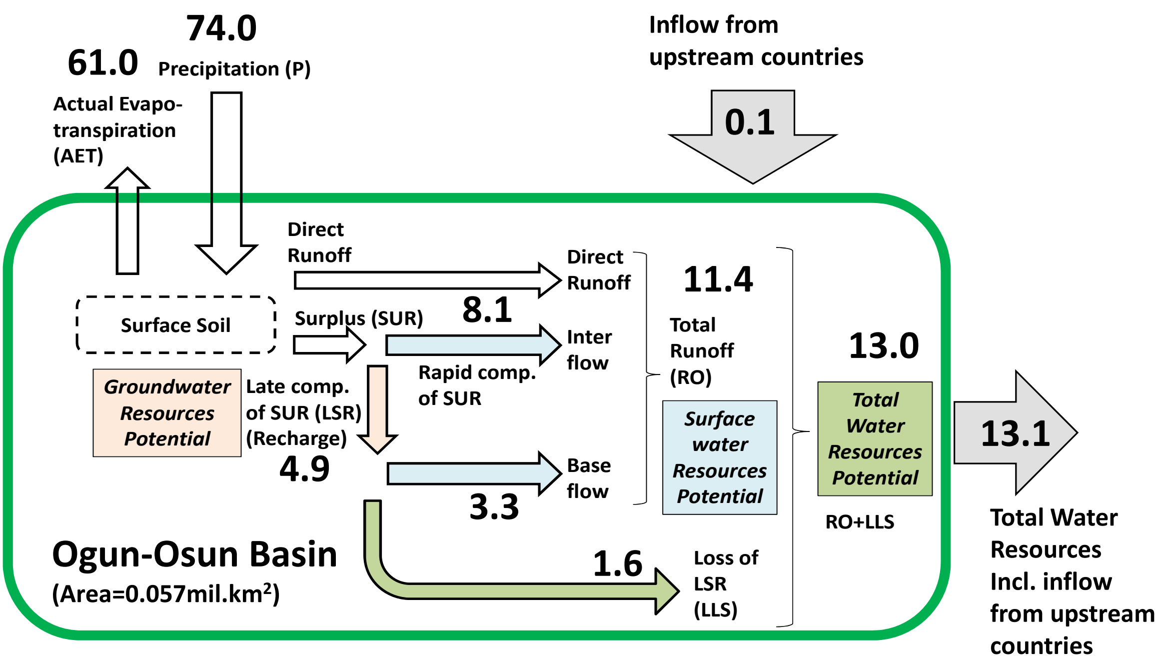
Table 4-14 shows the estimated water resources potential.

The average precipitation in Ogun-Oshun Basin is about 1,289mm. About 16% of the precipitation becomes runoff and the rest are lost as evapotranspiration and/or others. Total internal generation of the runoff is 11.4BCM/year and the surface water resources potential is estimated at 11.5BCM/year. The total water resources potential can be evaluated by adding the component that is lost without becoming surface runoff among recharge. The internal generation of total water resources potential is estimated at 13.0BCM/year and the total water resources potential with inflow flow neighbor countries is estimated at 13.1BCM/year. Total groundwater resources potential is estimated at 4.9BCM/year as a renewable source on the basis of the estimated groundwater recharge.

Table 4-14 Estimated Water Resources Potential in Ogun-Oshun Basin

		Ogun-Oshun Basin	HA-6	Entire Country
Water Resources Potential				
Total Water Resources Potential [1)]				
Including inflow from outside Nigeria	(BCM/year)	13.1	43.7	375.1
Only internal generation in Nigeria	(BCM/year)	13.0	43.6	286.6
Surface Water Resources Potential				
Including inflow from outside Nigeria	(BCM/year)	11.5	35.7	332.7
Only internal generation in Nigeria	(BCM/year)	11.4	35.6	244.2
Groundwater Resources Potential				
Groundwater Recharge	(BCM/year)	4.9	23.4	155.8
Runoff Condition （Only internal generation in Nigeria）				
Precipitation (P)	(mm/year)	1,289	1,540	1,148
Total Runoff (RO)	(mm/year)	199	359	268
Groundwater Recharge (GRE)	(mm/year)	85	236	171
Loss of Recharge (LOS)	(mm/year)	28	80	47
Runoff Rate (RO/P)	(%)	15.4	23.3	23.4
Recharge Rate (GRE/P)	(%)	6.6	15.3	14.9
Loss Rate (LOS/P)	(%)	2.1	5.2	4.1
Total Water Res. Rate ((RO+LOS)/P)	(%)	17.5	28.5	27.4

Note:
1) Total Water Resources Potential
= Surface Water Resource Potential + Groundwater Recharge – Base Flow Runoff
= Surface Water Resource Potential + Loss of Groundwater Recharge



Unit: BCM/year (Billion m³/year)

Source: JICA Project Team

Water Resources Potential by State

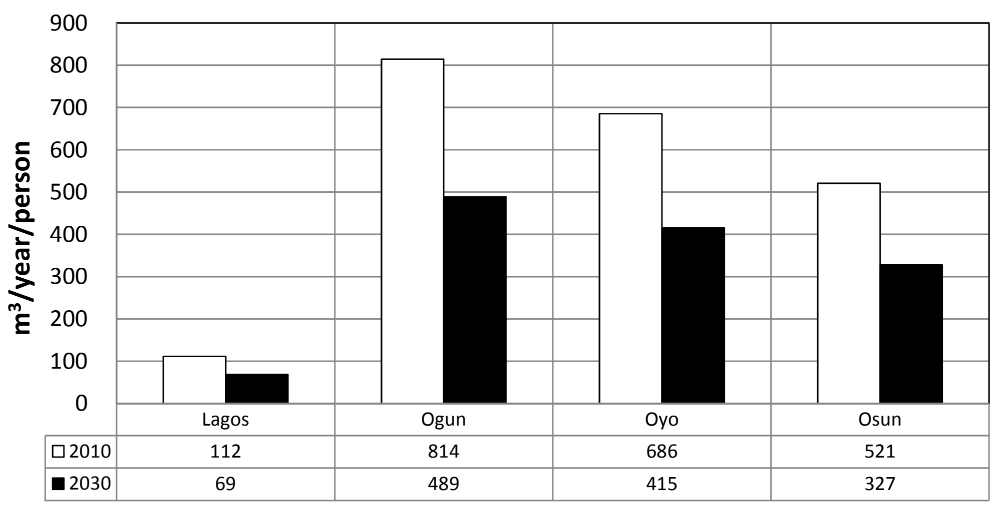
The water resources potential described above is on the basis of hydrological boundary. Although the boundary of state does not coincide with the hydrological boundary, the water resources potential (only internal generation) by state in Ogun-Oshun Basin is also evaluated as shown in Table 4-15.

Table 4-15 Water Resources Potential by State in Ogun-Oshun Basin (Internal generation only)

		Lagos	Ogun	Oyo	Osun
Water Resources Potential (Only internal generation with the territory of the state)					
Total Water Resources Potential (Only internal generation with the territory of the state)	(BCM /year)	1.46	4.19	4.65	2.31
Surface Water Resources Potential (Only internal generation with the territory of the state)	(BCM/ year)	1.15	3.42	4.32	2.03
Groundwater Resources Potential (Groundwater Recharge)	(BCM/ year)	0.74	1.93	1.33	0.89
Runoff Condition (Only internal generation with the territory of the state)					
Precipitation (P)	(mm/year)	1,606.4	1,351.7	1,152.8	1,331.8
Total Runoff (RO)	(mm/year)	317.4	204.5	156.0	236.9
Groundwater Recharge (GRE)	(mm/year)	202.4	115.2	48.0	103.9
Loss of Recharge (LOS)	(mm/year)	83.6	46.0	12.0	33.6
Runoff Rate (RO/P)	(%)	19.8	15.1	13.5	17.8
Recharge Rate (GRE/P)	(%)	12.6	8.5	4.2	7.8
Loss Rate (LOS/P)	(%)	5.2	3.4	1.0	2.5
Total Water Res. Rate ((RO+LOS)/P)	(%)	25.0	18.5	14.6	20.3

Source: JICA Project Team

Figure 4-22 shows the water resources potential (only internal generation) per person by state. In Logos State, due to its large population the water resources potential per person is much smaller compared to the other states. Lagos State can utilize water resources generated in the upstream state. Lagos strongly relies on the water resources in upstream.



Source: JICA Project Team

Figure 4-22 Water Resources Potential per Person by State (Only internal generation)

Annex-Table 4

Annex-T 4-1 Average Monthly Precipitation by Sub Hydrological Areas (SHAs) in Ogun-Oshun Basin

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average Precipitation (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
6	60001	60001	127	2,701.1	18	37	86	132	232	333	259	103	224	207	68	18	1,712
	601	601	129	391.8	13	31	82	115	195	258	153	54	145	162	46	19	1,271
	602	602_e	130	844.5	4	26	63	134	153	148	125	91	179	124	21	14	1,083
		602_i	131	3,311.6	7	27	73	131	162	173	136	79	171	138	30	15	1,140
	603	603	132	1,965.7	15	30	80	129	206	278	181	70	163	166	53	14	1,385
	60401	60401	133	2,034.9	13	26	78	139	177	223	172	84	172	156	45	12	1,294
	604021	604021	134	168.9	9	25	78	140	156	178	150	84	170	143	34	12	1,179
	604023	604023_e	135	72.9	4	20	47	114	134	158	159	144	207	116	16	10	1,128
		604023_i	136	9,040.6	5	19	58	111	143	154	146	120	199	129	21	10	1,115
	60403	60403	137	6,011.7	6	22	72	127	154	165	138	101	194	150	33	10	1,174
	60405	60405	138	4,704.2	6	16	52	96	149	157	141	133	219	129	24	9	1,130
	605	605	139	1,102.3	19	31	78	136	216	299	218	91	189	180	58	12	1,477
	606	606	140	4,398.1	10	27	75	139	179	221	189	109	198	186	47	9	1,380
	607	607	141	417.6	16	32	79	125	212	287	242	98	219	205	65	13	1,601
	608	608	142	9,764.4	8	25	71	119	163	182	157	118	225	180	41	12	1,302
	609	609	143	113.5	16	36	86	128	215	300	259	108	238	208	65	17	1,674
	610	610	144	6,462.0	9	30	83	132	171	211	201	132	237	194	46	14	1,462
	699	699	150	4,809.4	6	14	47	90	140	150	160	151	207	119	14	7	1,105

Source: JICA Project Team

Annex-T 4-2 Average Monthly PET by Sub Hydrological Areas (SHAs) in Ogun-Oshun Basin

HA	SHA	SHA divided by National Boundary	No	Area (km2)	80 % Dependable Precipitatin (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
6	60001	60001	127	2,701.1	6	14	44	87	180	262	155	40	134	141	39	3	1,105
	601	601	129	391.8	2	7	40	72	153	197	70	19	89	111	26	3	789
	602	602_e	130	844.5	1	8	25	94	105	112	69	42	134	81	7	1	678
		602_i	131	3,311.6	2	10	33	97	116	137	83	33	116	93	11	1	733
	603	603	132	1,965.7	3	8	42	83	153	200	93	24	98	119	29	1	853
	60401	60401	133	2,034.9	4	9	38	96	128	171	96	31	116	111	17	1	819
	604021	604021	134	168.9	3	9	36	94	112	141	91	37	116	100	12	2	754
	604023	604023_e	135	72.9	1	5	21	78	84	115	101	70	155	74	3	1	707
		604023_i	136	9,040.6	2	4	29	75	102	119	95	68	160	95	5	3	758
	60403	60403	137	6,011.7	3	5	38	86	121	130	95	55	149	110	12	3	807
	60405	60405	138	4,704.2	3	3	28	64	112	129	110	87	184	81	2	4	807
	605	605	139	1,102.3	6	8	39	88	163	213	112	27	116	126	29	1	928
	606	606	140	4,398.1	4	11	41	95	136	169	108	39	130	140	19	2	894
	607	607	141	417.6	5	7	36	82	161	203	130	28	118	140	32	1	941
	608	608	142	9,764.4	5	9	43	80	135	154	106	61	185	138	17	5	941
	609	609	143	113.5	7	8	48	87	168	233	151	43	144	153	28	2	1,071
	610	610	144	6,462.0	5	10	51	96	132	170	135	59	169	142	21	4	993
	699	699	150	4,809.4	3	2	21	58	106	119	110	99	168	82	2	2	773

Source: JICA Project Team

Annex-T 4-3 80%Yearly Dependable Monthly Precipitation by Sub Hydrological Areas (SHAs) in Ogun-Oshun Basin

HA	SHA	SHA divided by National Boundary	No	Area (km2)	Average PET (mm)												
					1	2	3	4	5	6	7	8	9	10	11	12	Total
6	60001	60001	127	2,701.1	113	112	129	125	127	115	112	108	106	110	112	113	1,381
	601	601	129	391.8	114	114	130	126	128	114	112	107	106	110	113	114	1,387
	602	602_e	130	844.5	114	115	131	125	126	113	111	105	103	109	111	111	1,373
		602_i	131	3,311.6	114	114	131	125	127	114	111	106	104	109	111	111	1,376
	603	603	132	1,965.7	111	110	126	122	124	112	109	105	103	108	110	111	1,352
	60401	60401	133	2,034.9	112	111	129	123	125	113	110	105	104	108	110	110	1,359
	604021	604021	134	168.9	113	113	131	125	126	114	111	106	104	109	110	110	1,371
	604023	604023_e	135	72.9	112	115	132	125	125	114	110	105	101	108	110	107	1,364
		604023_i	136	9,040.6	108	111	130	124	124	113	108	103	100	105	106	104	1,335
	60403	60403	137	6,011.7	108	108	129	124	123	112	107	103	101	105	105	105	1,330
	60405	60405	138	4,704.2	102	104	126	122	121	109	105	100	96	101	100	98	1,284
	605	605	139	1,102.3	111	111	128	123	125	114	110	106	104	108	110	111	1,360
	606	606	140	4,398.1	110	110	129	124	124	113	109	104	103	108	108	109	1,349
	607	607	141	417.6	114	113	132	127	128	116	112	108	106	111	112	113	1,394
	608	608	142	9,764.4	103	103	125	121	121	110	104	99	98	103	103	102	1,292
	609	609	143	113.5	114	114	132	127	129	117	113	108	107	111	113	114	1,398
	610	610	144	6,462.0	106	106	126	121	122	112	106	101	101	105	106	106	1,318
	699	699	150	4,809.4	105	110	130	125	124	113	108	102	98	104	102	100	1,321

Source: JICA Project Team

Annex-T 4-4 Runoff Yield by Sub Hydrological Areas (SHAs) in Ogun-Oshun Basin

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	AverageMonthly Runoff Yield (Height) (mm/month)												Average Annual Runoff Yield (mm/year)	Average Annual Preci-pitation (mm/year)	Average Runoff Rate (%)
					1	2	3	4	5	6	7	8	9	10	11	12			
6	60001	60001	127	2,701.1	6.0	2.9	2.4	4.6	13.0	52.9	77.3	43.0	64.5	66.3	28.6	13.0	375	1,712	21.9
	601	601	129	391.8	1.8	0.9	1.5	3.2	9.5	34.5	32.4	13.4	18.6	25.2	8.5	4.0	153	1,271	12.1
	602	602_e	130	844.5	1.1	0.5	0.5	4.1	6.0	7.5	7.6	6.2	21.2	15.3	5.1	2.4	78	1,083	7.2
		602_i	131	3,311.6	1.4	0.6	0.9	4.2	6.7	11.9	12.7	7.1	20.6	18.9	6.4	3.0	94	1,140	8.3
	603	603	132	1,965.7	2.8	1.3	1.4	4.5	10.9	47.4	48.3	23.3	31.5	34.8	13.1	6.0	225	1,385	16.3
	60401	60401	133	2,034.9	2.3	1.1	1.1	5.1	7.9	21.4	26.7	14.5	27.9	28.9	10.5	4.9	152	1,294	11.8
	604021	604021	134	168.9	0.4	0.1	0.4	5.1	6.2	10.6	12.7	7.2	25.8	25.2	5.5	1.6	101	1,179	8.6
	604023	604023_e	135	72.9	0.6	0.2	0.0	2.5	4.6	8.4	20.4	31.8	60.3	29.2	7.4	2.1	167	1,128	14.8
		604023_i	136	9,040.6	0.6	0.2	0.2	2.5	5.3	8.0	14.3	16.7	48.2	30.6	7.3	2.1	136	1,115	12.2
	60403	60403	137	6,011.7	0.8	0.2	0.6	4.3	6.7	10.0	15.1	13.5	45.5	39.5	9.4	2.7	148	1,174	12.6
	60405	60405	138	4,704.2	0.8	0.2	0.1	1.6	6.2	9.0	12.4	17.7	61.5	38.5	9.5	2.7	160	1,130	14.2
	605	605	139	1,102.3	4.1	1.9	1.6	4.6	11.4	45.9	58.9	31.9	45.2	47.7	19.6	8.9	282	1,477	19.1
	606	606	140	4,398.1	4.1	1.9	1.5	5.8	9.0	19.0	30.9	22.9	42.9	48.8	19.1	8.9	215	1,380	15.6
	607	607	141	417.6	5.6	2.6	1.9	3.9	10.9	36.8	61.7	34.4	56.3	62.2	26.6	12.1	315	1,601	19.7
	608	608	142	9,764.4	2.2	0.8	0.7	3.5	7.9	13.8	24.1	24.7	71.9	67.3	19.0	6.3	242	1,302	18.6
	609	609	143	113.5	6.2	2.9	2.1	3.8	11.7	43.8	74.5	41.2	69.0	69.5	29.2	13.4	367	1,674	21.9
	610	610	144	6,462.0	5.5	2.6	2.0	4.9	9.1	18.3	37.0	31.5	64.5	63.6	25.7	12.0	277	1,462	18.9

Source: JICA Project Team

Annex-T 4-5 Average Discharge, Q_{80M} and Q_{97DS}90%Y at Downstream End of SHA

HA	SHA	SHA divided by National Boundary	SN	Area (km2)	Average Monthly Discharge (m3/s)												Average Discharge (m3/s)	Q_{80M} (m3/s)	Q_{97DS}90%Y (m3/s)
					1	2	3	4	5	6	7	8	9	10	11	12			
6	60001	60001	127	2,701	6.0	3.2	2.4	4.8	13.2	55.1	78.0	43.3	67.2	66.9	29.8	13.1	32.1	3.1	0.35
	601	601	129	392	0.3	0.1	0.2	0.5	1.4	5.2	4.7	2.0	2.8	3.7	1.3	0.6	1.9	0.0	0.00
	602	602_e	130	844	0.4	0.2	0.1	1.3	1.9	2.4	2.4	2.0	6.9	4.8	1.7	0.8	2.1	0.0	0.00
		602_i	131	3,312	2.1	1.1	1.3	6.6	10.2	17.6	18.1	10.8	33.2	28.3	9.8	4.4	12.0	0.2	0.00
	603	603	132	1,966	2.0	1.1	1.0	3.4	8.0	35.9	35.5	17.1	23.9	25.5	9.9	4.4	14.0	0.7	0.02
	60401	60401	133	2,035	6.9	2.5	2.9	26.0	50.5	85.0	125.3	129.7	410.6	283.7	73.5	21.7	101.8	2.9	0.04
	604021	604021	134	169	2.1	0.7	0.6	9.2	18.6	28.7	49.5	57.5	171.6	105.5	26.1	7.2	39.9	0.4	0.00
	604023	604023_e	135	73	0.0	0.0	0.0	0.1	0.1	0.2	0.6	0.9	1.7	0.8	0.2	0.1	0.4	0.0	0.00
		604023_i	136	9,041	2.0	0.6	0.6	8.8	18.2	28.0	48.6	57.0	169.9	104.0	25.8	7.1	39.3	0.3	0.00
	60403	60403	137	6,012	3.1	1.0	1.5	12.8	25.9	39.4	55.6	61.3	217.1	156.2	39.1	10.8	52.1	1.1	0.03
	60405	60405	138	4,704	1.4	0.4	0.1	2.9	10.9	16.3	21.8	31.1	111.7	67.6	17.3	4.8	23.9	0.2	0.00
	605	605	139	1,102	1.7	0.9	0.6	2.0	4.7	19.5	24.2	13.1	19.2	19.6	8.3	3.7	9.9	0.7	0.02
	606	606	140	4,398	6.7	3.4	2.5	9.8	14.8	32.3	50.7	37.6	72.8	80.1	32.4	14.5	30.0	2.7	0.08
	607	607	141	418	0.9	0.4	0.3	0.6	1.7	5.9	9.6	5.4	9.1	9.7	4.3	1.9	4.2	0.3	0.01
	608	608	142	9,764	8.1	3.4	2.5	13.2	28.8	52.1	87.9	90.0	271.1	245.4	71.5	23.1	75.0	3.8	0.26
	609	609	143	114	0.3	0.1	0.1	0.2	0.5	1.9	3.2	1.7	3.0	2.9	1.3	0.6	1.3	0.1	0.00
	610	610	144	6,462	13.3	6.9	4.7	12.3	22.0	45.6	89.3	76.1	160.7	153.4	64.0	28.8	56.7	6.4	0.33

Source: JICA Project Team

Annex-T 4-6 Pollution Load by Sub Hydrological Areas (SHAs) in Ogun-Oshun Basin

HA	SHA	SHA divided by National Boundary	No	Area (km2)	2010					2030				
					Domestic	**Industrial**	**Livestock**	**Fishpond**	**Total**	**Domestic**	**Industrial**	**Livestock**	**Fishpond**	**Total**
6	60001	60001	127	2,701.1	34,405	10,092	2,219	165	46,881	43,944	12,907	3,503	264	60,618
	601	601	129	391.8	1,824	516	87	9	2,436	1,973	558	125	15	2,671
	602	602_e	130	844.5	0	0	0	0	0	0	0	0	0	0
		602_i	131	3,311.6	9,356	2,686	731	80	12,853	11,473	3,303	1,056	128	15,960
	603	603	132	1,965.7	148,489	44,404	1,084	89	194,066	269,463	80,594	1,676	143	351,875
	60401	60401	133	2,034.9	24,825	7,338	496	52	32,711	39,062	11,548	724	83	51,417
	604021	604021	134	168.9	966	282	37	4	1,290	1,031	301	54	7	1,393
	604023	604023_e	135	72.9	0	0	0	0	0	0	0	0	0	0
		604023_i	136	9,040.6	18,805	5,214	5,705	546	30,271	33,652	9,317	8,520	875	52,364
	60403	60403	137	6,011.7	20,058	5,612	3,901	373	29,944	33,908	9,480	5,829	597	49,814
	60405	60405	138	4,704.2	8,333	2,299	3,362	319	14,314	14,197	3,918	5,032	511	23,658
	605	605	139	1,102.3	14,068	4,168	553	43	18,833	18,189	5,386	873	68	24,516
	606	606	140	4,398.1	51,391	15,055	1,810	178	68,434	71,441	20,906	2,691	285	95,322
	607	607	141	417.6	2,899	859	239	19	4,016	3,488	1,035	369	31	4,923
	608	608	142	9,764.4	88,446	25,361	3,806	1,466	119,079	145,918	41,832	6,196	2,349	196,296
	609	609	143	113.5	78	22	25	3	129	134	38	37	4	214
	610	610	144	6,462.0	31,198	8,893	1,609	1,062	42,762	49,741	14,179	2,826	1,702	68,448
	699	699	150	4,809.4	5,960	1,659	1,895	177	9,691	12,162	3,390	2,885	284	18,720
		Total		**58,315**	**461,103**	**134,461**	**27,560**	**4,585**	**627,709**	**749,776**	**218,691**	**42,395**	**7,347**	**1,018,210**

Unit: ton/year
Source: JICA Project Team

CHAPTER 5 WATER BALANCE BETWEEN DEMAND AND SUPPLY

In the present chapter, the water balance between demand and supply capacity is discussed, on the basis of the projected water demand in Chapter 3 and the water resources potential shown in Chapter 4. Firstly, in Section 5.1, the overall water balance between total water demand and water resources potential in Ogun-Oshun Basin is presented. Secondly, the procedure of water balance study is explained in Section 5.2. Finally, in Sections 5.3 and 5.4, the methodology on examining water balance and its result are presented for groundwater and surface water, respectively.

5.1 Overall Water Balance between Total Water Demand and Water Resources Potential

Table 5-1 shows the total water demand and water resources potential in Ogun-Oshun Basin.

Table 5-1 Overall Water Balance between Total Water Demand and Water Resources Potential in Ogun-Oshun Basin

			Ogun-Oshun Basin
Total Water Resources Potential			
Including inflow from outside Nigeria	(BCM/year)	(1)	13.1
Only Internal Generation	(BCM/year)	(2)	13.0
Groundwater Resources Potential	(BCM/year)	(3)	4.9
Total Water Demand			
Existing (2010)	(BCM/year)	(4)	1.1
	(%)	(4)/(1)	8.4
	(%)	(4)/(2)	8.5
Future (2030) Scenario-A	(BCM/year)	(5)	2.6
	(%)	(5)/(1)	19.8
	(%)	(5)/(2)	20.0
Future (2030) Scenario-B	(BCM/year)	(5)	3.2
	(%)	(5)/(1)	24.4
	(%)	(5)/(2)	24.6

Remarks:
Scenario-A: Scenario based on socio-economic framework and methodology for estimating water demand applied in M/P2103
Scenario-B: Scenario based on water demand projection by State
Source: JICA Project Team

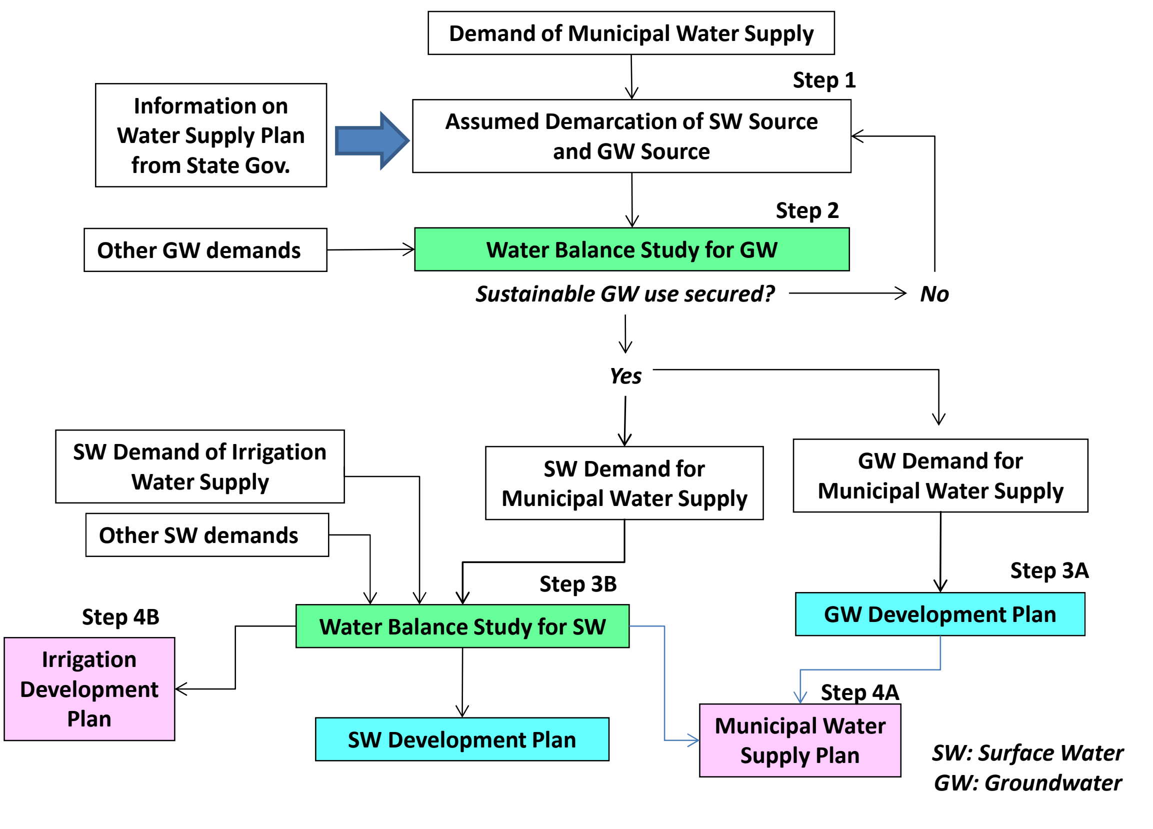
The existing total water demand in Ogun-Oshun Basin is estimated at 1.11BCM/year. It is expected to increase to 2.59BCM/year for Scenario-A and 3.19BCM/year for Scenario-B, respectively. The water use rate is here defined as the ratio between the total water demand and the surface water resources potential. The water use rate in 2010 is 8.5%. In 2030, the ratio will become 20.0% for Scenario-A and 24.6% for Scenario-B, respectively. The total water demand in 2030 is still much less than the total water resources potential. However, because the water demand and water resources are unevenly distributed, the necessity of water resources development should be examined by the water balance between supply and demand al local level.

5.2 Procedure of Water Balance Study

The water usage can be categorized into two types; groundwater and surface water uses. The water resources development plan should consider the water balance for both usages so as to secure sustainable use of water resources.

Figure 5-1 shows the procedure of the water balance study. The following steps are considered.

- Step 1: The demarcation between usage of groundwater and surface water for municipal water supply is set, on the basis of the existing plans by state government.
- Step 2: The water balance for groundwater usage which include not only municipal water but also other purposes is checked, in order to secure sustainable usage of groundwater. If it is judged that the groundwater usage is sustainable, the next steps would be examined. If not, the demarcation between groundwater and surface water uses would be adjusted, and the groundwater balance would be checked again.
- Step 3A: The necessary development of groundwater is determined based on the results of Step2. The groundwater development plan is formulated.
- Step 3B: The surface water demand for municipal water supply is fixed based on the results of Step2. The water balance study for surface water is examined and the surface water development plan is formulated, considering the municipal water, irrigation water and other demands.
- Step 4A: The municipal water supply plan is formulated utilizing the results of step 3.
- Step 4B: The irrigation development plan is formulated utilizing the results of step 3B.



Source: JICA Project Team

Figure 5-1 Procedure of Water Balance Study

5.3 Balance between Demand and Supply Capacity for Groundwater Source

5.3.1 Balance of Groundwater Recharge and Groundwater Demand

(1) Existing Groundwater Supply Facilities

For information on groundwater supply facilities nationwide, there is "Baseline Survey for Water Supply and Sanitation Facilities" (FMWR, 2006). The result is shown below.

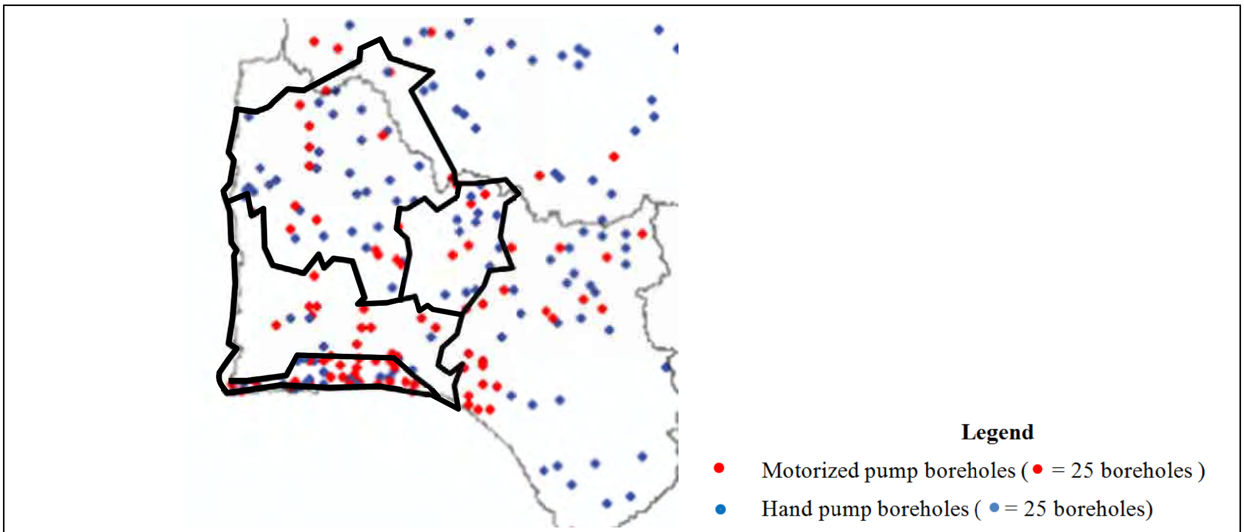
- Borehole with motorized pump : 2,586
- Boreholes with hand pump : 3,155
- Shallow hand-dug wells : 371

According to survey results, total number of boreholes (motorized pumps and hand pumps) is 5,741. Amount of groundwater extraction is estimated about 190 thousand m^3/day.

Table 5-2 Borehole and wells in Ogun-Oshun Basin

State	Aquifer	Type of boreholes			Operation rate (%)
		Motorized pump	Hand pump	Shallow dug well	
Lagos	Sedimentary	1,106	880	0	62
Ogun	B/S	490	182	93	58
Osun	Basement	367	819	98	35
Oyo	Basement	623	1,274	180	60

Source: JICA Project Team



Source: JICA Project Team

Figure 5-2 Existing Boreholes of Ogun-Oshun Basin

(2) Potential Supply Capacity

Case where borehole operation rate increases

Average operation rate of borehole is as low as 35 to - 62% in Ogun-Oshun Basin. Therefore, water coverage rate will be significantly increased by increasing borehole operation rate.

- Current extraction rate of Ogun-Oshun Basin : 190,000m^3/day
- Assumed extraction rate in case of 100% borehole operation : 330,000 m^3/day

It also can be considered that decrease in borehole capacity by time might cause decrease in borehole operation rate. However, above reason cannot be proved due to lack of data. Therefore, it is concluded that low operation rate of boreholes is mainly caused by breakout of pumps in Nigeria.

Case where pumps are replaced

Hand-pumps are installed into most of the existing boreholes for rural water supply in Ogun-Oshun Basin. Pumping capacity of hand pump is around 10m^3/day. It means that groundwater extraction capacity of boreholes will be increased by replacing hand pumps with motorized pumps.

- Groundwater pumping amount is 7,940,000 m3/day in case where borehole are operated 100% by replacing hand pumps with motorized pumps.

Of cause above proposal is based on assumption. Not all the boreholes have enough capacity for motorized pumps. It must be kept in mind that some boreholes do not have enough capacity even for hand pump.

Conclusion

Based on the discussion above, there are four (4) types of yield for boreholes.

a) Groundwater supply capacity of aquifer.
b) Current available yield of existing boreholes.
c) Available yields of existing boreholes in case where borehole operation rate is improved to 100%.
d) Available yield of existing boreholes in case where hand-pumps are replaced with motorized pumps.

Above "b) Current available yield of existing boreholes" above will be regarded as current supply capacity of existing boreholes. Future demand will be satisfied by drilling new boreholes. Therefore, the future water demand will be compared with aquifer capacity as a way of analyzing water balance between demand and supply.

5.3.2 Balance of Demand and Supply of Groundwater

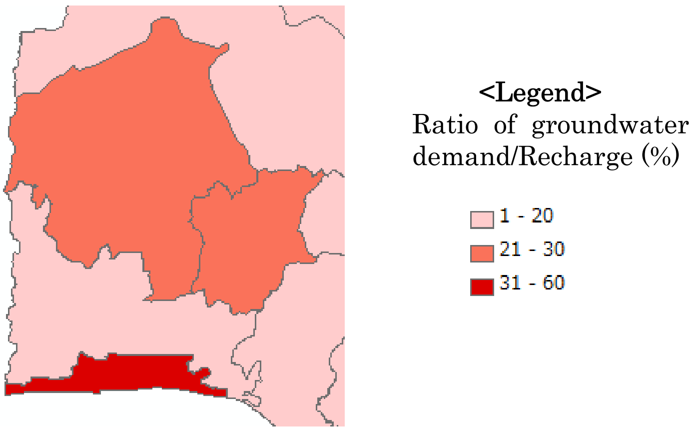
Balance between groundwater recharge and demand are shown in Table 5-3 and Figure 5-3. Ratio of groundwater demand/recharge is 29% on average of Ogun-Oshun Basin.

However it is 19-60% on a state by state basis, showing large difference among the states, showing higher value of Lagos State. This is because of significant difference in groundwater demand between states. It is expected that water demand and supply balance will be critical even in the central and northern part of Osun-Ogun Basin where basement rocks is distributed, though it will be not so serious as in Lagos.

Table 5-3 Groundwater Recharge and Groundwater Demand (2030)

Sta te	State	Groundwater recharge (MCM/year)	Groundwater demand (2030) (MCM/year)					
			Water supply	Private irrigation	Live stock	aquaculture	total	Groundwater demand/ recharge
	Lagos	734	424	5	1	10	440	60%
	Ogun	1,152	108	97	1	14	220	19%
	Osun	1,066	131	18	1	68	217	20%
	Oyo	1,399	263	46	5	81	396	28%
	合計	4,351	926	166	8	173	1,273	29%

Source: JICA Project Team



Source: JICA Project Team

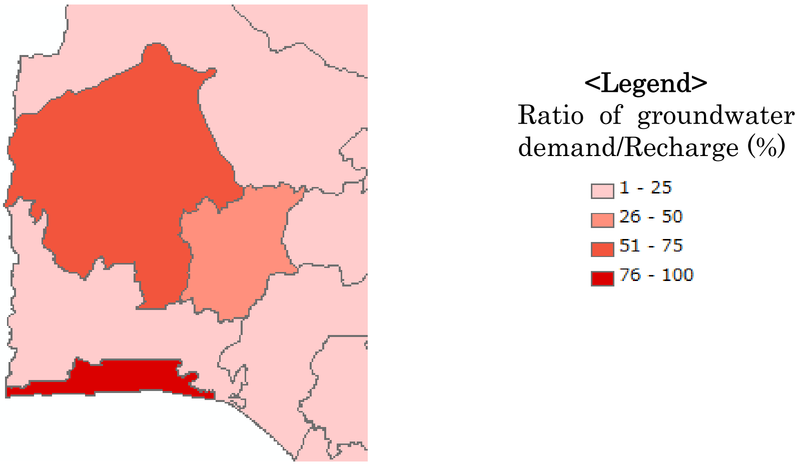
Figure 5-3 Balance of Groundwater Demand and Recharge in 2030

Balance of groundwater recharge and demand is shown in Table 5-4 and Figure 5-4 resulting from Climate change (scenario case-1). Ratio of groundwater demand/recharge is 40% on an average of Ogun-Oshun Basin. However it is 19 to 85% on a state by state basis, showing a large difference. Accordingly, effect of Climate Change will make the difference larger in water balance among states, especially water storage will be serious in Lagos State, and Oyo state follows it locally. Groundwater shortage will occur by unbalance between distribution of groundwater recharge and groundwater demand, even though amount of groundwater demand is smaller than amount of groundwater recharge.

Table 5-4 Groundwater Recharge and Demand by Effect of Climate Change (2030)

No state	state	Groundwater recharge (MCM/year)	Groundwater demand(2030) (MCM/year)				total	Groundwater recharge (MCM/year)
			Water supply	Private irrigation	Live stock	aquaculture		
24	Lagos	531	424	14	1	10	449	85%
27	Ogun	1,152	108	97	1	14	220	19%
29	Osun	739	131	20	1	68	220	30%
30	Oyo	799	263	52	5	81	402	50%
	Total	3,221	926	183	8	173	1,291	40%

Source: JICA Project Team



Source: JICA Project Team

Figure 5-4 Predicted Lowering of Groundwater Level in 2030 by Influence of Climate Change

5.3.3 Analysis of Groundwater Balance by Groundwater Simulation

(1) Prediction of Groundwater lowering in 2030

Groundwater balance was analyzed State by State in the previous section. However, distribution of groundwater recharge and demand is not even within LGAs of a state. For example, groundwater demand shows large difference LGA by LGA. Moreover, aquifer occurs over a wide area crossing state boundaries. Therefore, it is not sufficient to evaluate groundwater balance within a state from hydrogeological viewpoint. To resolve the problem, groundwater simulation was performed to analyze more precisely un-even distribution of groundwater recharge, groundwater demand and aquifer.

Simulation was performed with steady state condition after water balance condition was established in the simulation model. Sustainable groundwater development will be examined whether calculated groundwater level stays in the depth from which planned boreholes can pump up groundwater or not. Model and calculation condition is shown in Table 5-5.

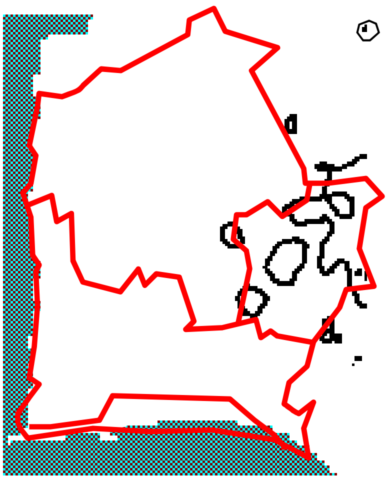
Table 5-5 Outline of Groundwater Simulation Model and Given Condition

item	Content
Software	Visual Modflow
Model structure	The entire Ogun-Oshun Basin was modeled with 36,255 cells. Size of one cell is 5km×5km. Model has 10 layers structures in vertical direction to 500m depth below the ground surface. Conductivity of the model was given following aquifer type.
Groundwater recharge	Analyzed result of groundwater recharge was given to model.
Water demand	Groundwater demand in LGAs of Ogun-Oshun Basin was given to the model by pumping rare (m^3/day) from boreholes. On the other hand, water demand of private irrigation, livestock and aqua-culture were given to the model as negative groundwater recharge.
Boundary and initial condition	As boundary condition, (a) Impermeable boundary was given to Basement rock areas, (b) Constant groundwater level condition was given to sedimentary rock areas. Dain condition was given to along main rivers.

Source: JICA Project Team

Draw-down of regional groundwater level, which will be caused by proposed groundwater development, was calculated in steady state condition and the simulation result is shown in Figure 5-4. Important points of the result are as follows.

- Maximum draw-down is less than 5m. Consequently, proposed groundwater development can be available by adjusting borehole depth to meet future draw-down of groundwater level.
- There will be the areas where draw down of groundwater level will be 5m in Oshogbo city. These areas will be the center of groundwater development in Ibadan large urban area.



<Legend>
Counter line of groundwater level decline is below:
-1m
-5m
-10m
-15m
-20m
-25m
-30m

Source: JICA Project Team

Figure 5-5 Predicted lowering of groundwater level in 2030

(2) Effect of Climate Change

Lowering of Groundwater level in 2030 under the influence of Climate Change (scenario Case-1) was predicted by groundwater simulation. Condition for simulation is shown in Table 5-6, and simulation result is shown in Figure 5-6.

Table 5-6 Outline of Groundwater Simulation Model and Given Condition by Climate Change

Condition	Content
Groundwater recharge	Scenario Case-1 of the Climate Change was applied to estimate groundwater recharge. Groundwater recharge of Table 5-5 was modified using decreasing rate by HA under the influence of Climate Change.
The others	Other condition is the same as those in Table 5-5.

Source: JICA Project Team

- Compared with Figure 5-5 and Figure 5-6, groundwater level will be lowered much more than in case without effect of Climate Change in entire Ogun-Oshun Basin, corresponding to decrease in groundwater recharge by Climate Change.
- Groundwater level will be lowered more than 0-5m in most of Ogun-Oshun Basin area. Groundwater lowering will be more dominant in the central to northern part of Ogun-Oshun Basin area where Basement rock is distributed.
- Lowering of Groundwater level will reach 20m-30m in the area around Oyo and Oshun urban area in Basement rock area.

It should be noticed that in some areas in 2030, groundwater extraction cannot continue at the current borehole depth, due to serious lowering of groundwater level by Climate Change, even though groundwater recharge is greater than amount of groundwater pumping. As explained in Chapter 4, lowering of groundwater level by Climate Change is more serious in high elevation areas than the other areas. Measures are proposed for future borehole planning.

<Legend>
Counter line of groundwater level decline is below:

-10m
-20m
-30m
-40m
-50m
-60m

Source: JICA Project Team

Figure 5-6 Predicted lowering of groundwater level in 2030 in case of Climate Change

- To drill borehole 20m deeper than current depth
- To make depth of pump location 20m deeper than now. Such arrangement should be considered in borehole construction plan.

Impact of the lowering of groundwater level under the influence of Climate Change will be enlarged by over pumping. To prevent such situation, responding to the influence of Climate Change, groundwater pumping must be controlled where there are many boreholes concentrated. Legal and institutional framework must be established to support groundwater monitoring system for pumping control. NIWRMC should take responsibility of these activities.

Above discussion is based on uncertain risk of Climate Change. Further detailed analysis and discussion are necessary in the future.

5.4 Balance between Demand and Supply Capacity for Surface Water Source

5.4.1 Methodology of Water Balance Study for Surface Water

(1) Consideration of Groundwater Abstraction and Water Use for Livestock/Aquaculture

The change in base flow due to abstraction of groundwater is approximately estimated on the basis of the simulated quasi-natural runoff. The following equations are employed to approximately estimate runoff with groundwater abstraction.

$$RO^* = DRO + IF + BF^*$$
$$BF^* = (1 - \alpha)BF$$
$$\alpha = \frac{\overline{AG}}{\overline{LSR}}$$

where *DRO*, *IF*, *BF* = direct runoff, interflow, base flow for quasi-natural condition, RO^*, BF^* = runoff, base flow with groundwater abstraction, α = reduction rate of base flow, $\overline{LSR}$ = average groundwater recharge (late component of surplus), and $\overline{AG}$ = average groundwater abstraction.

The mechanism of reduction of base flow due to groundwater abstraction is complex. However, it is expected that the effect of groundwater abstraction on runoff could appear in relatively large scale, because of the scale of groundwater aquifer. In the present project, reduction rate of base flow α is computed for each HA, and applied it for each HA. The computed α for HA-6 is shown in Table 5-7.

Table 5-7 Reduction Rate of Base Flow due to Groundwater Abstraction in HA-6

Scenario	Groundwater Recharge (LSR) (mm/year)	Groundwater Abstraction (2010) (mm/year)	Reduction Rate α (2010)	Groundwater Abstraction (2030) (mm/year)	Reduction Rate α (2030)
Scenario-A	235.6	8.8	0.04	13.6	0.06
Scenario-B	235.6	8.8	0.04	11.4	0.05

Source: JICA Project Team

The surface water use for livestock and aquaculture inside SHA is also taken into account as follows.

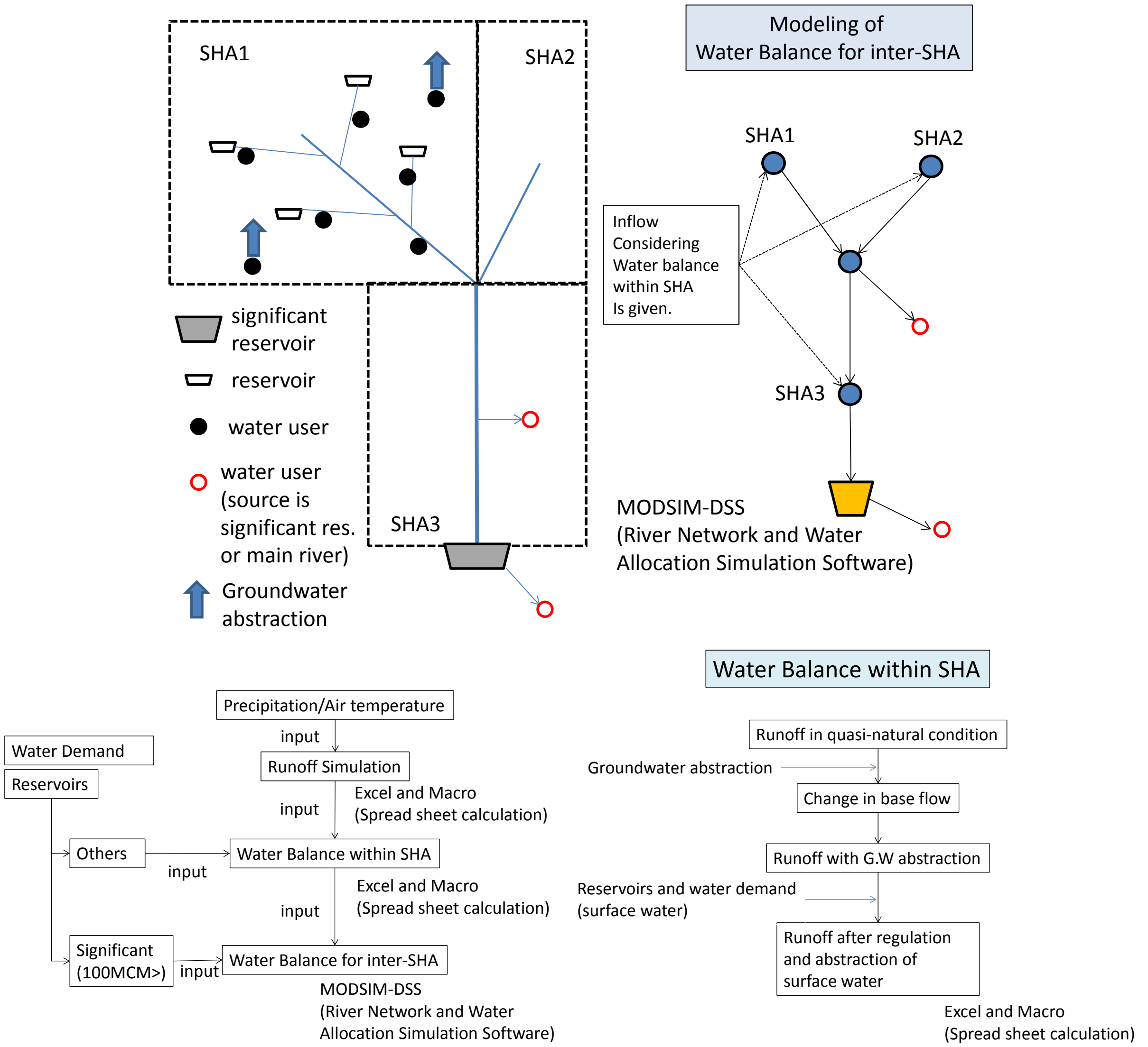
$$RO^{**} = (1 - \beta)RO^*$$
$$\beta = \frac{\overline{U_{LA}}}{\overline{RO^*}}$$

where RO^{**}= runoff with groundwater abstraction and water use for livestock and aquaculture, $\overline{U_{LA}}$ = average surface water use for livestock and aquaculture, $\overline{RO^*}$ = average runoff with groundwater abstraction.

(2) Classification of Water Use Facilities

It is inefficient to deal with all water use facilities that scatter and have various scales in same manner. In the present project, the water balance is examined by classifying the water use facilities into the following two categories (refer to Figure 5-7).

- Water use facilities whose source is either significant dams or main rivers which flows across SHA
- Water use facilities whose source is in the catchment area of SHA



Source: JICA Project Team

Figure 5-7 Detail Water Balance Study for Surface Water

(3) Aggregated Water Balance within SHA

Water use facilities whose source is in the catchment area of SHA are aggregated in each SHA, and aggregated water balance inside SHA is computed by spread sheet (MS-Excel). The aggregated dams, water demand for municipal water and irrigation area are shown in Annex-T 5-1 and 5-2.

In the water balance computation, the retune of used water is considered as follows.

- It is assumed that the return flow from urban water use is 10% of the demand at source[1].
- It is assumed that the return flow from irrigation water use is set at 10% of the demand at source. The delay of the return flow is considered. The factor of the delay is set at 0.5, which means that 50% of the return flow would return within a month, and the remaining is taken over to the next month[2].

[1] Considering that the coverage rate of sewerage system in Nigeria is very low, it is assumed that most of supplied piped water for urban water use would not return to river course nearby. For conservative estimation, the 10% return is assumed.

[2] It is assumed that the unused water for crops (50% of diversion water requirement) would be infiltrated into surface soil and eventually run off to river course. The additional runoff volume could be 50% x 24% (average runoff rate in Nigeria) =12% of the diversion water requirement. For conservative estimation, the 10% return is assumed.

(4) Water Balance Study for Inter-SHA

The inter-SHA water balance is directly modeled by the model network in MODSIM-DSS[3] as follows.

- The nodes for inflow are basically given by SHA unit. The computed runoff considering all local water use and return flow inside SHA described in the section (1)-(3) is given as inflow data.
- The significant reservoirs whose total storage capacity is more than 100MCM and other important reservoirs are directly modeled by the model network (see Table 5-8 for Scenario-A, Scenario-B is described in Section 5.4.3).
- As for water users, 8 locations for municipal water supply, 4 locations for irrigation water supply are considered (see Tables 5-9 and 5-10 for Scenario-A, Scenario-B is described in Section 5.4.3).

Table 5-8 Dams Directly Modeled by MODSIM-DSS Model Network

SN	HA	SHA	Dam	Status	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km^2)	Evaporation (mm/year)
59	6	608	Asejire	E	32.90	30.50	5.60	1,652
65	6	608	Erinle	E	94.00	92.50	17.20	1,587
70	6	60405	Ikere Gorge	E	690.00	565.00	53.00	1,629
81	6	604023_i	Oyan	E	270.00	265.00	44.00	1,713
3501	6	608	Odedele	P	182.60	142.70	22.90	1,675

Status: E=Existing, U=Under-construction, P=Proposed
Source: JICA Project Team

Table 5-9 Major Municipal Water Users Modeled by MODSIM-DSS Model Network

MODSIM -DSS Node	Water Demand (MCM/year)		Source	SN WTP	SHA	SN-SHA	State	Scheme	Operation Rate (%)		[A]*	Capacity (m^3/day)
	2010	2030							2010	2030		
M_Asejire	34.63	66.21	Asejire	211	608	142	Oyo	Ibadan/Asejire	45.2	80.0	E	186,000
			Asejire	212	608	142	Oyo	Ibadan/Osegere	45.2	80.0	E	13,500
			Asejire	218	608	142	Oyo	Lalupon	45.2	80.0	E	436
			Asejire	1093	608	142	Oyo	Lagelu	0.0	80.0	P	8,000
			Asejire	1096	608	142	Oyo	Ona-Ara	0.0	80.0	P	8,000
M_Erinle	32.74	57.95	Erinle	179	608	142	Osun	Ede/Old	45.2	80.0	E	9,000
			Erinle	180	608	142	Osun	Ede/New	45.2	80.0	E	180,000
M_Odedele	0.00	109.92	Oshun R.	1097	608	142	Oyo	Ibadan/Odedele-1	0.0	80.0	P	120,000
			Oshun R.	1098	608	142	Oyo	Ibadan/Odedele-2	0.0	80.0	P	120,000
			Oshun R.	1099	608	142	Oyo	Ibadan/Odedele-3	0.0	79.0	P	120,000
M_Lagos	90.56	344.20	Ogun R.	123	60401	133	Lagos	Adiyan	45.2	80.0	E	318,220
			Ogun R.	124	60401	133	Lagos	Iju	45.2	80.0	E	204,570
			Ogun R.	1055	60401	133	Lagos	Adiyan-2	0.0	75.4	P	318,220
			Ogun R.	1056	60401	133	Lagos	Adiyan-3	0.0	75.4	P	318,220
M_Abeokuta	16.80	29.74	Ogun R.	142	60401	133	Ogun	Abeokuta Old	45.2	80.0	E	15,000
			Ogun R.	143	60401	133	Ogun	Abeokuta New	45.2	80.0	E	82,000
M_Apoje	3.20	32.58	Oshun R.	150	608	142	Ogun	Ijebu-Igbo/Apoje	45.2	80.0	E	18,500
			Oshun R.	1073	608	142	Ogun	Apoje Regional-1	0.0	35.1	P	200,000
			Oshun R.	1074	608	142	Ogun	Apoje Regional-2	0.0	0.0	N	200,000
M_Odomola	0.00	151.07	Oshun R.	1052	608	142	Lagos	Odomola-1	0.0	75.4	P	113,650
			Oshun R.	1053	608	142	Lagos	Odomola-2	0.0	75.4	P	409,140
			Oshun R.	1054	608	142	Lagos	Odomola-3	0.0	0.0	N	431,870
M_Mokoloki	0.00	76.65	Ogun R.	1075	60401	133	Ogun	Mokoloki Regional-1	0.0	80.0	P	250,000
			Ogun R.	1076	60401	133	Ogun	Mokoloki Regional-2	0.0	0.0	N	250,000
			Ogun R.	1077	60401	133	Ogun	Mokoloki Regional-3	0.0	0.0	N	200,000

[A]*=Condition：E=existing, G=On-going(to be completed by 2014), P=Proposed
Source: JICA Project Team

[3] MODSIM-DSS is developed by Colorado State University. It supports the water allocation considering priorities among several multi-sector water users with Graphical User Interface. The software can be downloaded from its web-site http://modsim.engr.colostate.edu/ with free.

Table 5-10 Major Irrigation Water Users Modeled by MODSIM-DSS Model Network

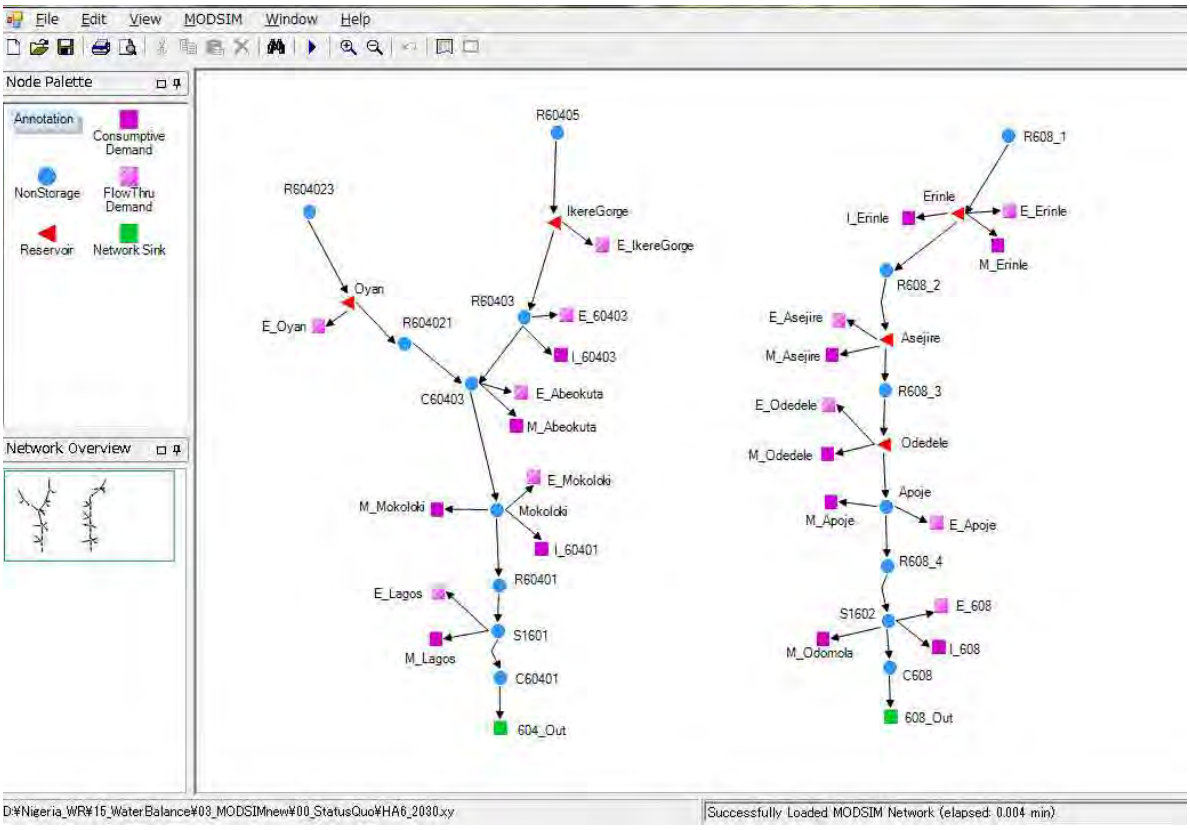
MODSIM -DSS Node	Irrigation Area (ha)		Source	SN	SHA	SN-SHA	Scheme	[A]*	Planned Area (ha)	Evaluated Irrigable Area (ha)
	2010	2030								
I_Erinle	500	500	Erinle	98	608	142	New Erinle	E	500	500
I_60401	500	12,000	Ogun R.	86	60401	133	Lower Ogun (Mokoloki)	E	12,000	12,000
I_60403	750	12,000	Ogun R.	84	60403	137	Middle Ogun (I.G)	E	12,000	12,000
I_608	630	630	Osun R.	94	608	142	Igbonla	E	1,500	130

Remarks: For the irrigation schemes which are not shown in the table, it is evaluated that the stable water supply with 80% yearly dependability can be secured for the planned irrigation area.
[A]*=Condition：E=existing、G=On-going、P=Proposed
Source: JICA Project Team

In the water balance computation, the retune of used water is considered as follows.

- It is assumed that the return flow from urban water use is 10% of the demand at source.
- It is assumed that the return flow from irrigation water use is set at 10% of the demand at source. The delay of the return flow is considered. The factor of the delay is set at 0.5, which means that 50% of the return flow would return within a month, and the remaining is taken over to the next month.

The graphical view of the model network using MODSIM-DSS in Ogun-Oshun Basin is shown in Figure 5-8.



Source: JICA Project Team

Figure 5-8 MODSIM-DSS Model Network for Ogun-Oshun Basin (Scenario-A)

(5) Water Balance Study for Water Use Facilities whose source is in the Catchment Area of SHA

For the relatively large scale water use facilities whose source is in the catchment area of SHA, individual water balance is examined and accordingly necessary water resources development is proposed.

- Municipal Water Supply: water purification plants whose volume of water source is more than 3MCM/year (9 locations in total)
- Irrigation Water Supply: Existing large scale irrigation scheme whose planed area is more than

500ha (11 locations in total)

The list of checking points is shown in Tables 5-11 and 5-12.

Table 5-11 List of Checking Points of Water Balance within SHA for Municipal Water Users

Scheme/City	Water Demand (MCM/year)		SN Source	Source	SN WTP	SHA	SN SHA	State	Scheme	Operation Rate (%)		[A]*	Capacity (m^3/day)
	2010	2030								2010	2030		
Eko-Ende	2.08	3.68	64	Eko-Ende	191	608	142	Osun	Eko-Ende	45.2	80.0	E	12,000
Eleyele	4.72	8.35	115	Eleyele	213	606	140	Oyo	Ibadan/Eleyele	45.2	80.0	E	27,240
Ife	0.00	9.20	1002	Ile-Ife	1084	610	144	Osun	Ife	0.0	80.0	P	30,000
Ilesha	0.00	18.40	1003	Ilesha	1083	608	142	Osun	Ilesha	0.0	80.0	P	60,000
Ota	1.59	5.64	5030	river	144	603	132	Ogun	Ota Old	45.2	80.0	E	2,450
			5030	river	145	603	132	Ogun	Ota New	45.2	80.0	E	6,750
			5030	river	1069	603	132	Ogun	Ota Old	0.0	80.0	P	2,450
			5030	river	1070	603	132	Ogun	Ota New	0.0	80.0	P	6,750
Ifo Akinsede/ Papalanto	2.08	3.68	5031	river	148	60401	133	Ogun	Ifo Akinsede/ Papalanto	45.2	80.0	E	12,000
Ijebu-Ode/ Yemoji	3.12	5.52	5032	river	151	606	140	Ogun	Ijebu-Ode/ Yemoji	45.2	80.0	E	18,000
Ogere & Shagamu	2.29	4.05	5033	river	152	606	140	Ogun	Ogere	45.2	80.0	E	6,700
			5033	river	157	606	140	Ogun	Shagamu	45.2	80.0	E	6,500
Otta Ikosi	0.00	5.58	5053	Aye R.	1051	606	140	Lagos	Otta Ikosi	0.0	80.0	G	18,184

[A]*=Condition：E=existing, G=On-going(to be completed by 2014), P=Proposed
Source: JICA Project Team

Table 5-12 List of Checking Points of Water Balance within SHA for Irrigation Water Users

SN IRR	Irrigation Area (ha)		Source	SN	SHA	SN-SHA	Scheme	[A]*	Planned Area (ha)	Evaluated Irrigable Area (ha)
	2010	2030								
I_Erinle	500	500	Erinle	98	608	142	New Erinle	E	500	500
I_60401	500	12,000	Ogun R.	86	60401	133	Lower Ogun (Mokoloki)	E	12,000	12,000
I_60403	750	12,000	Ogun R.	84	60403	137	Middle Ogun (I.G)	E	12,000	12,000
I_608	630	630	Osun R.	94	608	142	Igbonla	E	1,500	130

Remarks: For the irrigation schemes which are not shown in the table, it is evaluated that the stable water supply with 80% yearly dependability can be secured for the planned irrigation area.
[A]*=Condition：E=existing、G=On-going、P=Proposed
Source: JICA Project Team

The following conditions are applied for the water balance study.

- Monthly flow pattern for SHA is given by the runoff affected by groundwater abstraction and water use for livestock and aquaculture which is shown in Section (1) and (2). Then, the monthly inflow at the checking point is computed by multiplying the ratio of total runoff volume at the checking point and the total runoff volume for the SHA where the checking point is located.
- When other water uses exist in upstream catchment, its catchment area is excluded for estimating inflow at the checking point.
- On the basis of minimum stream flow requirement at the downstream end of SHA, that at the checking point is also estimated by multiplying the ratio of total runoff volume at the checking point and the total runoff volume for the SHA where the checking point is located.
- In case that storage dam supplies water for both municipal and irrigation water, the priority storage zone for municipal water is set by trial and error so as to secure both the safety level of 80% yearly dependability for irrigation water use and that of 90% yearly dependability for municipal water use.

5.4.2 Results of Water Balance Study for Scenario-A

(1) Water Source for Municipal Water Supply

As the results of the water balance study for the relatively large scale water purification plants, it is evaluated that some water sources could experience the deficit for supplying necessary water volume with 90% yearly dependability.

The recommended measures against those deficit as well as the results of the water balance study are summarized in Table 5-13. The municipal water supply plan as well as surface water development plan in Chapter 7 refers the recommendation shown in the table.

Table 5-13 Evaluation of Water Source for Municipal Water Supply and Recommended Measures

State	Surface Water Demand (MCM/Year)		Deficit (2030) (MCM /year)	Recommended Measures for Water Source	Recommended Measures for Water Purification Plant
	2010	2030			
Lagos	93.7	678.5	-5.58	1. Construction of new dam for Otta Ikosi Scheme (Dam SN:2205 GS=20.6MCM)	1. Postponement of construction of the following WTWs (for demand up to 2030) 1) Yewa Phase-2 (WTW, Desalination) (InsCap=227,300m^3/day) 2) Odomola Phase-3 (WTW) (InsCap=431,870m^3/day)
Ogun	30.2	159.8	-15.21	1. Construction of new dam for Ota Scheme (Dam SN:4014 GS=6.4MCM) 2. Construction of new dam for Ijebu-Ode/Yemoji Scheme (Dam SN:4018 GS=3.3MCM) 3. Construction of new dam for Ogere & Shagamu Scheme (Dam SN:2205 GS=20.6MCM)	1. Postponement of construction of the following WTWs (for demand upto 2030) 1) Yewa Regional-1 (WTW) (InsCap=100,000m^3/day) 2) Yewa Regional-2 (WTW) (InsCap=100,000m^3/day) 3) Apoje Regional-2 (WTW) (InsCap=200,000m3/day) 4) Mokoloki Regional Phase-2 (WTW) (InsCap=250,000m^3/day) 5) Mokoloki Regional Phase-3 (WTW) (InsCap=200,000m^3/day)
Oyo	43.5	205.6	-116.64	1. Constructon of proposed Odedele dam for Odedele/Ibadan Scheme (Dam SN:3501 GS=182MCM)	

Remarks
1) GS＝Gross storage volume
2) For the states that are not shown in the table, it is evaluated that the water source for the water purification plants whose volume of water source is more than 3MCM/year can be supplied with 90% yearly dependability.

Source: JICA Project Team

(2) Water Source for Irrigation Water Supply

As the results of the water balance study for the existing large irrigation schemes whose planned area is more than 500ha, it is evaluated that the irrigable area in terms of stable water supply with 80% yearly dependability is less than the planned area in some schemes. The evaluated irrigable area for these schemes is shown in Table 5-14. The irrigation development plan as well as surface water development plan in Chapter7 refers the evaluated results shown in the table.

Table 5-14 Evaluation of Existing Irrigation Schemes in Terms of Availability of Water Source

SN	HA	Irrigation Scheme	Planned Area (ha)	Developed Area (ha)	Evaluated Irrigable Area (ha)	Remarks
82	6	Upper Ogun	2,000	10	600	
83	6	Ofiki(A)	2,000	24	60	
85	6	Sepeteri(A)	2,000	24	30	
87	6	Iwo	1,000	0	0	
88	6	Ilero	2,000	0	70	
89	6	Otta	1,000	340	0	
90	6	Eyinwa	1,000	300	10	
91	6	Oke-Odan	600	250	400	
93	6	Okuku	600	0	30	
94	6	Igbonla	1,000	130	130	

Remarks: For the irrigation schemes which are not shown in the table, it is evaluated that the stable water supply with 80% yearly dependability can be secured for the planned irrigation area. It should be noted that the irrigation schemes whose source is wetland area or Lake Chad are not evaluated by the water balance study.

Source: JICA Project Team

(3) Hydropower Generation by Significant Dams

On the basis of the simulated results by the water balance study for the water demand in 2030, the hydropower generation by the significant dams is estimated. The results are shown in Table 5-15.

Table 5-15 Estimated Hydropower Generation by Significant Dams

Dam	Install Capacity (MW)	Average Generated Energy (GWh/year)	80% yearly dependable Generated Energy (GWh/year)	Remarks
Oyan	9	24.9	15.2	It is assumed that all released water is used for hydropower generation.
Ikere George	6	21.9	16.7	It is assumed that all released water is used for hydropower generation.

Remarks:
1) It is assumed that overall efficiency is 0.7.
2) Since H-V-A relation is available for the present project, the fluctuation of water level is taken into account for estimating hydropower generation.

Source: JICA Project Team

(4) Excess Storage Volume in Significant Dams

It is clarified that there could be excess storage volume in some significant dams, even if the demand for irrigation and municipal water supply in 2030 is considered. The possible additional water supply volume with 90% yearly dependability as well as excess storage volume is shown in Table 5-16. The excess storage volume can be utilized for several different purposes such as irrigation, municipal water supply, enhancement of firm energy of hydropower generation, reduction of peak flood discharge and enhancement of river environment. It is necessary to discuss how to use the excess storage volume by stakeholders.

Table 5-16 Excess Storage Volume in Significant Dams

No	Dam	HA	Effective Storage Volume (MCM)	Excess Storage Volume (MCM)	Location to Evaluate Possible Additional Water supply Volume	Possible Additional Water Supply Volume with 90% yearly dependability (MCM/year)
12	Oyan & Ikere Gorge	6	830	365	Akute Intake in Lagos State	360

Source: JICA Project Team

(5) Water Balance at Representative Points

The results of water balance study by MODSIM-DSS model at Akute and Odomola, representative points, are presented in Annex-T 5-3 and Annex-F 5-1.

(6) Remarks on Water Balance Study

The water balance study in the present project has been conducted by utilizing the currently available data and information on water use facilities as well as the estimated water quasi-natural flow. There are also many assumptions such as the setting of minimum stream flow requirement. All of these may affect the results of the water balance study. It should be noted that the results of the water balance study are based on those data, information and the assumptions.

It is recommended that the effort to refine the estimation of flow condition by improving hydrological observation and the data/information on water use facilities be continued, in order to proceed to the next step for implementation of the water resources project. The refined water balance study should be conducted when the individual project will be implemented.

5.4.3 Additional Water Source for Scenario-B

(1) Water Supply Plan of Lagos State

Water supply facilities which requires surface water source for Scenario-A and –B together with water demand at source are presented in Table 5-17, according to Section 7.1. One can see that the Scenario-B needs additional 910MCM/year for the entire Lagos State compared to Scenario-A. The required main surface water sources are 11MCM/year at Akute in Ogun River, 142MCM/year at Odomola in Oshun River and 676MCM/year at unspecified locations.

Table 5-17 Water Supply Plan of Lagos State

Scenario-A

SN-Intake	Water Demand (MCM/year)		Source	SN-WTP	Scheme	Capacity (m^3/day)	Operation Rate (%)		[A]*
	2010	2030					2010	2030	
022	3.2	46.3	*river (wetland)*	125	Ishashi	18,184	45.2	80.0	E
				1058	Ishashi Expansion-1	36,368	0.0	75.4	P
				1059	Ishashi Expansion-2	104,558	0.0	75.4	P
5052	0.0	65.7	Lagoon (Desali.)	1049	Yewa Phase-1	227,300	0.0	75.4	P
				1050	Yewa Phase-2	227,300	0.0	0.0	N
5053	0.0	5.6	Aye R.	1051	Otta Ikosi	18,184	0.0	80.0	G
5054	0.0	65.7	Lagoon (Desali.)	1057	Ibesha	227,300	0.0	75.4	P
8016	90.6	344.2	Ogun R. (Akute)	123	Adiyan	318,220	45.2	80.0	E
				124	Iju	204,570	45.2	80.0	E
				1055	Adiyan-2	318,220	0.0	75.4	P
				1056	Adiyan-3	318,220	0.0	75.4	P
8024	0.0	151.1	Oshun R. (Odomola)	1052	Odomola Phase-1	113,650	0.0	75.4	P
				1053	Odomola Phase-2	409,140	0.0	75.4	P
				1054	Odomola Phase-3	431,870	0.0	0.0	N
Total	93.8	678.5							

[A]*=Condition：E=existing, G=On-going(to be completed by 2014), P=Proposed, N=Not recommended before 2030
Source: JICA Project Team

Scenario-B

SN-Intake	Water Demand (MCM/year)		Source	SN-WTP	Scheme	Capacity (m^3/day)	Operation Rate (%)		[A]*
	2010	2030					2010	2030	
022	3.2	48.8	*river (wetland)*	125	Ishashi	18,184	45.2	80.0	E
				1058	Ishashi Expansion-1	36,368	0.0	80.0	P
				1059	Ishashi Expansion-2	104,558	0.0	80.0	P
5052	0.0	139.4	Lagoon (Desali.)	1049	Yewa Phase-1	227,300	0.0	80.0	P
				1050	Yewa Phase-2	227,300	0.0	80.0	P
5053	0.0	5.6	Aye R.	1051	Otta Ikosi	18,184	0.0	80.0	G
5054	0.0	69.7	Lagoon (Desali.)	1057	Ibesha	227,300	0.0	80.0	P
8016	90.6	355.4	Ogun R. (Akute)	123	Adiyan	318,220	45.2	80.0	E
				124	Iju	204,570	45.2	80.0	E
				1055	Adiyan-2	318,220	0.0	80.0	P
				1056	Adiyan-3	318,220	0.0	80.0	P
8024	0.0	292.7	Oshun R. (Odomola)	1052	Odomola Phase-1	113,650	0.0	80.0	P
				1053	Odomola Phase-2	409,140	0.0	80.0	P
				1054	Odomola Phase-3	431,870	0.0	80.0	P
	0.0	675.8			Additional	2,204,185	0.0	80.0	P
Total	93.8	1,587.4							

[A]*=Condition：E=existing, G=On-going(to be completed by 2014), P=Proposed
Source: JICA Project Team

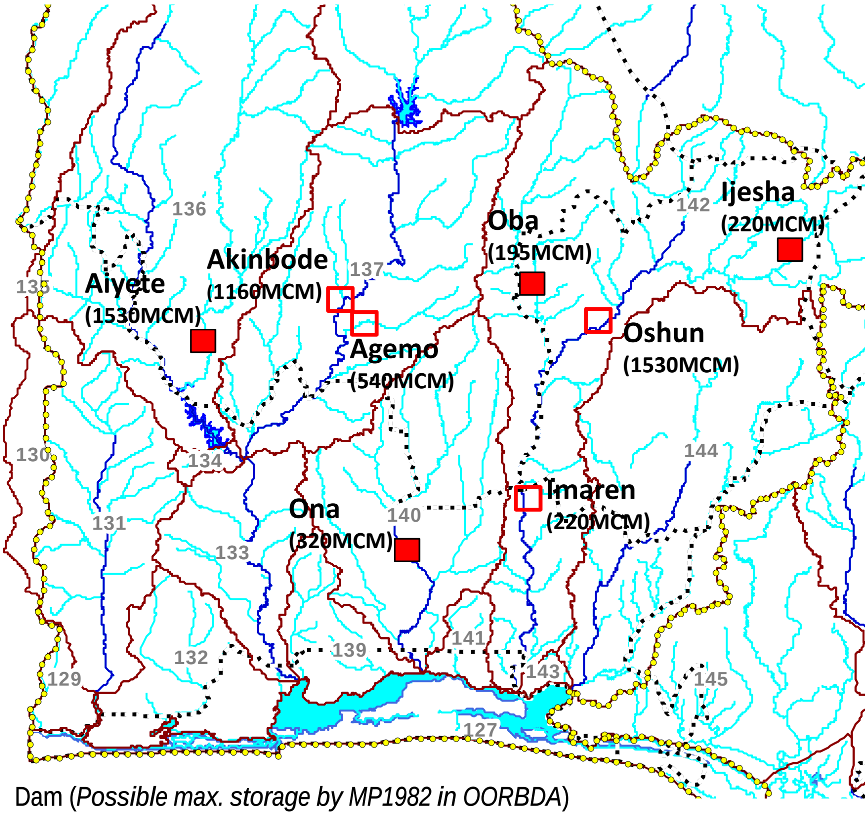
(2) Options for Additional Water Source

There can be the following options for additional water source for Scenario-B.

- Utilization of the excess storage in Ogun and Oshun Rivers; It is estimated that additional 360MCM/year at Akute in Lagos State and 96MCM/year at Odomola in Lagos State on the premises of the construction of the proposed Odedele dam.
- Reduction of the planned irrigation area of Middle Ogun and Lower Ogun irrigation schemes; Development of 6,000ha instead of 24,000ha.
- Construction of new dams in Ogun and Oshun Rivers; Utilization of the potential dam sites shown in Master Plan for Ogun-Oshun Basin in 1982
- Desalination of water in lagoon

(3) Potential Dam Sites shown in Master Plan for Ogun-Oshun Basin in 1982

Potential dam sites shown in Master Plan for Ogun-Oshun Basin in 1982 could be utilized as candidate sites for new water source in Ogun and Oshun Rivers. Among these sites, significant dams with more than 100MCM and without implemented are the eight sites shown in Figure 5-9.



Source: JICA Project Team

Figure 5-9 Potential Dam Sites shown in Master Plan for Ogun-Oshun Basin in 1982

The current conditions of the expected reservoir areas have been preliminary examined for the eight sites by means of satellite image. As shown in Table 5-18, it is indicated that large scale resettlement or replacement of major infrastructures is necessary for four sites. The development of the four sites is therefore not recommended. The remaining four sites are selected for further water balance study.

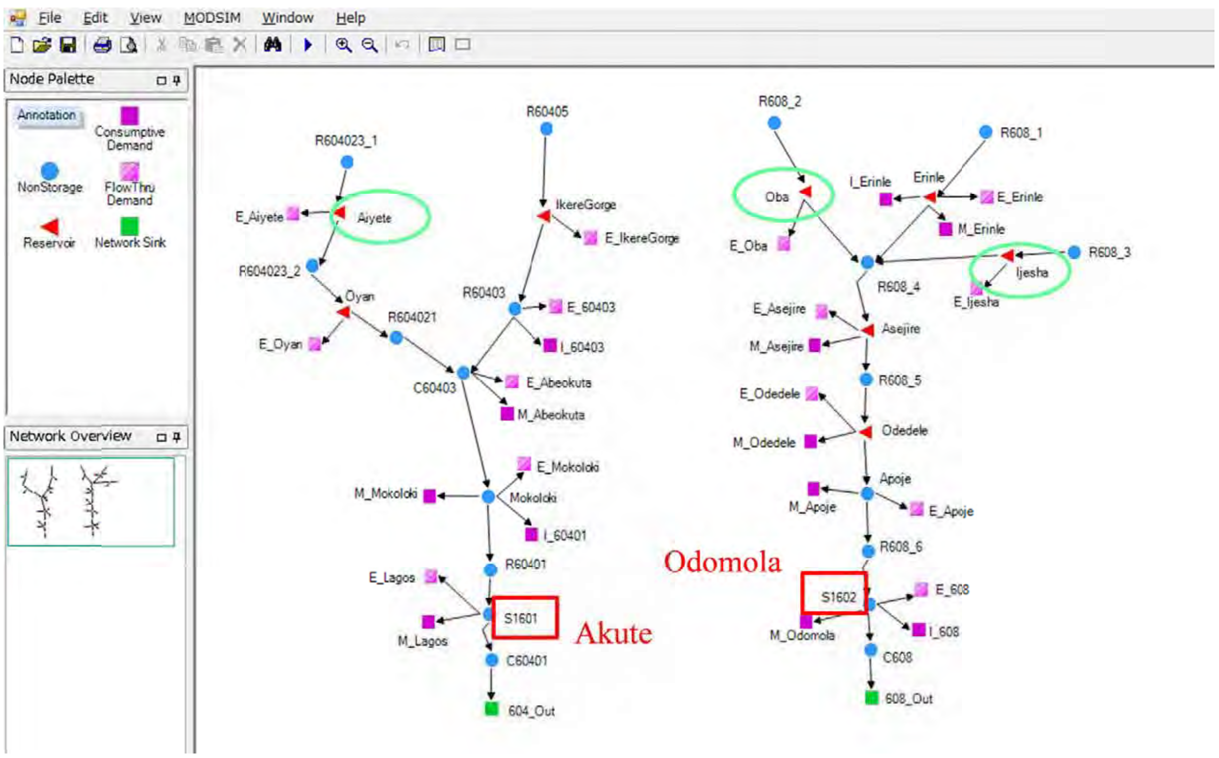
Table 5-18 Current Conditions of Potential Dam Sites shown in Master Plan for Ogun-Oshun Basin in 1982

Candidate Sites	Potential Capacity* (MCM)	Current Condition	Selected for further water balance study
Aiyete	1,550	It was recommended to be constructed in Master Plan for Ogun-Oshun Basin in 1982. It is estimated that the inflow volume is 550MCM/year in average.	X
Akinbode	1,160	There is large scale settlement in the expected reservoir area, according to satellite image.	
Agemo	540	There is large scale settlement in the expected reservoir area, according to satellite image. The inflow volume is small due to its small catchment area.	
Ona	320		X
Imaren	220	There is the proposed Odedele dam in the expected reservoir area.	
Oba	195		X
Oshun	1,530	There is a national railway in the expected reservoir area, according to satellite image.	
Ijesha	220		X

* Values shown in Master Plan for Ogun-Oshun Basin in 1982
Source: JICA Project Team

(4) Water Balance Study

As shown in Figure 5-10, the Aiete dam in Ogun River, the Oba and Ijesha dams in Oshun River are additionally included in the MODSIM-DSS model, with the relationship among water level, reservoir area and reservoir volume examined. The additionally available water volume with these dams is studied.



Source: JICA Project Team

Figure 5-10 MODSIM-DSS Model Network for Ogun-Oshun Basin (Scenario-B)

The alternative cases for water source development including the option of the reduction of the planned irrigation area are shown in Table 5-19. In the table, available water volume with 90% yearly dependability for each case is also shown.

Table 5-19 Additionally Available Water Volume

Akute in Ogun River

Case		Reduction of planned irrigation area (24,000ha →6,000ha)	Aiyete dam (Gross storage= 543MCM)	Additionally available water volume (MCM/year)
1	Existing	No	No	360
2	Only reduction of planned irrigation area	Yes	No	660
3	Only new dam construction	No	Yes	660
4	reduction of planned irrigation area + new dam construction	Yes	Yes	840

Source: JICA Project Team

Odomola in Oshun River

Case		Oba dam (Gross storage= 197MCM)	Ijesha dam (Gross storage= 248MCM)	Additionally available water volume (MCM/year)
1	Existing	No	No	96
2	Only Oba dam	Yes	No	216
3	Oba dam + Ijesha dam	Yes	Yes	324

Source: JICA Project Team

It is possible to supply additional 1,166MCM/year in total, when all of the options shown in Table 5-19 are implemented. It is enough volume to meet the need in Scenario-B.

(5) Tentatively Recommended Plan

According to the water supply plan for Lagos State shown in Table 5-17, the necessary volume of the additional water source at Odomola in Oshun River is 142MCM/year. It cannot be supplied by the water source facilities proposed for Scenario-A as well as the existing facilities. Construction of the new dam is thereby required. It is tentatively recommended to construct the Oba dam which is closer to the intake point of Odomola.

Assuming the construction of the Oba dam, the necessary new water source in Ogun River becomes 613MCM/year (=676+11+142-216). To ensure the 613MCM/year, either the construction of Aiyete dam or the reduction of the planned irrigation area is required. Considering the importance of the development of regional economic activity, it is better to avoid the reduction of the irrigation area. The construction of Aiyete dam is thereby tentatively recommended.

However, it is also desirable to keep the option of the reduction of irrigation area to address further increase of municipal water demand beyond 2030. Considering this, it is recommended to develop the irrigation area in Middle Ogun and Lower Ogun with step by step manner; 6,000ha in short term (by 2020) and the remaining 18,000ha in long term (by 2030). By this, it is possible to adapt future changes in plan due to further increase in water demand

The tentatively recommended plan for additional water source for Scenario-B is summarized in Table 5-20.

Table 5-20 Tentatively Recommended Plan for Additional Water Source for Scenario-B

Item	Menu
Construction of new dams	1. Construction of Aiyete dam (Gross storage=543MCM) in Ogun River
	2. Construction of Oba dam (Gross storage=197MCM) in Oshun River
Irrigation Development	3. Change in implementation plan for development of Middle Ogun, Lower Ogun irrigation schemes; 6,000ha in short term (by 2020) and the remaining 18,000ha in long term (by 2030)

Source: JICA Project Team

It should be noted that the storage capacity examined here is only for supplying municipal water. The multi-purpose development considering other purposes such as hydropower generation and flood control as necessity arises may be examined in the next step for implementation. The optimum storage size and dimension of dam would be studied.

5.4.4 Estimation of Risk Associated with Climate Change

(1) Risk related to Water Supply-Demand Balance Associated with Climate Change

In order to estimate the risk on water supply-demand balance associated with climate change, the water balance study with the runoff and water demand considering under the climate change scenario of Case-1 shown in Chapter 4. The Case-1 considers only changes in air temperature and gives smaller runoff compared to Case-2.

As the results of the water balance study for the relatively large scale water purification plants whose abstraction volume is more than 3MCM/year under the climate change scenario of Case-1, it is expected that the safety level of water supply could be lower than 90% yearly dependability in some places, as shown in Table 5-21.

Table 5-21 Estimated Lowering on Safety Level for Municipal Water Supply by Climate Change Scenario of Case-1

Number of Water Sources for Municipal Water Supply				
More than 90% yearly dependability	80-90% yearly dependability	50-80% yearly dependability	Less than 50% yearly dependability	Total
14	4	0	0	18

Source: JICA Project Team

As the results of the water balance study for the existing large irrigation schemes whose planned area is more than 500ha under the climate change scenario of Case-1, it is expected that the available irrigation area in terms of stable water supply with 80% yearly dependability could decrease with about 98% in Ogun-Oshun Basin.

The hydropower generation by the significant dams could be reduced to 60-90% of the base climate condition, in case of climate change scenario of Case-1.

(2) Risk related to Water Supply-Demand Balance Associated with Trans-boundary Water

The catchment belongs to upstream countries is quite limited in Ogun-Oshun Basin. It is limited to the upstream part of Yewa River. It is thereby judged that there is almost no risk related to water supply-demand balance associated with trans-boundary water.

5.4.5 Summary of Finding in Water Balance Study

On the basis of the results of the water balance study, the findings are summarized as below.

(1) Lagos State

Water resources in Lagos state in terms of internal generation is very limited. However, Lagos can utilize the developed water resources in the upstream states. For Scenario-A, on the basis of the water balance study, the water can be supplied by the existing dams except small local source. For Scenario-B, additional water source should be developed. Construction of two new dams is proposed tentatively.

Lagos State has a plan to utilize water in the lagoon with desalination. It is strongly recommended to conduct a comprehensive study on water quality and environment in the lagoon. By this study, it would be possible to examine in detail the selection of appropriate water sources for municipal water supply for Lagos.

(2) Ogun State

It is judged that some local water sources in Ogun State cannot supply water stably. It is recommended to construct new dams for such sites.

Ogun State is located at the middle reach of Ogun and Oshun Rivers. In the upper reach, there is Oyo and Osun States, where there are large water sources. In the lower reach, there is Lagos State, which is a large water consumer. Ogun Sate has to consider the balance between upstream and downstream, thus is to be a key player for water management in the basin.

(3) Oyo States

It is clarified that the construction of the proposed Odedele dam is necessary to meet the future water demand in Ibadan. It is recommended that the Odedele dam is constructed as planned.

For Scenario-B, it is recommended to construct a new dam in Oyo State in order to meet the future water demand in Lagos. As an upstream state, it is necessary to consider to supply water to the downstream. Collaboration between upstream state and downstream state would become more important in future.

(4) Osun States

It is judged that main water sources for municipal water supply can meet the future water demand in 2030.

For Scenario-B, it is recommended to construct a new dam in Osun State in order to meet the future water demand in Lagos. As an upstream state, it is necessary to consider to supply water to the downstream. Collaboration between upstream state and downstream state would become more important in future.

Annex-Table 5

Annex-T 5-1 Aggregated Dams, Water Demand for Municipal Water and Irrigation Area in Ogun-Oshun Basin for 2010

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5127	6	60001	127	aggregated	0.0	0.0	0.00	0	74.51	0.90	4.24	79.65	0.099	0.00	0.00	0	1.41	0.14
5129	6	601	129	aggregated	0.0	0.0	0.00	0	2.00	0.40	0.23	2.63	0.094	0.00	0.00	0	0.08	0.13
5130	6	602_e	130	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5131	6	602_i	131	aggregated	5.5	4.3	0.15	1,710	10.42	3.40	1.93	15.75	0.094	0.00	0.46	250	0.64	0.21
5132	6	603	132	aggregated	0.0	0.0	0.00	0	322.47	1.40	2.25	326.12	0.099	0.00	1.59	340	0.75	0.17
5133	6	60401	133	aggregated	2.0	1.6	0.24	1,680	39.01	1.90	1.27	42.18	0.097	0.00	2.08	45	0.42	0.14
5134	6	604021	134	aggregated	0.0	0.0	0.00	0	1.10	0.10	0.10	1.29	0.094	0.00	0.00	0	0.03	0.19
5135	6	604023_e	135	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5136	6	604023_i	136	aggregated	5.7	4.7	1.38	1,627	19.57	6.20	13.49	39.26	0.088	0.00	0.23	44	4.50	0.37
5137	6	60403	137	aggregated	14.6	11.9	2.87	1,639	20.99	5.70	9.21	35.90	0.087	0.00	2.23	0	3.07	0.35
5138	6	60405	138	aggregated	6.4	5.1	1.45	1,592	8.58	2.20	7.89	18.67	0.087	0.00	0.26	24	2.63	0.35
5139	6	605	139	aggregated	0.0	0.0	0.00	0	26.93	2.40	1.09	30.41	0.098	0.00	2.60	0	0.36	0.12
5140	6	606	140	aggregated	7.8	6.1	2.24	1,643	56.88	3.00	4.37	64.25	0.089	0.00	7.84	451	1.46	0.16
5141	6	607	141	aggregated	0.0	0.0	0.00	0	3.89	0.30	0.49	4.68	0.095	0.00	0.00	0	0.16	0.13
5142	6	608	142	aggregated	28.4	23.2	5.20	1,595	74.51	8.80	33.79	117.09	0.083	0.00	7.75	1,050	11.26	0.48
5143	6	609	143	aggregated	0.0	0.0	0.00	0	0.09	0.10	0.07	0.25	0.094	0.00	0.00	0	0.02	0.05
5144	6	610	144	aggregated	0.0	0.0	0.00	0	24.62	5.00	24.22	53.84	0.080	0.00	2.23	200	8.07	0.46
5150	6	699	150	aggregated	0.0	0.0	0.00	0	5.64	1.80	4.38	11.82	0.086	0.00	0.00	0	1.46	0.19

Source: JICA Project Team

Annex-T 5-2 Aggregated Dams, Water Demand for Municipal Water and Irrigation Area in Ogun-Oshun Basin for 2030

Scenario-A

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5127	6	60001	127	aggregated	0.0	0.0	0.00	0	61.16	2.20	6.63	69.99	0.097	0.00	0.00	0	2.21	0.22
5129	6	601	129	aggregated	0.0	0.0	0.00	0	1.60	1.00	0.36	2.96	0.078	0.00	0.00	0	0.12	0.20
5130	6	602_e	130	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5131	6	602_i	131	aggregated	5.5	4.3	0.15	1,710	9.44	8.60	3.05	21.09	0.078	0.00	0.81	250	1.02	0.33
5132	6	603	132	aggregated	6.4	5.0	1.50	1,660	365.48	3.40	3.53	372.40	0.097	0.00	5.64	0	1.18	0.27
5133	6	60401	133	aggregated	32.0	25.0	4.06	1,682	38.99	4.60	2.00	45.59	0.086	0.00	3.68	302	0.67	0.22
5134	6	604021	134	aggregated	0.0	0.0	0.00	0	0.86	0.30	0.16	1.32	0.078	0.00	0.00	0	0.05	0.31
5135	6	604023_e	135	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5136	6	604023_i	136	aggregated	11.3	9.9	2.05	1,630	25.96	15.50	21.35	62.81	0.072	0.00	4.09	114	7.12	0.59
5137	6	60403	137	aggregated	14.6	11.9	2.87	1,639	26.37	14.40	14.57	55.34	0.071	0.00	9.47	0	4.86	0.55
5138	6	60405	138	aggregated	6.4	5.1	1.45	1,592	10.89	5.50	12.49	28.88	0.071	0.00	0.46	30	4.16	0.56
5139	6	605	139	aggregated	20.6	16.1	4.61	1,673	21.72	6.00	1.71	29.43	0.093	0.00	10.17	0	0.57	0.19
5140	6	606	140	aggregated	11.1	8.7	3.74	1,660	58.60	7.50	6.92	73.01	0.073	0.00	16.63	161	2.31	0.25
5141	6	607	141	aggregated	0.0	0.0	0.00	0	3.24	0.80	0.77	4.81	0.082	0.00	0.00	0	0.26	0.20
5142	6	608	142	aggregated	53.4	42.7	8.33	1,596	122.48	21.80	53.90	198.18	0.072	0.00	144.85	1,580	17.97	0.77
5143	6	609	143	aggregated	0.0	0.0	0.00	0	0.11	0.20	0.11	0.42	0.078	0.00	0.00	0	0.04	0.09
5144	6	610	144	aggregated	14.0	10.9	1.67	1,608	46.15	12.20	38.69	97.04	0.072	0.00	13.15	700	12.90	0.74
5150	6	699	150	aggregated	0.0	0.0	0.00	0	10.12	4.30	6.93	21.35	0.073	0.00	0.00	0	2.31	0.30

Source: JICA Project Team

Scenario-B

SN	HA	SHA	SN-SHA	Dams					Groundwater					Sub-surface	Surface Water			
				Name	Gross Storage Volume (MCM)	Active Storage Volume (MCM)	Surface Area (km2)	Evapo-ration (mm/year)	Municipal (MCM/y)	Irrigation (MCM/y)	Agri (L&A) (MCM/y)	Total (MCM/y)	Return Rate of Municipal (-)	Fadama (MCM/ year)	Municipal (MCM/y)	Irrigation (ha)	Agri (L&A) (MCM/y)	Reduction Rate by L&A (%)
5127	6	60001	127	aggregated	0.0	0.0	0.00	0	20.46	2.20	6.63	29.29	0.095	0.00	0.00	0	2.21	0.22
5129	6	601	129	aggregated	0.0	0.0	0.00	0	1.60	1.00	0.36	2.96	0.078	0.00	0.00	0	0.12	0.20
5130	6	602_e	130	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5131	6	602_i	131	aggregated	5.5	4.3	0.15	1,710	9.44	8.60	3.05	21.09	0.078	0.00	0.81	250	1.02	0.33
5132	6	603	132	aggregated	6.4	5.0	1.50	1,660	124.99	3.40	3.53	131.91	0.095	0.00	5.64	0	1.18	0.27
5133	6	60401	133	aggregated	32.0	25.0	4.06	1,682	28.34	4.60	2.00	34.94	0.081	0.00	3.68	302	0.67	0.22
5134	6	604021	134	aggregated	0.0	0.0	0.00	0	0.86	0.30	0.16	1.32	0.078	0.00	0.00	0	0.05	0.31
5135	6	604023_e	135	aggregated	0.0	0.0	0.00	0	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0	0.00	0.00
5136	6	604023_i	136	aggregated	11.3	9.9	2.05	1,630	25.96	15.50	21.35	62.81	0.072	0.00	4.09	114	7.12	0.59
5137	6	60403	137	aggregated	14.6	11.9	2.87	1,639	26.37	14.40	14.57	55.34	0.071	0.00	9.47	0	4.86	0.55
5138	6	60405	138	aggregated	6.4	5.1	1.45	1,592	10.89	5.50	12.49	28.88	0.071	0.00	0.46	30	4.16	0.56
5139	6	605	139	aggregated	20.6	16.1	4.61	1,673	10.46	6.00	1.71	18.17	0.087	0.00	10.17	0	0.57	0.19
5140	6	606	140	aggregated	11.1	8.7	3.74	1,660	58.48	7.50	6.92	72.90	0.073	0.00	16.63	161	2.31	0.25
5141	6	607	141	aggregated	0.0	0.0	0.00	0	2.74	0.80	0.77	4.31	0.079	0.00	0.00	0	0.26	0.20
5142	6	608	142	aggregated	53.4	42.7	8.33	1,596	122.21	21.80	53.90	197.91	0.072	0.00	144.85	1,580	17.97	0.77
5143	6	609	143	aggregated	0.0	0.0	0.00	0	0.11	0.20	0.11	0.41	0.078	0.00	0.00	0	0.04	0.09
5144	6	610	144	aggregated	14.0	10.9	1.67	1,608	46.15	12.20	38.69	97.04	0.072	0.00	13.15	700	12.90	0.74
5150	6	699	150	aggregated	0.0	0.0	0.00	0	10.12	4.30	6.93	21.35	0.073	0.00	0.00	0	2.31	0.30

Source: JICA Project Team

Annex-T 5-3 Water Balance at Representative Points

1601:U.S. of Akute Intake in Ogun R.; 1602: U.S. of Intake for Odomola WTW in Oshun R.

1. Quasi-Natural Flow

Ref Point	$Q_{average}$	Q_{20M}	Q_{50M}	Q_{80M}	Q_{97DS}90%Y
	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1601	102	139	32	3	0.043
1602	75	104	29	4	0.257

2. Storage Dam and Upstream Water Use

Ref Point	Year	Total Storage Volume in Upstream Catchment	Total Surface Water Demand in Upstrem Catchment	Average Flow after Water Use in Upstream	Flow Reduction from Quasi-Natural Flow
		(MCM)	(m3/s)	(m3/s)	(%)
1601	2010	983	0.95	98.3	-4
	2030	1,019	12.42	87.8	-14
1602	2010	154	2.61	70.9	-6
	2030	154	5.71	60.3	-20

3. Water Demand and Supply Capacty

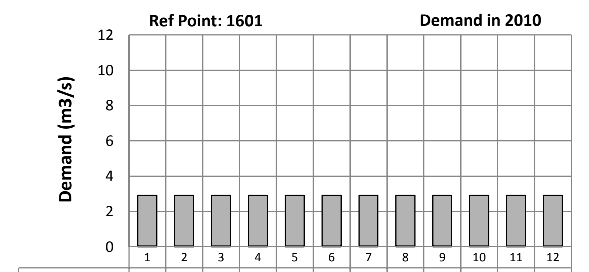
Ref Point	Year	Water Demand for Surface Water									Supply Capacity			
		Env. Flow	Others	Municipal Water Demand	Irrigation Water Demand			Env. Flow + Others +Mun Water Demand	Total Water Demand		90% Year Dependable Flow at the Month with Minimum Demand		80% Year Dependable Flow at the Month with Maximum Demand	
					Ave	Max	Month at max demand		Ave	Max	Quasi-Natural	Regulated	Quasi-Natural	Regulated
		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)		(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
1601	2010	0.04	0.00	2.87	0.00	0.00	Jan	2.91	2.91	2.91	0.17	30.27	1.76	30.27
	2030	0.04	0.00	10.91	0.00	0.00	Jan	10.95	10.95	10.95	0.17	22.37	1.76	22.37
1602	2010	0.26	0.00	0.00	0.04	0.10	Jan	0.26	0.30	0.36	0.22	7.23	3.69	7.26
	2030	0.26	0.00	4.79	0.04	0.10	Jan	5.05	5.09	5.15	0.22	8.09	3.69	8.19

Note: "Others" includes release for groundwater recharge for Fadama.

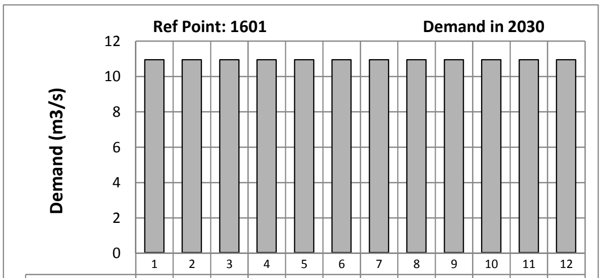
Source: JICA Project Team

Annex-Figure 5

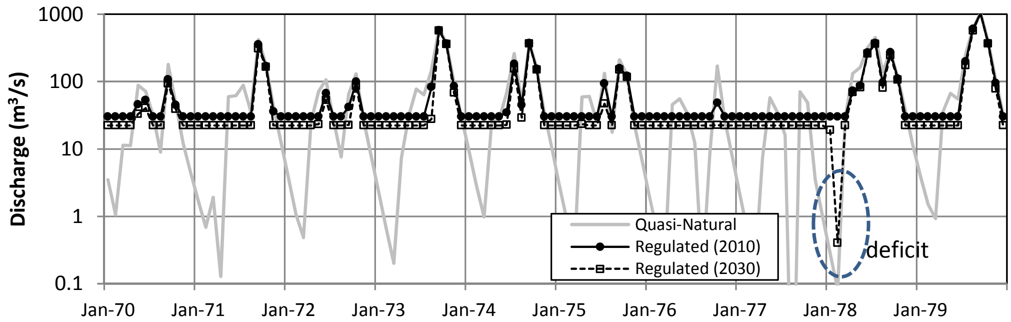
1601: Akute

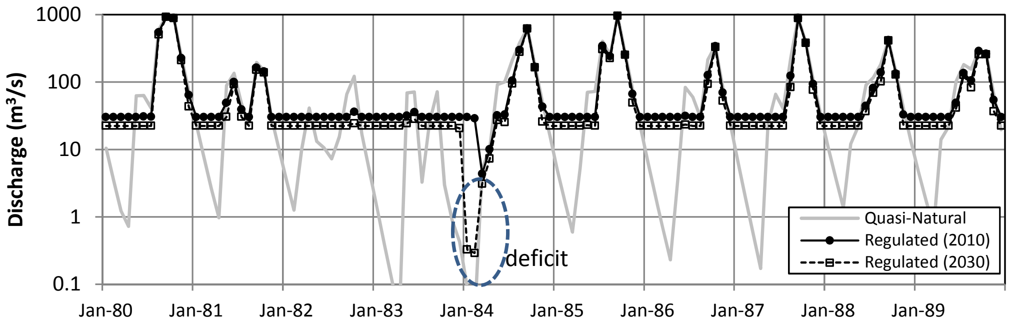


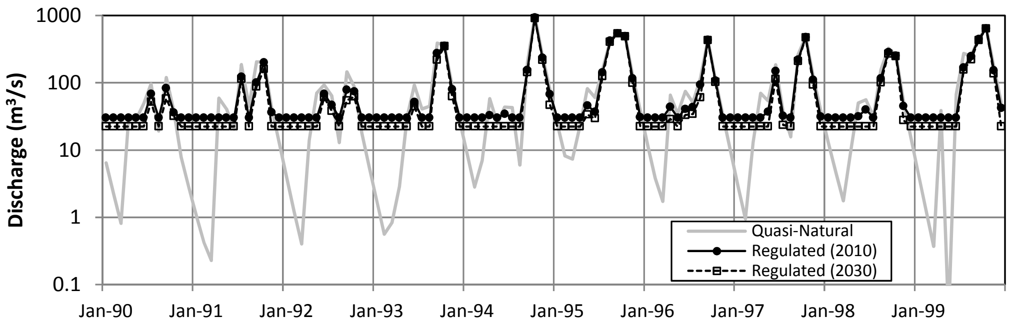
	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

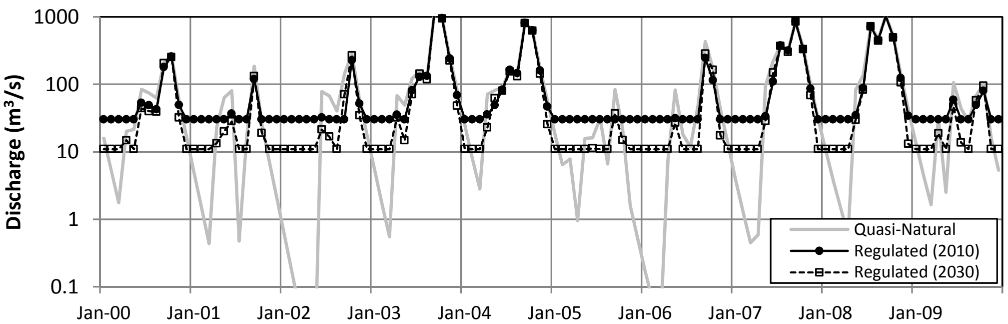


	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91	10.91
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04





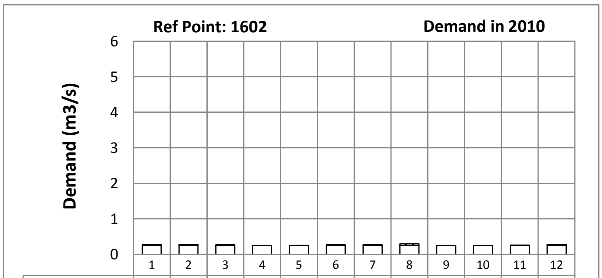




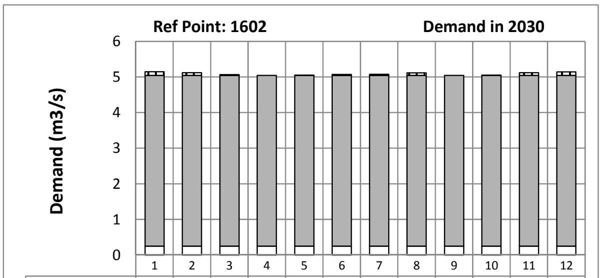
Source: JICA Project Team

Annex-F 5-1 Water Balance at Representative Point (1/2)

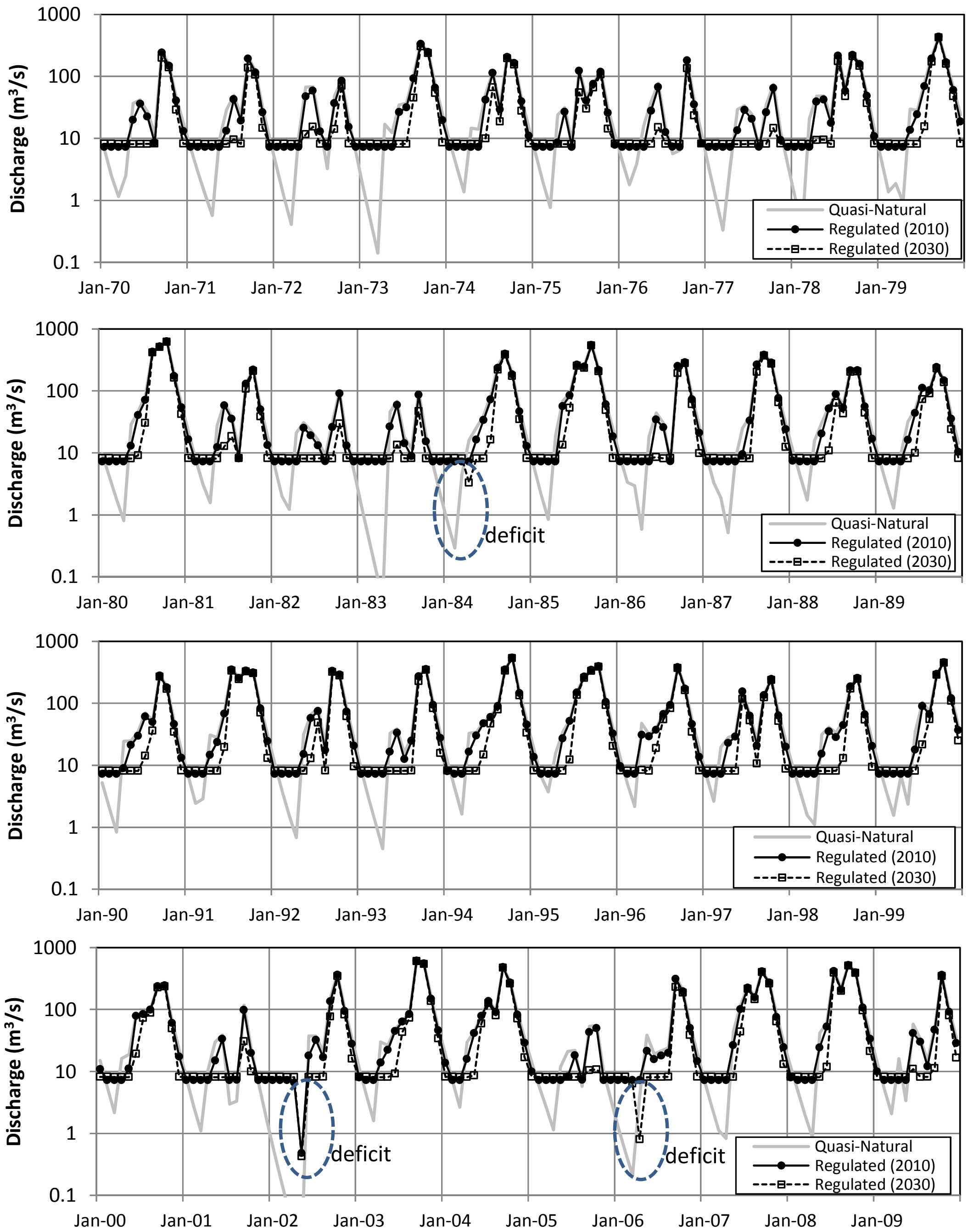
1602: Odomola



	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.03	0.03	0.01	0.00	0.00	0.01	0.02	0.04	0.00	0.00	0.01	0.03
Municipal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26



	1	2	3	4	5	6	7	8	9	10	11	12
Irrigation	0.10	0.08	0.02	0.00	0.01	0.02	0.03	0.07	0.00	0.01	0.08	0.10
Municipal	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79
Fadama & others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MSFR	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26



Source: JICA Project Team

Annex-F 5-1 Water Balance at Representative Point (2/2)

CHAPTER 6 WATER SOURCES DEVELOPMENT PLAN

In the present chapter, the water source development plan is described, referring to the results of water balance study shown in Chapter 5. The strategy of water source development follows the one shown in the M/P2013. During the process of formulation of the CMP, the water demand projection has been reviewed considering the input from stakeholders, and it was reflected to the water balance study. The water source development plan is proposed based on the results of the water balance study. The groundwater and surface water sources development are presented in Section 6.1 and 6.2, respectively. In Section 6.3, water source conservation is further discussed.

6.1 Groundwater Development Plan

6.1.1 Merit of Groundwater Use in Nigeria

Merit of groundwater resources in Ogun-Oshun Basin should be considered as mentioned below:

- Groundwater is stored in aquifer, which is distributed in every place in Nigeria.
- Groundwater can be used even in dry season. In this point, groundwater is superior to surface water and rain-harvesting water.
- Cost of groundwater development and usage is less expensive than that of surface water in case where amount of groundwater development is small. Therefore, groundwater is suitable for rural water supply and small town water supply, which cannot expect large investment.
- Generally, groundwater has better water quality than surface water and does not need high level treatment even for drinking.

On the other hand, groundwater has demerit below:

- Amount of groundwater flow is small compared with amount of groundwater stored in aquifer. Therefore groundwater level will decline regionally when groundwater is extracted more than replenishment (=groundwater recharge). As a result, environmental hazard such as land subsidence and sea water intrusion will take place.

6.1.2 Optimum Method of Groundwater Development

Optimum groundwater development by aquifer of Ogun-Oshun was examined based in groundwater recharge using borehole filed theory. Aquifer of Ogun-Oshun Basin is classified into two types as shown in Table 6-1.

Table 6-1 Aquifer Type

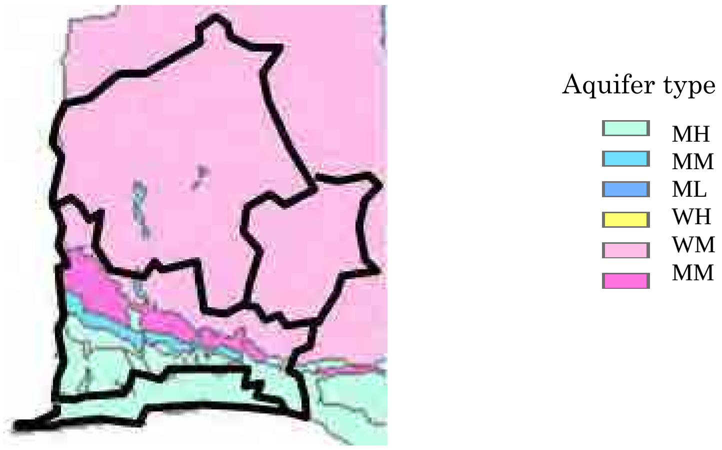
Geology		Model
Basement rock	Weathered rock	Weathered aquifer
Sedimentary rock	Weathered rock	
	Sandstone within alternation of sandstone and shale	Multiple Aquifer

Source: JICA Project Team

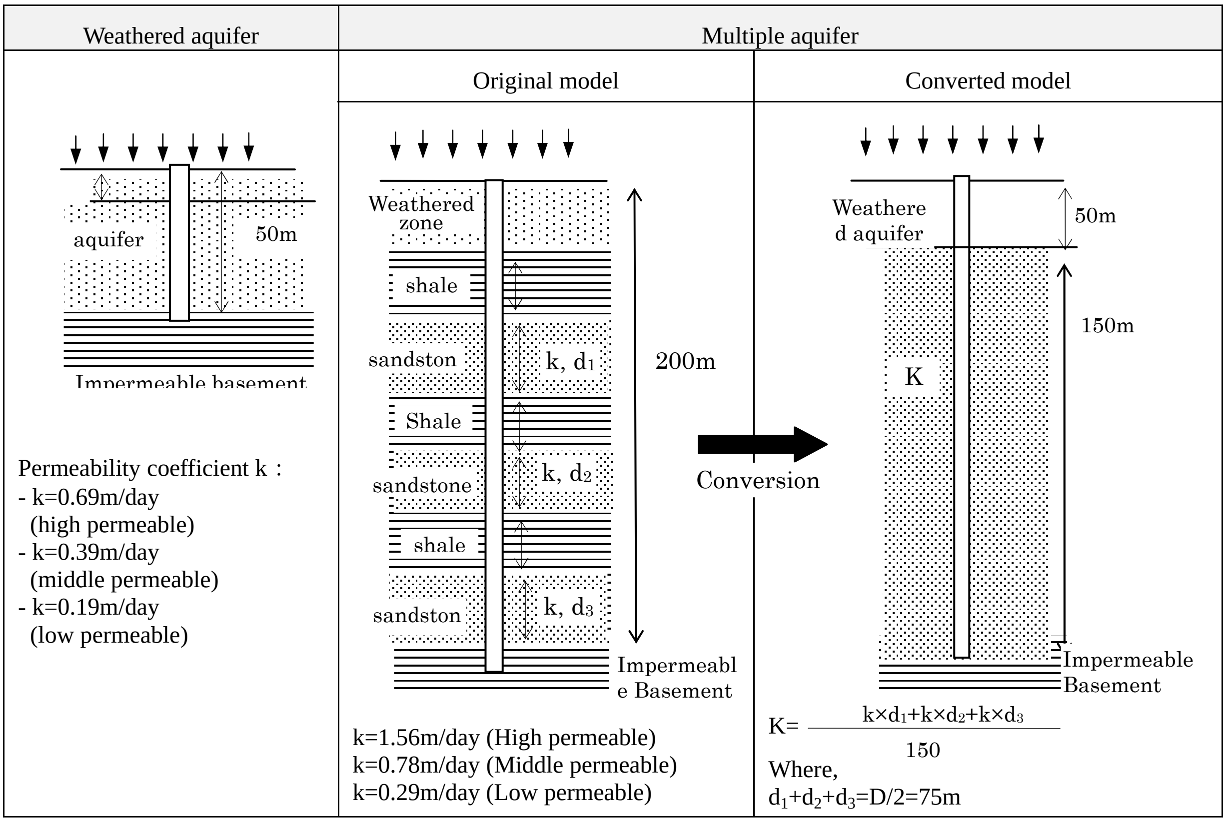
Representative hydrogeological parameters were selected for based on hydrogeological characteristics of weathered aquifer and multiple aquifers as shown in Figure 6-1 and Table 6-2.

Table 6-2 Aquifer Model

Model	Symbol		Aquifer type	Thickness of aquifer	Permeability coefficient (see 7-1)	Static groundwater level
Weathered aquifer	**W**eathered **H**igh permeability	WH	Weathered Basement rock and weathered part of the other type rocks	50m	0.69	GL-10m
	Weathered **M**iddle permeability	WM			0.39	
	Weathered **L**ow permeability	WL			0.19	
Multiple aquifer	**M**ultiple **H**igh permeability	MH	Sandstone or sandy formation within alternation of sandstone and shale	200m	1.56	GL-50m
	Multiple **M**iddle permeability	MM			0.78	
	Multiple **L**ow permeability	ML			0.39	



Source: JICA Project Team



Source: JICA Project Team

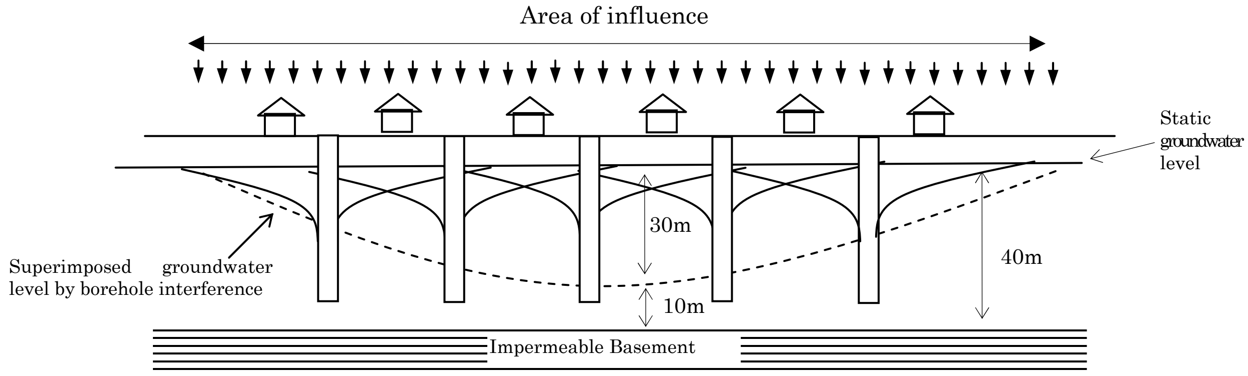
Figure 6-1 Aquifer Model

Amount of current groundwater development and number of the existing boreholes are taken into consideration in estimation of aquifer parameters. Amount of newly available groundwater was calculated for 6 aquifer types shown in Table 6-3, based on groundwater recharge and aquifer parameters, applying borehole field theory.

Limit of pumping

Weathered aquifer: As shown in Figure 6-3, it is assumed that pumping limit happens when distance between impermeable basement rock and the lowest groundwater level is 10m by pumping. It means that draw-down of groundwater level of 30m is set as pumping limit.

Multiple aquifer: Draw-down of 50m is assumed as pumping limit.



Source：JICA Project Team

Figure 6-2 Image of Pumping Limit of Weathered Aquifer

Available yield of borehole field is expressed by the formula in Table 6-3, which is approximated function of i) groundwater recharge, ii) number of boreholes, iii) distance between boreholes.

Table 6-3 Groundwater Development Potential

Aquifer type T: Transmissibity (m^2/day) K: Conductance (m/day) L: Aquifer thickness (m)			Formula to estimate sustainable yield of borehole field(m^3/day) • Number of boreholes in borehole field (N) • Groundwater recharge (P, mm/year) • Distance between boreholes (D, m)		Yield per Borehole (m^2/day)	
		T=K*L	One borehole	More than 2 boreholes	Average	Range
WH	**W**eathered **H**igh permeability	62	$Y=11.08\times T\times P^{0.06}$	$Y=T\times(0.74+0.43)\times N^{0.53}\times P^{0.25}\times D^{0.47})$	480	100-1,000
WM	**W**eathered **M**iddle permeability	31			380	300-500
WL	**W**eathered **L**ow permeability	16			150	100-300
MH	**M**ultiple **H**igh permeability	104	$Y=13.58\times T\times P^{0.05}$	$Y=T\times(0.81+1.20\times N^{0.42}\times P^{0.20}\times D^{0.37})$	990	700-1,500
MM	**M**ultiple **M**iddle permeability	58			560	500-900
ML	**M**ultiple **L**ow permeability	29			280	200-500

Source：JICA Project Team

Optimum groundwater development plan was proposed using formula on Table 6-3, which was applied to groundwater recharge of 6 aquifers classified for Ogun-Oshun Basin Optimum groundwater development means that amount of groundwater recharge will be pumped up efficiently within influence area, by optimizing borehole distribution and yield of each borehole.

6.1.3 Groundwater Development Plan by Aquifer

(1) Basic Policy

Basic policy of groundwater development is as follows:

- Groundwater development should be sustainable in view pint of water balance
- Groundwater development should be efficient in economic view point

Groundwater will be developed for water supply, private irrigation, livestock and aqua-culture. Policy for groundwater development for each water use sector is as follows:

(2) Municipal Water Supply

(2-1) Distribution of Water Demand

Groundwater will be developed in large scale for water supply sector than the other sectors. Therefore, groundwater development will be planned in detail for LGA by LGA based on groundwater demand of each LGA.

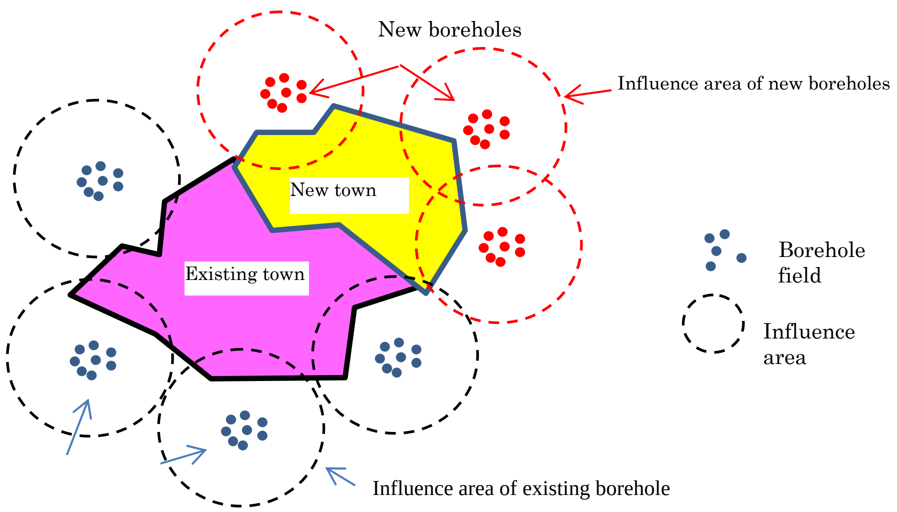
(2-2) System for Groundwater Development

System for groundwater development is proposed as shown in Table 6-4.

Table 6-4 System of Groundwater Development

Classification	System of groundwater development
Urban/semi-urban, small town	Well fields will be constructed around urban/semi-urban/small town area, supplying water by independent water supply system with well field. See Figure 6-3.
Rural	Boreholes will be constructed individually for water supply for communities using hand-pumps and motorized pumps. Ratio between hand pumps and motorized pumps is estimated as 4:6. This ratio is assumed to be kept until year of 2030.

Source: JICA Project Team



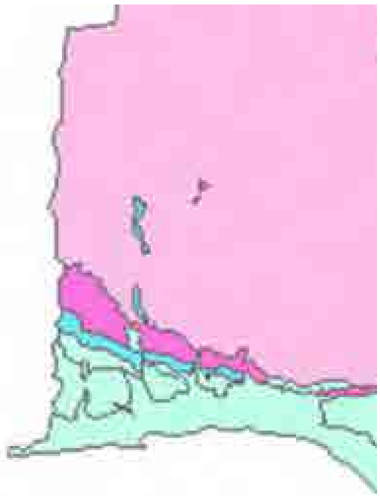
Source: JICA Project Team

Figure 6-3 Image of Municipal Water Supply by Borehole Field

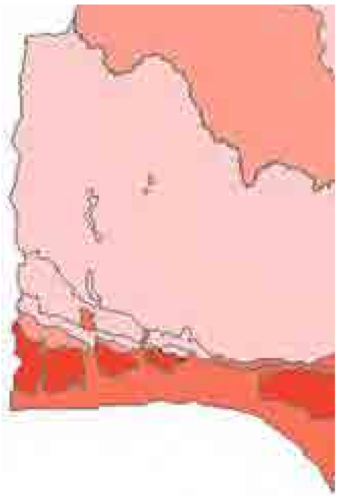
Borehole field will be planned for each LGA, with image shown in Figure 6-4. Design parameters by this Project are below:

- Number of borehole fields by LGA
- Available yield from each borehole fields
- Number of boreholes in each borehole field

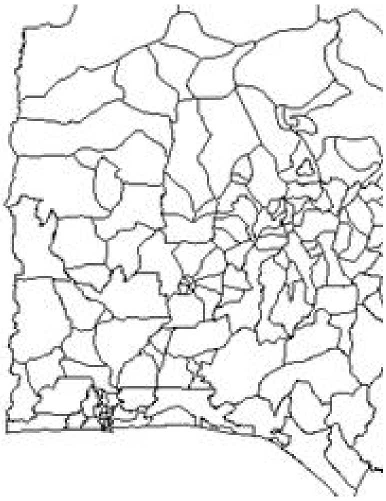
Factors to be considered in planning borehole field are shown in Figure 6-5.



Aquifer classification



Groundwater recharge



Water demand by LGA for water supply (by LGA)

Water demand by State for private (by State)

Source: JICA Project Team

Figure 6-4 Content of Factors to be considered in Groundwater Development Plan

Available yield (Y) and number of boreholes (N) were estimated from three (3) factors: i) type of aquifer, ii) groundwater recharge (P) and iii) distance between boreholes (D), using relationship shown in Table 6-5 and Table 6-5.

Table 6-5 Relationship between Geological Formation and Aquifer Type of Ogun-Oshun Basin

Formation	Aquifer type
Alluvial Sediments	MH
Benin Formation	MH
Ilaro Formation	MH
Ogwashi-Asaba Formation	WM
Abeokuta Formation	MM
Basement Complex	WM

Source: JICA Project Team

(2-3) Condition of Borehole Field Planning

Optimum yield of borehole filed

As shown in Figure 6-4, borehole filed will expand with population growth of cities/towns. It should be noticed that number of boreholes can be set minimum in entire Ogun-Oshun Basin by giving optimum yield to each borehole field, which depends on capacity of aquifer. This project proposed optimum yield of borehole fields by aquifer type. The result of analysis for optimum yield is shown in Table 6-6.

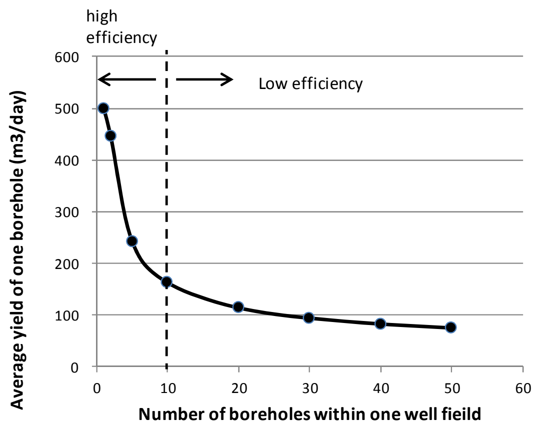
Table 6-6 Optimum Yield of Borehole Field

Aquifer type	Urban/small urban/small town		Rural*			
	Motorized pump		Motorized pump		Hand pump	
	Optimum yield of boreholes field (m^3/day)	Population to be supplied (persons)	Optimum yield of boreholes field (m^3/day)	Population to be supplied (persons)	Independent borehole (m^3/day)	Population to be supplied (persons)
WH	1,000	10,000	Less than 150	Less than 5,000	10	Less than 300
WM	500	5,000				
WL	400	4,000				
MH	1,500	15,000				
MM	1,000	10,000				
ML	900	9,000				

Remarks
*: Optimum borehole yield for rural water supply will be decided not by aquifer capacity but by community population.
Source: JICA Project Team

Number of boreholes by borehole filed

As number of boreholes increases, available yield from each borehole will decrease as shown in Figure 6-6. Therefore, 10 boreholes should be max in each borehole filed for high efficiency in economical view point.



Source: JICA Project Team

Figure 6-5 Number of Boreholes and Yield from each Borehole in Borehole Filed

Limitation by groundwater recharge

For sustainable groundwater development, amount of groundwater development should be less than amount of groundwater recharge within each LGA. On the other hand, if groundwater development is larger than groundwater recharge within LGA, additional consideration is necessary.

Borehole specification

Borehole specification is shown in Table 6-7. Borehole specification depends on aquifer type. Important point in specification is summarized below.

- Borehole length is set as 50m in the Basement Rock area.
- In the Sedimentary rock area, Borehole length will be between 50-600m depending on geological condition at place by place. However, in this Project, borehole length is set as 200m to deal the entire Nigeria by simplified and unified way in hydrogeological view point.
- Borehole diameter should be 6 inch for motorized pump and 4 inch for hand pump. However, in this Project 6 inch diameter is recommended even for hand pumps borehole. This is for future change of pump type from hand pump to motorized pump in rural water supply.

Table 6-7 Borehole Specification

Aquifer type	Urban/small urban/small town		Rural			Note
	Motorized pump		Motorized pump	Hand pump	Borehole diameter (inch)	
	Borehole depth (m)	Borehole diameter (inch)	Borehole depth (m)	Borehole diameter (inch)		
WH	50	6	50	50	6	Distance between boreholes in borehole filed is 200m
WM	50	6	50	50	6	
WL	50	6	50	50	6	
MH	200	6	200	50	6	
MM	200	6	200	50	6	
ML	200	6	200	50	6	

Source: JICA Project Team

(2-4) Borehole Construction Plan

Current yield

For planning of new borehole construction, the current yield from existing boreholes must be known. The current yield from the existing boreholes by state in Ogun-Oshun Basin is shown in Table 6-8.

Table 6-8 Yield of existing Boreholes

State	Urban/small urban/small town	Rural	
	Motorized pump	Motorized pump	Motorized pump
	m^3/day	m^3/day	m^3/day
Lagos	1,142,528	2,619	5,456
Ogun	231,094	14,301	1,056
Osun	121,265	30,226	2,867
Oyo	305,109	37,604	7,644

Source: JICA Project Team

Relationship between yield by rehabilitated boreholes and newly drilled borehole

Amount of groundwater by newly drilled boreholes will be estimated form relationship below, considering available yield by borehole rehabilitation

Amount of groundwater by newly drilled boreholes	=	Amount of groundwater to be developed by 2030	-	Amount of groundwater by rehabilitated boreholes

Project Team used the number of boreholes which can be rehabilitated by state based on the result of survey by local contract. Available yield from rehabilitated borehole was estimated as same as the average yield of existing boreholes.

Table 6-9 Amount of Groundwater by Newly Drilled Boreholes and by Borehole Rehabilitation

State	Amount of groundwater to be developed by 2030		Amount of groundwater by rehabilitated boreholes		Amount of groundwater by newly drilled boreholes		
	Urban/small urban/small town	Rural	Urban/ small urban/ small town	Urban/small urban/small town	Rural	Urban/ small urban/ small town	
					Motorized pump	Motorized pump	Hand pump
	m^3/day	m^3/day	m^3/day	m^3/day	m^3/day	m^3/day	m^3/day
Lagos	0	10,676	0	4,949	0	3,436	2,291
Ogun	0	49,617	0	11,120	0	23,098	15,399
Osun	157,308	48,011	78,654	24,007	78,654	14,403	9,602
Oyo	293,193	77,890	146,597	30,165	146,597	28,635	19,090

Source: JICA Project Team

Borehole drilling plan

Based on method explained above, optimum borehole construction plan was examined by LGA and finally arranged by State as shown in Table 6-10. Two matters below should be noticed.

- Number of newly drilled boreholes should be estimated considering water demand growth rate and borehole operation rate (80%).
- Amount of yield by rehabilitated boreholes should be less than 50% of total amount groundwater to be developed by 2030.

Table 6-10 Number of newly Drilled Borehole and Rehabilitated Boreholes to meet Water Demand of 2030

State		Number of newly drilled borehole							Number of rehabilitated borehole		
		Urban/small urban/small town			Rural				Urban/small urban/small town	Rural	
		Motorized pump			Motorized pump			Motorized pump	Motorized pump	Motorized pump	Motorized pump
		200m	50m	total	200m	50m	total				
24	Lagos	0	0	0	33	0	33	286	0	1	334
27	Ogun	0	0	0	154	73	226	1,925	0	12	76
29	Osun	0	235	235	0	140	140	1,200	67	19	208
30	Oyo	6	424	430	6	251	258	2,386	160	27	510

Source: JICA Project Team

Number of newly drilled boreholes for motorized pump is 15,361 for water supply of urban/small urban/small town, 9,105 for rural water supply. On the other hand, number of hand pumps is 82,538 for rural water supply.

(3) Private Irrigation, Livestock and Aquaculture

Method for groundwater development for private irrigation, livestock and aqua-culture is shown in Table 6-11. It is assumed that groundwater will be developed by not well field but single well in those sectors.

Table 6-11 Method of Groundwater Development

Classification	Method for groundwater development
Private irrigation	Groundwater development by single boreholes
Live stock	Groundwater development by shallow hand-dug well
Aquaculture	Groundwater development by single boreholes

Source: JICA Project Team

(3-1) Distribution of Water Demand

It is assumed that groundwater demand is distributed equally within State of Ogun-Oshun Basin. Number of boreholes is estimated considering aquifer capacity within State. It means that many boreholes are necessary in low capacity aquifer, and on the contrary few boreholes are enough in high capacity aquifer.

(3-2) Available Yield by Aquifer

Available yield (Y) by aquifer is estimated using Table 6-12.

Table 6-12 Aquifer Type and Sustainable Yield

Aquifer type	Available yield (m^3/day)		
	Private irrigation	Live stock	Aqua culture
WH	100	10	100
WM	50	10	50
WL	10	10	10
MH	200	10	200
MM	100	10	100
ML	50	10	50

Source: JICA Project Team

(3-3) Borehole Drilling Plan

Based on the method explained above, borehole drilling plan was proposed as shown in Table 6-13.

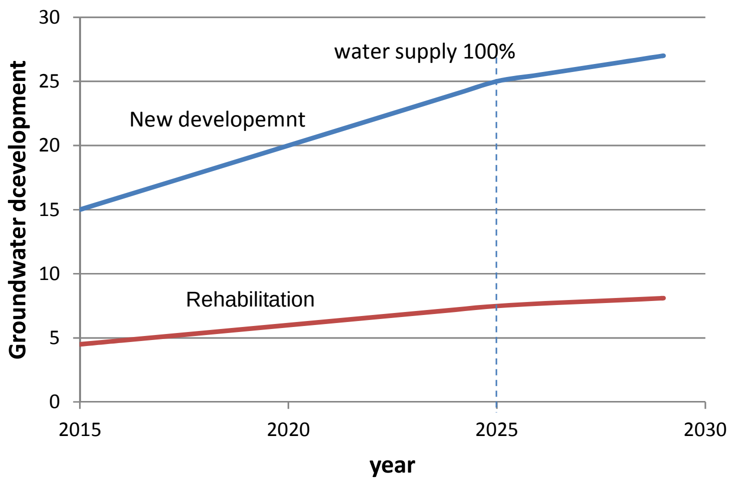
Table 6-13 Number of Boreholes to Meet Water Demand in 2030 of Private Irrigation, Livestock and Aquaculture

No	State	Private irrigation	Live stock	Aqua -culture
24	Lagos	42	127	61
27	Ogun	1,713	76	120
29	Osun	577	64	99
30	Oyo	1,507	333	1,395

Source: JICA Project Team

6.1.4 Project Implementation Schedule

After the preparation period of in 2014, groundwater development will be implemented from 2015 to 2025 with the same rate to attain 100% water supply in 2025. Then, groundwater will be continuously developed keeping 100% water supply until 2030 with same development rate. Image of groundwater development is shown in Figure 6-7.



Source: JICA Project Team

Figure 6-6 Image of Groundwater Development by step

Table 6-14 Number of Rehabilitated Borehole by Year

State	Urban/small urban/small town	Rural	State
	Motorized pump	Motorized pump	hand pump
Lagos	0	0	22
Ogun	0	1	5
Osun	5	1	14
Oyo	11	2	34
Total	16	4	75

Source: JICA Project Team

Table 6-15 Numbers of boreholes to be drilled in a year

State	Urban/small urban/small town			Rural			
	Motorized pump			Motorized pump			hand pump
	200m	50m	Total	200m	50m	Total	
Lagos	0	0	0	2	0	2	19
Ogun	0	0	0	10	5	15	128
Osun	0	16	16	0	9	9	80
Oyo	1	28	29	1	17	18	159
Total	1	44	45	13	31	44	386

Source: JICA Project Team

6.2 Surface Water Development Plan

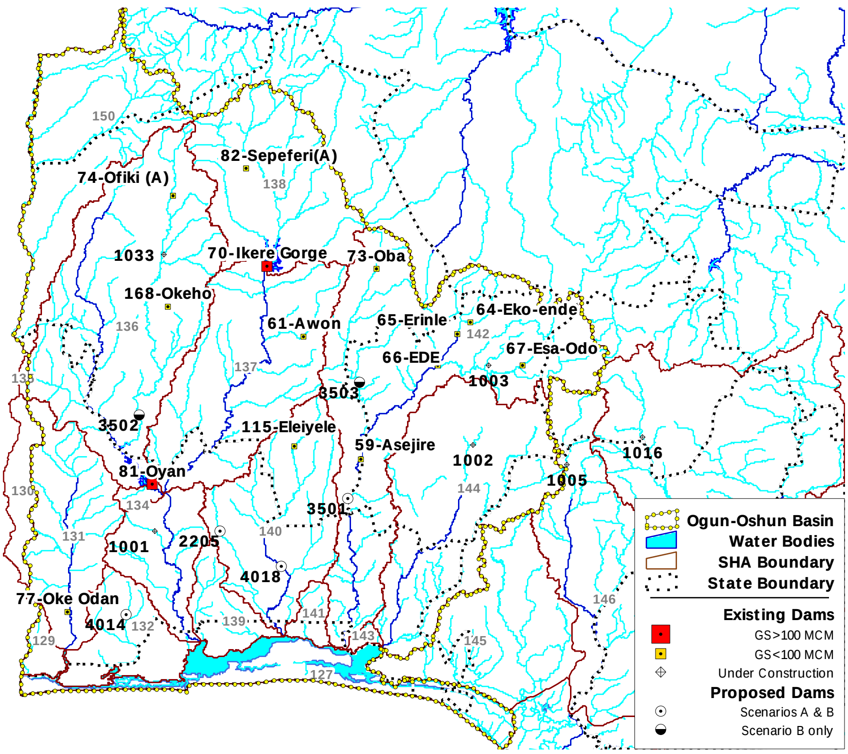
6.2.1 Existing Surface Water Development Facilities

The total number of existing dams in Ogun-Oshun Basin, which the project could confirm, is 37. The list and location of these dams are shown in Annex-T 6-1 and Annex-F 6-1. Among these dams, the outline of the dams whose storage capacity is more than 10MCM and water balance is examined in Chapter 5 is shown in Table 6-16. The location of these dams is shown in Figure 6-8.

Table 6-16 Major Dams in Ogun-Oshun Basin

SN	SHA	SN-SHA	Name	State	Owner	Drainage Area (km^2)	Inflow (MCM / year)	Height of dam (m)	Gross storage (MCM)	Effective storage (MCM)	Reservoir area (km^2)	Purpose*
70	**60405**	**138**	**Ikere Gorge**	**Oyo**	**OORBDA**	**4,704**	**754.0**	**55.00**	**690.0**	**565.0**	**53.00**	**IR,WS,HP,FI**
81	**604023_i**	**136**	**Oyan**	**Ogun**	**OORBDA**	**9,113**	**1,241.0**	**30.44**	**270.0**	**265.0**	**40.00**	**IR,WS,HP,FI**
65	**608**	**142**	**Erinle**	**Osun**	**SWB**	**1,220**	**265.6**	**27.00**	**94.0**	**92.5**	**17.20**	**WS, FI**
59	**608**	**142**	**Asejire**	**Oyo**	**WCOS**	**7,646**	**1,773.1**	**26.20**	**32.9**	**30.5**	**5.60**	**WS**
61	**60403**	**137**	**Awon**	**Oyo**	**WCOS**	**454**	**71.7**	**13.10**	**10.0**	**8.4**	**1.90**	**WS**
67	**608**	**142**	**Esa-Odo**	**Osun**	**WCOS**	**1,193**	**356.0**	**15.00**	**8.2**		**0.13**	**WS**
115	**606**	**140**	**Eleiyele**	**Oyo**	**WCOS**	**321**	**74.9**	**2.44**	**7.0**	**5.5**	**2.10**	**WS**
77	**602_i**	**131**	**Oke Odan**	**Ogun**	**OORBDA**	**71**	**9.2**	**10.00**	**5.5**		**0.15**	**WS**
64	**608**	**142**	**Eko-ende**	**Osun**	**WCOS**	**537**	**124.7**	**13.70**	**5.5**	**5.3**	**0.94**	**WS**
66	**608**	**142**	**Erinle(EDE)**	**Osun**	**SWB**	**1,466**	**319.3**	**10.50**	**5.3**		**1.60**	**WS**
73	**608**	**142**	**Oba**	**Oyo**	**WCOS**	**341**	**61.8**	**13.40**	**4.6**	**4.1**	**1.40**	**WS**
82	**60405**	**138**	**Sepeferi(A)**	**Oyo**	**OORBDA**	**3**	**0.3**	**13.60**	**2.6**	**2.4**	**0.14**	**IR,WS**
74	**604023_i**	**136**	**Ofiki (A)**	**Oyo**	**OORBDA**	**11**	**1.4**	**12.60**	**1.3**	**1.2**	**0.50**	**IR,WS**
168	**604023_i**	**136**	**Okeho**	**Oyo**		**21**	**3.5**	**10.00**	**0.8**			
78	**608**	**142**	**Okuku**	**Osun**	**SWB**	**3**	**0.6**	**10.40**	**0.7**		**0.22**	**WS**

*Purpose: FC=Flood control, IR=Irrigation, WS=Urban Water Supply, HP=Hydropower, FI=Fishery, OT=Others
Source: JICA Project Team



Source: JICA Project Team

Figure 6-7 Location of Major Dams in Ogun-Oshun Basin

The total storage capacity of the existing dams in Ogun-Oshun Basin is 1.16BCM. These are mainly used for irrigation and municipal water supply.

According to dam department of FMWR, the number of dams under construction in Ogun-Oshun Basin is 4 and their total storage volume is 0.75MCM (see Table 6-17). The details and the location are shown in Annex-T 6-1 and Annex-F 6-1.

Table 6-17 Dams under Construction in Ogun-Oshun Basin

SN	Name of dam	State	Year of Contract	Project Cost (Bil. Naira)	Gross Storage (MCM)	Remarks
1001	Owiwi	Ogun	2005	6.90	30.0	Dam body completed
1002	Ile-Ife	Osun	2004	3.74	14.0	Dam 75% completed
1003	Ilesha	Osun	2005	2.44	25.0	Dam 55% completed
1033	Igbojaye	Oyo			5.6	

Remarks: as of 2011
Source: FMWR

6.2.2 Management Status of Major Dams

During the process of the formulation of the M/P2013, the survey on the management status of the major dams was conducted. The survey contains the collection of dam operation data as well as interview on the outline of the current condition of dam and reservoirs. The details on the survey are presented in Item (2) of Section SR4.2.2, Volume-5 Supporting Report. The followings are noted from the survey.

- Dam operation data in major dams in Ogun-Oshun Basin are not sufficient to examine the condition of the operation. Many dams do not keep even reservoir water level data.
- It is pointed out that there are problem of sedimentation and nuisance growth of algae and aquatic vegetation in reservoirs. However, the data to discuss these are not sufficient.
- There are no big problems on equipment for operation of gate in many dams.
- The equipment of hydrological observation is not functional in many dams.

It is strongly recommended that the study on the condition of reservoirs of the major dams in Ogun-Oshun Basin including water quality be conducted urgently.

6.2.3 Strategy and Proposed Projects on Surface Water Development in the M/P2013

The strategy on surface water development is set in the M/P2013 as shown in Table 6-18.

Table 6-18 Strategy on Surface Water Development

Objective	Strategy
Effective Utilization of Existing Dams	Many of the existing dams do not keep their original functions, because of lack of proper operation and maintenance including management of information on reservoir operation. It is necessary to revive these dams urgently, for preparing the expected increase in the water demand. The followings are considered. ● Enhancement of dam management, including preparation of manual for dam management ● Rehabilitation of dams ● Enhancement of dam operation
Preparation of Sufficient Surface Water Source to Address Increasing Water Demand in Consideration of Unevenly Distributed Water Resources in the Country	The necessary water resources development would be proposed by utilizing the proposed dams in M/P1995 as the potential dams as well as the other potential sites. ● By examining water balance for the potential dam sites, efficiency of each site is roughly evaluated. The priority for development should be given to the sites with higher efficiency. ● In the area where water resources is very limited and the future demand is expected to be more than the supply capacity of water source, the demand control such as reduction of the planned irrigation area and/or changing the crop should be considered as one of options for managing the available water, in order to avoid the conflict among water users. ● The integrated development with hydropower generation and irrigation components is proposed in order to promote self-reliant project.

Source: JICA Project Team

The proposed projects in the M/P2013 are shown in Table 6-19, in consideration of the strategy.

Table 6-19 Proposed Surface Water Development Project

Objective	Proposed Project	
Effective Utilization of Existing Dams	1-1	Capacity development of dam management
	1-2	Rehabilitation of equipment for proper operation of major dams
	1-3	Rehabilitation of deteriorated dams
Preparation of Sufficient Surface Water Source to Address Increasing Water Demand in Consideration of Unevenly Distributed Water Resources in the Country	2-1	Surface water development for municipal water supply
	2-2	Surface water development for irrigation development
	2-3	Integrated surface water development

Source: JICA Project Team

6.2.4 Proposed Projects on Surface Water Development in Ogun-Oshun Basin

(1) Effective Utilization of Existing Dams

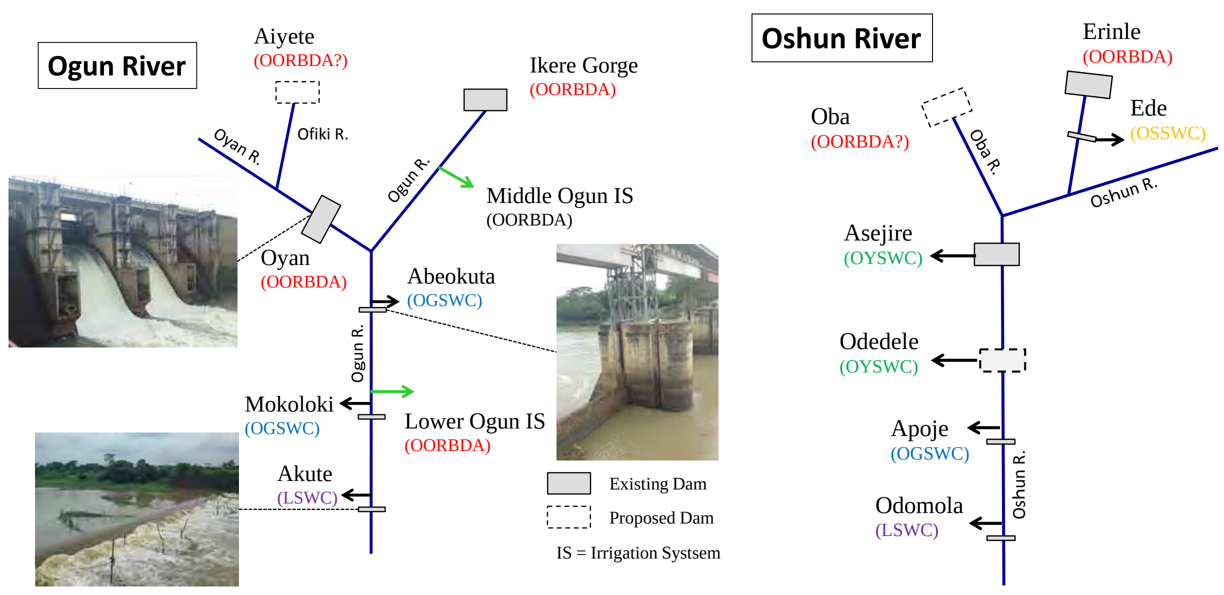
The effective utilization of the existing dams is the important issue in Ogun-Oshun Basin. It would be enhanced, following the strategy in the M/P2013,

Project 1-1: Capacity Development of Dam Management

The direction of improvement of dam management is discussed in Section 8.4.1 as one of important elements of water resources management. This project is to enhance the capacity of dam department of FWMR, as well as dam owners such as RBDAs, SWB on dam management. By this project, the capacity of dam management in Ogun-Oshun Basin is enhanced.

In Ogun-Oshun Basin, further increase in water demand and water resources development is expected. Coordinated operation of water resources facilities should be promoted under the condition which the owner of each facility is different as shown in Figure 6-9.

In Section 8.4.1, the improvement of operation of dams is further discussed with some examples of the existing dams in Ogun-Oshun Basin.



Source: JICA Project Team

Figure 6-8 Major Dams and Intake Facilities in Ogun-Oshun Basin

Project 1-2: Rehabilitation of Equipment for Proper Operation of Major Dams

This project is to rehabilitate the equipment for proper operation of dams such as meteorological, hydrological monitoring, monitoring for reservoir operation.

In order to secure the sustainability of the equipment, the reason why the damage of the equipment occurred would be examined. Then, maintenance plan of the equipment should also be prepared. The integrated usage of monitoring data of river flow by NIHSA and dam operation data by dam owner should be considered.

Most of the equipment for dam operation in Ogun-Oshun Basin is deteriorated. Necessary rehabilitation would be implemented.

Project 1-3: Rehabilitation of Deteriorated Dams

This project is to rehabilitate deteriorated dam which may threaten the downstream area. The rehabilitation would be implemented case by case up to 2030. The detail conditions should be studied for individual dam and accordingly the countermeasure would be implemented.

(2) Preparation of Sufficient Surface Water Source to Address Increasing Water Demand in Consideration of Unevenly Distributed Water Resources

Project 2-1: Surface Water Development for Municipal Water Supply

This project is to prepare stable water source for municipal water supply against the water source where the safety level is expected to be lower than 90% yearly dependability in 2030. On the basis of the results of water balance study shown in Chapter 5, the surface water source development projects shown in Table 6-20 for Scenario-A and 6-21 for Scenario-B are proposed in Ogun-Oshun Basin. The increase in storage volume is 213MCM for Scenario-A and 953MCM for Scenario-B. The locations of the proposed sites are shown in Figure 6-8.

Table 6-20 Surface Water Development for Municipal Water Supply (Scenario-A)

No	Project	HA	State	Water Supply Scheme	SN	H (m)	GS (MCM)
16	Ibu dam project	6	Ogun	Otta Ikosi/Ogere/Shagamu Water Supply Scheme	2205	19	20.6
19	Ota dam project	6	Ogun	Ota Water Supply Scheme	4014	16	6.4
20	Araromi Ake/ Ijebu-Ode-Yemoji dam project	6	Ogun	Ijebu-Ode/Yemoji Water Supply Scheme	4018	12	3.3
23	Odedele dam project	6	Oyo	Odedele/Ibadan Water Supply Scheme	3501	30	182.6

Remarks: SN=Serial number of dam, H=Height of dam, GS=Gross storage
Source: JICA Project Team

Table 6-21 Surface Water Development for Municipal Water Supply (Scenario-B)

No	Project	HA	State	Water Supply Scheme	SN	H (m)	GS (MCM)
16	Ibu dam project	6	Ogun	Otta Ikosi/Ogere/Shagamu Water Supply Scheme	2205	19	20.6
19	Ota dam project	6	Ogun	Ota Water Supply Scheme	4014	16	6.4
20	Araromi Ake/ Ijebu-Ode-Yemoji dam project	6	Ogun	Ijebu-Ode/Yemoji Water Supply Scheme	4018	12	3.3
23	Odedele dam project	6	Oyo	Odedele/Ibadan Water Supply Scheme	3501	30	182.6
101	Aiyete dama project	6	Oyo	Water Supply Scheme for Lagos	3502	53	543.0
102	Oba dam project	6	Osun	Water Supply Scheme for Lagos	3503	22	197.0

Remarks: SN=Serial number of dam, H=Height of dam, GS=Gross storage
Source: JICA Project Team

Project 2-2: Surface Water Development for Irrigation Development

This project is to secure necessary water volume for irrigation development, according to irrigation development plan proposed in the master plan. There is no proposed project for the irrigation project with new dam development in Ogun-Oshun Basin.

Project 2-3: Integrated Surface Water Development

This is an integrated project to combine hydropower generation and irrigation development. This scheme is not proposed in Ogun-Oshun Basin due to the expected increase in municipal water demand in future.

Remarks on Selected Dams Sites

The selection of the dam sites is based on the preliminary study during the formulation of the master plan. It should be noted that the proposed schemes are conceptual level, and thereby further detail study would be required for their implementation.

6.3 Water Resources Conservation Plan

The conservation of water resources may be defined as the various types of activities to be executed by different stakeholders to conserve or protect the water quality and water quantity. Both water resources surface and groundwater must be targeted for conservation.

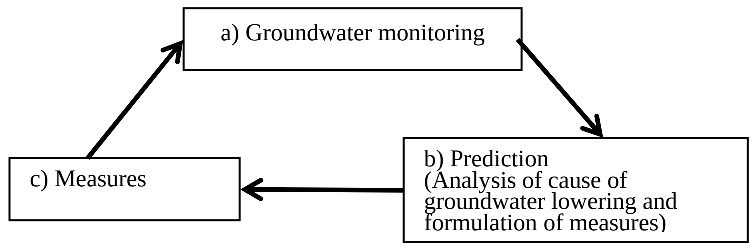
6.3.1 Groundwater Conservation

(1) Purpose and Importance of Groundwater Conservation

Groundwater must be conserved in terms of quantity and quality for sustainable groundwater usage. Groundwater management is indispensable for groundwater conservation.

<u>Quantity conservation</u>

When groundwater is extracted more than groundwater recharge, regional groundwater level lowering will occur, which will cause decrease in pumping yield or drying up of boreholes and land subsidence. To prevent such problems, cycle of a) monitoring, b) prediction and c) measures must be continuously implemented as show in Figure 6-10. NIWRMC and CMO should take responsibility of implementation of the cycle.



Source: JICA Project Team

Figure 6-9 Concept of Groundwater Management Comprising Monitoring, Prediction and Measures

<u>Quality conservation</u>

Groundwater will be contaminated when contaminated surface water infiltrate into aquifer. Moreover, when sea water has intruded into aquifer, groundwater will become salty. Type of groundwater contamination is shown in Table 6-22.

Table 6-22 Type of Groundwater Contamination and Countermeasures

Type of groundwater contamination		Cause	Measures
Man-made contamination	Sea water intrusion into aquifer	Over pumping	Legal control of pumping
	Infiltration of domestic and industrial waste into aquifer	• Lack of sewerage system • Low quality borehole construction work • Illegal dumping waste into borehole	• Improvement of sewerage system • Perfect sealing of borehole casing • Legal control of dumping
Contamination originated from geology	Groundwater contamination by harmful minerals in underground layer	• Shale with salty minerals • Harmful materials by mining activity	Identification of contaminated aquifer and prohibition of extraction from it

Source: JICA Project Team

(2)Method of Groundwater Management for Conservation

Method of groundwater management for conservation should be formulated place by place based on local hydrogeological characteristics and water use condition. However, standard method should be employed as basis of groundwater management for each case. It is proposed that groundwater management should be implemented by NIWRMC and NIHSA for entire Nigeria following the standard method as shown below.

(1) Hydrogeology and groundwater survey and analysis

- Survey on aquifer structure and characteristics
- Analysis of groundwater recharge
- Survey on current groundwater extraction
- Survey on groundwater hazard (groundwater level lowering, sea water intrusion, saline groundwater, groundwater contamination, impact of climate change)
- Survey on groundwater regulation to control groundwater extraction

(2) Water balance model

- Numerical model (aquifer distribution, groundwater recharge condition, groundwater pumping condition)

(3) Groundwater usage and development plan

- Analysis on current water supply and demand balance
- Forecasting future water demand and groundwater development plan
- Examination of feasibility of proposed groundwater development based on groundwater balance
- Examination of conjunction use of groundwater and surface water

(4) Groundwater Development based on M/P and Catchment Management Plan year by year

(5) Groundwater management

- Monitoring of groundwater level and quality related to groundwater development
- Comparison of actual groundwater behavior and predicted one.
- Modification of groundwater development plan if necessary
- Implementation of groundwater regulation such as extraction control based on discussion and agreement among CMO and stakeholders.

Source: JICA Project Team

Figure 6-10 Method for Groundwater Management and Development

Groundwater management plan should take into account of scale of target aquifer. Scale of aquifer can be classified as a) Large, b) Medium, c) Small, d) local, and management method should be decided corresponding to above classification as shown in Table 6-23.

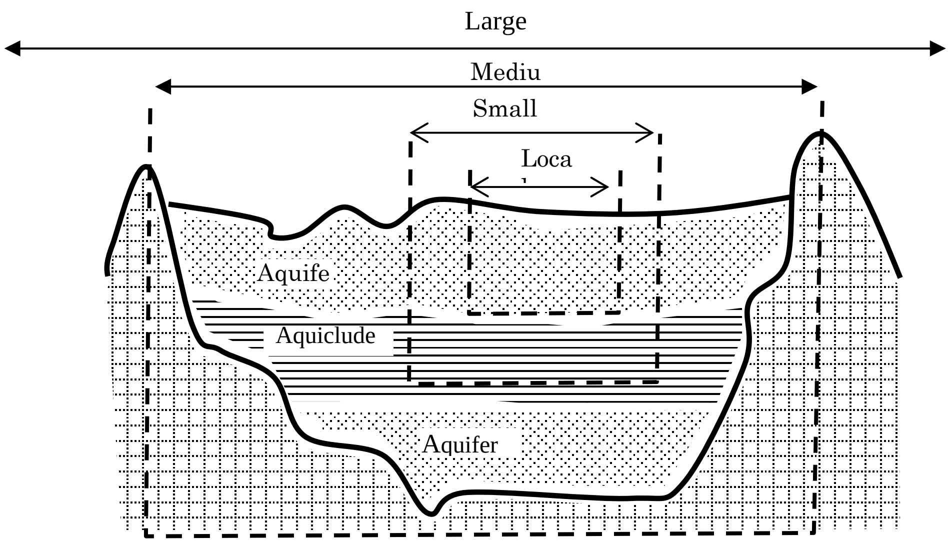
(3) Institutional Issue on Groundwater Management

Institutional improvement is necessary to resolve issues above. NIWRMC should implement activities below.

- Registration of boreholes
- Setting of permissible groundwater level
- Formulation of Groundwater management manual
- Information sharing among organizations in charge of groundwater management and groundwater users.
- Establishment of registration system of borehole drilling company

Table 6-23 Groundwater Management Plan and Responsible Organization

Scale of Area		Plan	Purpose of management	Responsible organization
a) Large	Multiple-Catchment level	• Nationwide M/P • Catchment Management Plan	Groundwater Basin Management	• NIWRMC • CMO • NIHSA
b) Medium	Catchment level	State Management Plan	• Allocation of groundwater extraction • Allocation of borehole density • Measures against groundwater hazard (sea-water intrusion, land subsidence, groundwater contamination)	
c) Small	LGA level			• State Government • LGA
d) Local	Community level		• Securing necessary yield for communities • Setting adequate yields of individual borehole • Setting enough distance among boreholes to prevent borehole interference • Measures against groundwater contamination	



Source: JICA Project Team

6.3.2 Conservation of Surface Water Source

(1) Issues on Conservation of Surface Water Source

The surface water resources need to be conserved from point and non-point sources of pollution. Point sources of pollution are those generated from untreated domestic, industrial and mining wastewater and the leachate generated at the solid waste disposal sites. While non-point sources are those originated from agricultural lands and solid waste that are transported into the water courses by heavy rains. In addition, soil erosion is another important source of sediments that affect directly the surface water.

As shown in Chapter 4, the monitoring for water quality in Ogun-Oshun Basin is not sufficient to grasp the current condition of water quality in surface water body. In order to discuss the water source conservation scientifically, it is indispensable to enhance the water quality monitoring.

Although the current monitoring is not sufficient, the following issues can be pointed out, on the basis of the available observation data, the preliminary assessed pollution load shown in Chapter 4 as well as information provided by stakeholders during stakeholders meeting.

- Based on the available water quality data, it is indicated that the water quality of rivers is in general good condition in both dry and wet seasons in terms of BOD and DO. Continuous monitoring is strongly recommended to assess current situation of water quality.
- Presence of heavy metals had been detected in some rivers that call for further water monitoring research in order to understand their causes.

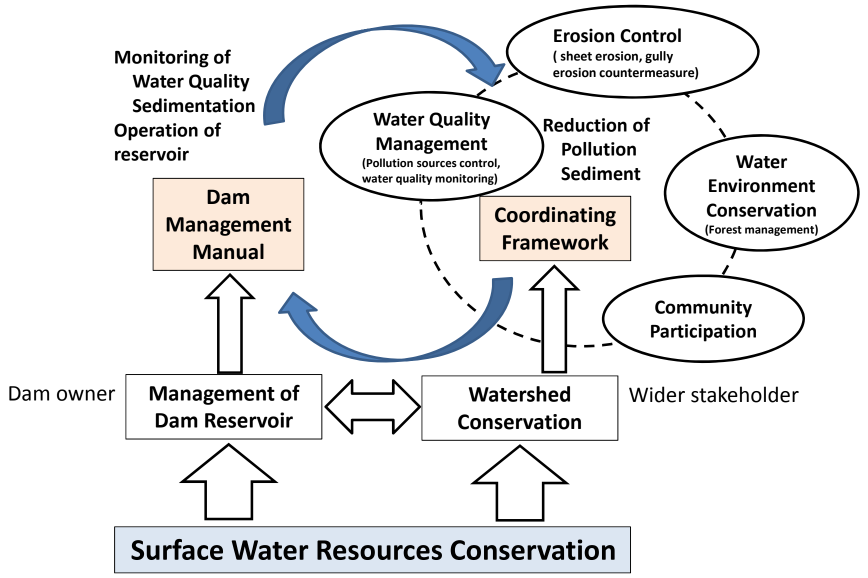
- The domestic pollution source occupies more than 70% in the total pollution load. The reduction of domestic pollution load depends on the progress of sanitation development and its maintenance such as how septage is properly treated.
- Water quality test conducted by Oyo State Water Corporation indicates the presence of E-coli in raw water source in Oshun River. It also indicates the importance of proper treatment of domestic waste water.
- It is important to develop the sanitation facilities as planned and to sustain its function properly, in order to mitigate the pollution load. It is also related to proper waste management.
- It is pointed out by the survey in the project that there are problem of sedimentation and nuisance growth of algae and aquatic vegetation in reservoirs. However, the data to discuss these are not sufficient. It is necessary to conduct the study on the condition of reservoirs.
- Almost all of pollution in Ogun-Oshun Basin finally reaches to the lagoon along coastal area. The fact is that Water Corporation of Lagos State is planning to use the lagoon as a water source in the future; however, according to the Lagos State Ministry of Environment, no holistic study was conducted in the lagoon to determine its suitability, therefore, it is recommended to implement a comprehensive research of the water quality and quantity of the lagoon to decide its potentiality and proper alternatives of treatment for its use

The strategies to address the individual issues are further discussed in the following sections.

- Dam management: Section 8.4.1
- Water environmental management, enhancement of water quality monitoring: Section 8.4.6
- Erosion control, River Management: Section 7.3.2

(2) Proposed Mechanism for Conservation of Surface Water Source

Conservation of surface water resources would be implemented inside dams and reservoirs as well as in a watershed area (see Figure 6-11). Both activities are related each other. The former is a part of the dam management activities, and will thereby be proposed to be enhanced together with the measures for the recovering and upgrading function of the existing dams. This is mainly implemented by dam owners. On the other hand, the latter needs cooperation among wider range of stakeholders in a watershed, which deals with environment management, water quality management, erosion control and so.



Source: JICA Project Team

Figure 6-11 Framework of Conservation of Surface Water Source

(3) Responsibilities of Main Stakeholders in Proposed Mechanism for Conservation of Surface Water Source

The main activities that are identified to be done inside the Dam/Reservoirs and Watershed for conservation of surface water resources are presented in Table 6-24. Likewise, in the same table is shown the main stakeholders and their responsibilities. It is also proposed that NIWRMC be responsible for coordinating the activities by various stakeholders through formulation and implementation of Catchment Management Plan at each hydrological area.

This proposal has been presented in the stakeholders meeting in Ogun-Oshun Basin. However, the discussion on this matter is not enough at this moment. It is necessary to continue the discussion among the stakeholders with wider areas, so as to establish corporative institutional arrangement for implementing proper water source conservation.

Table 6-24 Proposed Responsibility and Activities for Conservation of Surface Water Source

Surface Water Resources Conservation		Responsibility Assignment Matrix: M=Main Responsibility, S=Sub Responsibilities, d=Participation in discussions																									
		dam owner (RBdA, SWB, etc)	**RBdA**	**StateWater Board**	**FMWR (dams division)**	**FMWR (Water Quality & Sanitation division)**	**FMWR (Irrigation &drainage division)**	**NIWRMC**	**NIHSA**	**Ministry of Power**	**NIMET**	**NESREA**	**FME (Pollution Control and Environmental Health)**	**FME (EIA division)**	**FME (Forestry department)**	**FME (Flood & erosion control)**	**FME (Aquatic plant control program)**	**Federal/State Ministry of Health**	**States Ministry of Environment**	**Federal Ministry of Mines**	**Federal Ministry of Trade and Investment**	**Oil Spill Agency**	**National Orientation Agency**	**Farmer Association**	**Industrial Association**	**NGOs**	**Nigerian Citizens (community participation)**
Activities																											
1.	**Management of dam/Receiver**																										
1.1	Proper operation of water release	**M**	S	d	S			S	d	d																	
1.2	Observation of hydro-meteorological condition	**M**	S	d	d			d	S		S																
1.3	Monitoring of water quality and sedimentation	**M**	S	d	d	S		d	S																		
1.4	Removal of weeds	**M**	S	d	d		S										S										
1.5	dredging of sediment	**M**	S	d	S	d								d													
1.6	Inspection of physical-structure condition	**M**	S	d	S																						
1.7	Operation of hydropower station	**M**	S	d	d					S																	
2.	**Watershed Conservation**																										
2.1	Coordination of Watershed Conservation Activities	d	S	d	d	d	d	**M**	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d
2.2	Water Quality Monitoring (water source and drinking water)	d	S	S	d	**M**		d	S	d	d	d	d				d	S	d	d	d			d	d	d	d
2.3	Control of pollution sources (domestic, industrial, agriculture, mining, etc.)	d	d	d	d	d	d	d	d	d	d	**M**	S	d			d	d	S	S	d	d		d	d	d	d
2.4	Water Quality Monitoring (water environment)	d	d	d	d	**M**	d	d	d	d		**M**	d	d			d	d	d	d	d			d	d	d	d
2.5	Erosion control	d	S	d	d	d	d	d	d	d		d	d		S	**M**			S	d				d		d	d
2.6	Weeds Control on Rivers and Channels (excluding navigation)	d	S	d	d	d	d	d				d					**S**		M					d		d	d
2.7	Water environment conservation (forest management)	d	d	d	d			d		d					**M**	d			S	d				d		d	d
2.8	Environmental education & awareness campaign	d	d	d	d	d		d	d			d	d		d	d	d	d	**M**	d			S	d	d	d	d

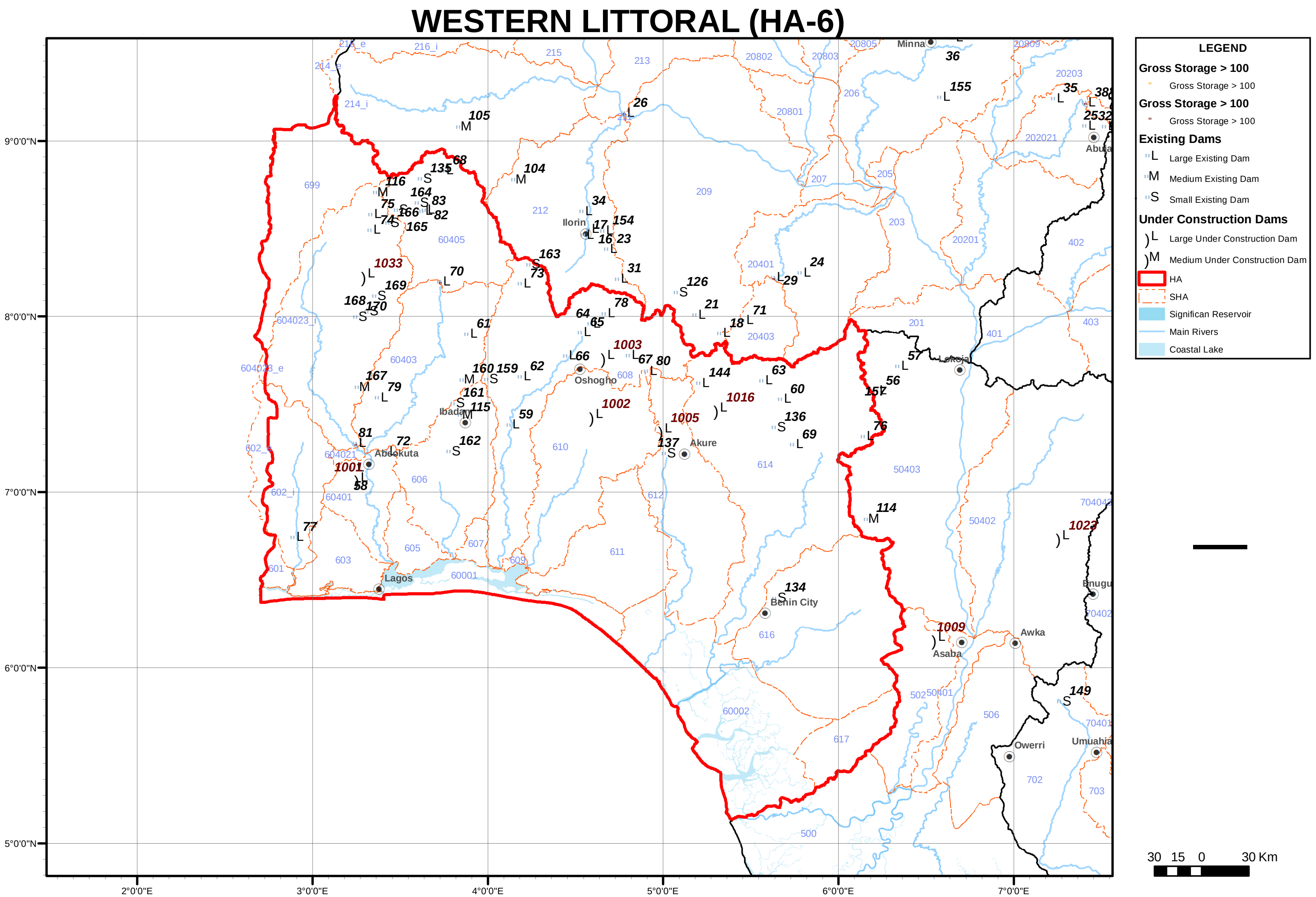
Source: JICA Project Team

Annex-Table 6

Annex-T 6-1 List of Existing and Under-Construction Dams in Ogun-Oshun Basin

SN	SHA	SN-SHA	Name	State	River	Lon	Lat	Owner	Comp. Year	Category	Drainage Area (km2)	Runoff height (mm/ year)	Average Inflow Volume (MCM/ year)	Height (m)	Crest length (m)	Gross Storage (MCM)	Active Storage (MCM)	Dam Type	Spillway Type	Spillway Design Dis. (m3/s)	Res. Area (km2)	Flood Control	Irrigation	Water Supply	Hydoropower	Fishery	Others
58	60401	133	Alagbata	Ogun	Alagbata	3.24407	7.11842	OORBDA	1981	L	14	87.2	1.2	10.00	1,000	1.0		Earthfill			0.05		x	x			
59	608	142	Asejire	Oyo	Osun	4.13314	7.36305	WCOS	1972	L	7,646	231.9	1,773.1	26.20		32.9	30.5	Earthfill + Concrete	Ogee	5,130	5.60			x			
61	60403	137	Awon	Oyo	Awon	3.89230	7.87950	WCOS	1942	L	454	157.9	71.7	13.10		10.0	8.4	Earthfill + Concrete	Ogee	255	1.90			x			
62	608	142	Ayiba(iwo)	Osun	Ayiba	4.19760	7.63690	WCOS	1957	L	56	219.3	12.3	11.56	455	2.6	1.5	Earthfill + Concrete	Ogee	91	0.60			x			
64	608	142	Eko-ende	Osun	Otin	4.59460	7.93707	WCOS	1973	L	537	232.3	124.7	13.70	620	5.5	5.3	Earthfill	Ogee	877	0.94			x			
65	608	142	Erinle	Osun	Erinle	4.53839	7.88925	SWB	1989	L	1,220	217.7	265.6	27.00	677	94.0	92.5	Earthfill	Ogee		17.20			x		x	
66	608	142	Erinle(EDE)	Osun	Erinle	4.45482	7.75597	SWB	1954	L	1,466	217.8	319.3	10.50	236	5.3		Earthfill + Concrete	Ogee	800	1.60			x			
67	608	142	Esa-Odo	Osun	Osun	4.81197	7.75812	WCOS	1977	L	1,193	298.4	356.0	15.00	100	8.2		Hom. Earthfill	Ogee	674	0.13			x			
68	60405	138	Igboho	Oyo	Koisin	3.75547	8.81034	OSADEP	1988	L	114	172.9	19.7	11.00	420	1.2	0.9	Earthfill	Crest type		0.80		x	x			
70	60405	138	Ikere Gorge	Oyo	Ogun	3.73790	8.17718	OORBDA	1991	L	4,704	160.3	754.0	55.00	580	690.0	565.0	Earthfill + Concrete	Ogee	6,850	53.00		x	x	x	x	
72	60401	133	Lekan Are	Ogun		3.43136	7.21030	OORBDA	1982	L	4	148.7	0.6	10.00	1,500	1.0		Earthfill	Ogee		0.19		x	x		x	
73	608	142	Oba	Oyo	Oba	4.19747	8.16584	WCOS	1964	L	341	181.1	61.8	13.40	500	4.6	4.1	Earthfill	Ogee	453	1.40			x			
74	604023_i	136	Ofiki (A)	Oyo	Ofiki	3.34081	8.47072	OORBDA	1983	L	11	131.3	1.4	12.60	580	1.3	1.2	Hom. Earthfill			0.50		x	x			
75	604023_i	136	Ofiki (B)	Oyo	Ofiki	3.34385	8.55996	OORBDA	1961	L	6	137.5	0.8	12.30	550	0.6	0.5	Hom. Earthfill	Ungated		0.16		x	x			
77	602_i	131	Oke Odan	Ogun	Oke Odan	2.89940	6.72280	OORBDA	1995	L	71	129.7	9.2	10.00	525	5.5		Hom. Earthfill	Ungated		0.15			x			
78	608	142	Okuku	Osun	Alabata	4.67478	7.99678	SWB	1942	L	3	211.3	0.6	10.40	360	0.7		Hom. Earthfill	Ungated	175	0.22			x			
79	60403	137	Opeki	Oyo	Opeki	3.38115	7.51759	WCOS	1967	L	588	130.4	76.7	10.50	253	2.6	1.9	Earthfill + Concrete	Ogee	778	0.60			x			
80	608	142	Oshun	Osun	Osun	4.91667	7.66667	OYO WCOYS	1977	L		NA	NA	11.00	730			Earthfill		2,300				x			
81	604023_i	136	Oyan	Ogun	Oyan	3.25563	7.25725	OORBDA	1983	L	9,113	136.2	1,241.0	30.44	1,044	270.0	265.0	Earthfill	Ogee	3,440	40.00		x	x	x	x	
82	60405	138	Sepeferi(A)	Oyo	Owutu	3.64935	8.58517	OORBDA	1984	L	3	106.0	0.3	13.60	685	2.6	2.4	Hom. Earthfill	Ungated weir		0.14		x	x			
83	60405	138	Sepeferi(B)	Oyo	Agbado Osoruwa	3.63615	8.57903	OORBDA	1989	L	9	105.8	1.0	13.50	720	1.9	1.3	Earthfill	Ungated weir		0.32		x	x			
115	606	140	Eleiyele	Oyo	Ona	3.85510	7.41860	WCOS	1942	M	321	233.4	74.9	2.44	235	7.0	5.5	Earthfill + Concrete	Ogee	368	2.10			x			
116	604023_i	136	Fofo	Oyo	Fofo	3.37147	8.68534	WCOS	1966	M	50	170.9	8.5	14.60	262	0.7	0.6	Earthfill + Concrete	Morning Glory	127	0.14			x			
135	60405	138	Ogbooro	Oyo	Ata	3.62591	8.76199	OSADEP	1986	S	13	168.9	2.2	8.00	350	0.3		Hom. Earthfill		7	0.10		x	x			
158	610	144	Ifewara	Osun		4.68645	7.48141		NA	z	9	197.7	1.8								0.20						
159	608	142	Pade	Oyo	Oniyanrin	4.00450	7.62106		1992	S	2	219.8	0.5	9.50	350	0.7											
160	60403	137	Alabata	Oyo	Ose	3.86636	7.61811		2010	M	59	198.8	11.6	11.00	420	2.0											
161	606	140	Akufo	Oyo		3.81458	7.48494		2008	S	0	146.2	0.0	8.50	120	0.1											
162	606	140	Sanusi	Oyo	Seleru	3.79133	7.21056		2007	S	26	169.9	4.3	9.50	250	0.6											
163	608	142	Ajinapa	Oyo	Oniyele	4.24603	8.27508			S	1	181.1	0.2	8.50	250	0.8											
164	60405	138	Ago Amodu	Oyo	Adu	3.60986	8.62567			S	21	107.1	2.3	6.00	200	0.1											
165	60405	138	Oje Owode	Oyo		3.48926	8.58532		1985	S	17	164.5	2.8	7.50	250	0.3											
166	604023_i	136	Ago Are	Oyo	Owo	3.44148	8.51158		1984	S	47	145.8	6.9	8.50	350	0.5											
167	604023_i	136	Ayete	Oyo	Okugba	3.26775	7.57811		1991	M	10	133.9	1.3	11.00	410	1.1											
168	604023_i	136	Okeho	Oyo	Ifo-Ile	3.32139	8.00749		1987	S	21	169.7	3.5	10.00	400	0.8											
169	604023_i	136	Ilero	Oyo	Ipalo	3.36690	8.09567		1984	S	6	138.8	0.9	9.50	250	0.5											
170	604023_i	136	Iganna	Oyo		3.25849	7.97703		1985	S	28	105.9	3.0	7.60	300	0.2											
1101	60401	133	Owiwi	Ogun		3.26758	7.06189		UC	L	168	87.6	14.7	20.00	900	30.0							x	x			
1102	610	144	Ile-Ife	Osun		4.60662	7.42334		UC	L	170	225.2	38.3	19.70		14.0								x			
1103	608	142	Ilesha	Osun		4.67270	7.75820		UC	L	285	249.9	71.2		450	25.0							x	x		x	
1033	604023_i	136	Igbojaye	Oyo	Aye	3.306961	8.222434		UC	L	233	124.4	29.0	18.00		5.6	5.2	Earthfill					x	x			

Annex-Figure 6



Annex-F 6-1 Location of Existing and Under-Construction Dams in HA-1

CHAPTER 7 WATER RESOURCES DEVELOPMENT PLAN

7.1 Water Supply and Sanitation Development Plan

The Project targets major four (4) states of Ogun-Oshun basin for water supply and sanitation development plan because its planning and implementation are under the jurisdiction of State Government.

7.1.1 Basic Concept

Existing water supply facilities in Nigeria have not been utilized as designed as is clear from low production efficiency or operating ratio of the facilities, such as nationwide 45.2% of surface water (water treatment works production-based) and 54.3% of groundwater (borehole number-based), and also 40.3% and 54.7% respectively in major four (4) states In fact, improvement of production efficiency or operating ratio of existing facilities and ensuring its sustainability by appropriate operation and maintenance are keys to boosting water supply coverage.

In order to correspond to increase in future water demand, the Project plans to improve low production efficiency of existing facilities using surface water in the short term and operating ratio of existing facilities using groundwater in the entire period, and furthermore to develop new facilities to be required additionally.

Water Supply development plan consists of the following two major components.

- Rehabilitation scheme of existing facilities
- New construction scheme of facilities (including expansion)

In consideration of sector policies and strategies, water resources potential and water balance between demand and supply in four (4) states, contents of existing State development plans and present water supply services, ongoing projects and plans, the Project will make the sector development plan based on the current status and more practical as much as possible.

7.1.2 State Development Plan

In major four (4) states, namely Lagos, Ogun, Osun and Oyo, the Project could not ascertain presence of comprehensive state water supply and sanitation development plan or equivalent, but confirmed their planning by questionnaires and interviews.

7.1.3 Current Status of Water Supply and Sanitation

(1) Government Institutions on the Water Supply and Sanitation Sector

In principle, responsibilities on project implementation, operation and maintenance of water provision are divided into three (3) tiers of government in Nigeria, such as the Federal, the States and the Local Governments.

Table 7-1 shows involvement of government institutions and community organizations in four (4) states, by water supply categorized into urban, semi-urban / small town and rural (see Section 3-2-2 (1-2)) which are based on population size, and it makes no difference among four (4) states. In fact, it is difficult to categorize actual water supply simply according to settlement type based on population size because of a mixture of water supply on the ground.

Besides, Local Government Councils are in charge of operation and maintenance, or partially implementation, of small town and rural water supply, and community-based organizations such as water supply and sanitation committee are involved in daily operation and maintenance activities.

Table 7-1 Government Institutions and Responsibilities on Water Supply and Sanitation

State	Sector	Organization	Settlement Category			Remarks
			Urban	S.U./S.T.	Rural	
Lagos	Water Supply	State Water Corporation (SWC)	✓	✓		Whole area of state in the future
		State Min. of Rural Development (SMRD)			✓	
	Sanitation	State Min. of Environment (SMEn)	✓	✓		Sewer, solid waste collection, waste-water management
		State Min. of Rural Development (SMRD)			✓	
Ogun	Water Supply	State Water Corporation (SWC)	✓	✓		
		State Min. of Rural Development (SMRD)		✓*	✓	* The target is a part of the area.
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓*	✓	* The target is a part of the area.
	Sanitation	State Min. of Environment (SMEn)	✓	✓*		Sewer, solid waste collection, waste-water management
		State Min. of Rural Development (SMRD)		✓*	✓	* The target is a part of the area.
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓*	✓	* The target is a part of the area.
Osun	Water Supply	State Min. of Water Resources (SMWR)	✓	✓	✓	Governing ministry
		State Water Corporation (SWC)	✓	✓		Mainly surface water
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓	✓	Mainly, groundwater
	Sanitation	State Min. of Environment & Sanitation. (SMEnS)	✓	✓*		Sewer, solid waste collection, waste-water management
		State Min. of Water Resources (SMWR)		✓*	✓	* The target is a part of the area.
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓*	✓	* The target is a part of the area.
Oyo	Water Supply	State Min. of Water Resources (SMWR)	✓	✓	✓	Governing ministry
		State Water Corporation (SWC)	✓	✓		Mainly surface water
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓	✓	Mainly, groundwater
	Sanitation	State Min. of Environment (SMEn)	✓	✓*		Sewer, solid waste collection, waste-water management
		State Min. of Water Resources (SMWR)		✓*	✓	* The target is a part of the area.
		Rural Water Supply & Sanitation Agency (RUWASSA)		✓*	✓	* The target is a part of the area.

Source: JICA Project Team

(2) Current Status of Water Supply

Same as M/P2013, the Project utilized the result of Core Welfare Indicators Questionnaire Survey (CWIQS, 2006) for water demand projection and calculated water supply coverage in major four (4) states as baseline data by accumulation of served population on LGA basis. Table 7-2 shows water supply coverage in major four (4) states.

However, it would appear that theses coverage don’t necessarily represent the actual conditions of water supply, in view of difficulty in demarcation of settlement type, facility utilization and working status on the ground such as insufficiency of facilities by poor maintenance, partial operation and restricted supply, and also presence of a lot of private wells and private water vendors

Table 7-2 Water Supply Coverage by State in 2006 (%)

	State	Urban	Semi-Urban	Rural	Overall
	Nationwide	**73.4 (72.2*)**	**- (51.3*)**	**40.0 (39.9*)**	**51.4 (56.2*)**
	4 states	**69.2***	**47.3***	**40.3***	**49.5***
24	Lagos	62.6	30.0	38.1	42.9 (38.3*)
27	Ogun	58.9	43.5	34.4	38.7 (43.2*)
29	Osun	81.4	57.3	45.5	51.7 (60.2*)
30	Oyo	71.9	71.9	44.7	47.6 (63.7*)

*: Calculated through accumulation of LGA-wise data by JICA Project Team as baseline data of the Project
Source: Core Welfare Indicators Questionnaire Survey (CWIQS), 2006

(3) Operational Situation of Public Water Supply Facilities

Common composition of public water supply facilities in major four (4) states are generally as shown in Table 7-3, categorized by water supply type based on population size, but these facilities exist often in parallel in urban, semi-urban and small town. Besides, a number of household and private estate have or share own water source statewide, and most of them are facilities rely on groundwater such as borehole equipped with handpump or small motorized pump.

Table 7-3 Common Composition of Public Water Supply Facilities

	Water Supply Type	Main Water Source	Common Composition of Facilities
1	Urban	Surface Water mainly but also groundwater	Water treatment works, pump and booster, pipeline, house/yard connections and standpipes.
2	Semi-Urban or Small Town	Groundwater mainly but also surface water or distribution from urban water facilities	Chlorination if needed, motorized pump, reservoir, pipeline, standpipes, and house/yard connections.
3	Rural	Groundwater	Handpump, 250m radius, 250-500 beneficiaries per point. And also, small piped facilities with motorized pump, elevated tank, and standpipes.

Source: JICA Project Team

The Project sees the picture of water supply facilities using groundwater through estimation by the number of facilities and their operating ratio, because existing information and interview to relevant authorities cannot lead to accurate outcome and also because of a great number of facilities around the area. Meanwhile, the Project analyzes water supply facilities using surface water in term of capacity of water treatment works by means of questionnaires and interviews.

(3-1) Water Supply Facilities using Surface Water

Public water supply facilities using surface water including subsurface water are generally operated and maintained by state water agency (SWA) and distribute water to mainly urban, semi-urban and small town after treatment of water taken from dam, river or stream. Water treatment works has typically conventional process with rapid filtration if large scale of production; but some are package plants if small scale.

Table 7-4 shows summary of existing public water supply facilities using surface or subsurface water, mostly treatment facilities verified by the Project, and Table 7-5 shows list of water treatment facilities or equivalent for surface or subsurface water in major four (4) states. To a greater or lesser, more than 240 facilities exist in Nigeria, 78 in major four (4) states, and the proportion of actual production to designed capacity, that is, production efficiency is 45.2% nationwide and 40.3% in major four (4) states in terms of water production through treatment. This shows us inefficiency of facility operation at least, and the inefficiency has been not necessarily attributable to planned operation but erratic power supply, aging of facilities and equipment, malfunction of equipment such as pump due to inadequate maintenance, and also supposedly oversize design by excess estimate of water demand.

Table 7-4 Existing Water Treatment Facility of Surface Water

No	State	Number of Water Treatment Facility※1			Capacity/Production (LCD)※2		
		Surface	Subsurface	Total	Design	Present	Efficiency
	Nationwide	**225**	**18**	**243**	**4,239.8**	**1,915.8**	**45.2**
	4 states	**78**	**0**	**78**	**1,212.9**	**488.5**	**40.3**
24	Lagos	3	0	3	541.0	344.4	63.7
27	Ogun	16	0	16	178.5	70.4	39.4
29	Osun	45	0	45	242.5	38.8	16.0
30	Oyo	14	0	11	251.0	34.9	13.9

*1: As of 2010. Simplified treatment facilities and chlorination only are included.
*2: As of 2012.
Source: JICA Project Team

Table 7-5 Existing Water Treatment Facility of Surface Water

SN	No.	Name	State	LGA	Water Source	Production (m3/day)		PEI*1
						Design	Present	(%)
1	24-1	Adiyan (WTW)	Lagos	Ifako-Ijaye	Ogun Riv.(Akute)	318,220	190,932	60.0
2	24-2	Iju (WTW)	Lagos	Ifako-Ijaye	Ogun Riv.(Akute)	204,570	153,428	75.0
3	24-3	Isashi (WTW)	Lagos	Ojo	Owo Riv.	18,184	0	0.0
4	27-1	Abeokuta Old (WTW)	Ogun	Abeokuta S.	Ogun Riv.	15,000	3,890	25.9
5	27-2	Abeokuta New (WTW)	Ogun	Abeokuta S.	Ogun Riv.	82,000	37,060	45.2
6	27-3	Ota Old (WTW)	Ogun	Ado-Odo/Ota	Unknown	2,450	0	0.0
7	27-4	Ota New (WTW)	Ogun	Ado-Odo/Ota	Unknown	6,750	1,210	17.9
8	27-5	Ilaro (P-WTW)	Ogun	Egbado South	Unknown	240	75	31.3
9	27-6	Ajilete (P-WTW)	Ogun	Egbado South	Unknown	810	0	0.0
10	27-7	IfoAkinsede/Papalanto(WTW)	Ogun	Ifo	Unknown	12,000	6,000	50.0
11	27-8	Itele (WTW)	Ogun	Ijebu East	Unknown	1,800	180	10.0
12	27-9	Ijebu-Igbo/Apoje (WTW)	Ogun	Ijebu North	Osun Riv.	18,500	9,250	50.0
13	27-10	Ijebu-Ode/Yemoji (WTW)	Ogun	Ijebu Ode	Unknown	18,000	9,000	50.0
14	27-11	Ogere (WTW)	Ogun	Ikenne	Unknown	6,700	3,350	50.0
15	27-12	Imeko (WTW)	Ogun	Imeko-Afon	Unknown	2,400	315	13.1
16	27-13	Owode-Egba (WTW)	Ogun	Obafemi-Owode	Unknown	1,700	0	0.0
17	27-14	Abiji (WTW)	Ogun	Ogun Waterside	Unknown	1,800	30	1.7
18	27-15	Akaka (WTW)	Ogun	Remo North	Unknown	1,800	0	0.0
19	27-16	Shagamu (WTW)	Ogun	Shagamu	Unknown	6,500	0	0.0
20	29-1	Orile-Owu (Mini-WTW)	Osun	Aiyedade	Unknown	600	0	0.0
21	29-2	Odeyinka (Mini-WTW)	Osun	Aiyedade	Unknown	300	0	0.0
22	29-3	Ile-Ogbo/Kuta (Mini-WTW)	Osun	Aiyedire	Unknown	200	40	20.0
23	29-4	Oluponna (Mini-WTW)	Osun	Aiyedire	Unknown	300	60	20.0
24	29-5	Iperindo (Mini-WTW)	Osun	Atakumosa E.	Unknown	300	0	0.0
25	29-6	Ifewara (Mini-WTW)	Osun	Atakumosa E.	Unknown	420	150	35.7
26	29-7	Ifewara (Mini-WTW)	Osun	Atakumosa W.	Unknown	200	0	0.0
27	29-8	Osu/Ilesha (Mini-WTW)	Osun	Atakumosa W.	Unknown	1,800	0	0.0
28	29-9	Igbajo (Mini-WTW)	Osun	Boluwaduro	Unknown	1,800	450	25.0
29	29-10	Otan/Iresi (Mini-WTW)	Osun	Boluwaduro	Unknown	600	120	20.0
30	29-11	Igbajo/Oke-Irun(Mini-WTW)	Osun	Boluwaduro	Unknown	600	120	20.0
31	29-12	Iree/Eripa (Mini-WTW)	Osun	Boripe	Unknown	600	120	20.0
32	29-13	Ada (Mini-WTW)	Osun	Boripe	Unknown	200	40	20.0
33	29-14	Ede/Old (WTW)	Osun	Ede North	Ede Dam	9,000	0	0.0
34	29-15	Ede/New (WTW)	Osun	Ede North	Ede Dam	180,000	27,500	15.3
35	29-16	Ejigbo (Mini-WTW)	Osun	Ejigbo	Unknown	2,400	480	20.0
36	29-17	Ife-Odan (Mini-WTW)	Osun	Ejigbo	Unknown	300	0	0.0
37	29-18	Mokuro (WTW)	Osun	Ife East	Unknown	1,000	450	45.0
38	29-19	Famia/Oyere (Mini-WTW)	Osun	Ife North	Unknown	200	0	0.0
39	29-20	Alajue (Mini-WTW)	Osun	Ife North	Unknown	200	0	0.0
40	29-21	Ifetedo (WTW)	Osun	Ife South	Unknown	3,700	950	25.7
41	29-22	Aye-Oba (Mini-WTW)	Osun	Ife South	Unknown	600	120	20.0
42	29-23	Omifunfun (Mini-WTW)	Osun	Ife South	Unknown	600	0	0.0
43	29-24	Mefoworade (Mini-WTW)	Osun	Ife South	Unknown	200	0	0.0
44	29-25	Ora (Mini-WTW)	Osun	Ifedayo	Unknown	200	0	0.0
45	29-26	Eko-Ende (WTW)	Osun	Ifelodun	Eko-Ende Dam	12,000	2,000	16.7
46	29-27	Dagbolu (Mini-WTW)	Osun	Ifelodun	Unknown	200	40	20.0
47	29-28	Iba (Mini-WTW)	Osun	Ifelodun	Unknown	150	30	20.0
48	29-29	Ila/Orangun (WTW)	Osun	Ila	Unknown	2,200	380	17.3
49	29-30	Ilesha (WTW)	Osun	Ilesha East	Efon-Alaaye,Ekiti	0	0	0.0
50	29-31	Ibodi/Oscoed (Mini-WTW)	Osun	Ilesha East	Unknown	600	120	20.0
51	29-32	Asejire (Mini-WTW)	Osun	Irewole	Unknown	1,200	0	0.0
52	29-33	Iwo/Ayiba (WTW)	Osun	Iwo	Ayiba Dam	9,080	2,500	27.5
53	29-34	Esa-Odo (WTW)	Osun	Obokun	Esa-Odo Dam	5,000	2,000	40.0
54	29-35	Oyan (Mini-WTW)	Osun	Odo-Otin	Unknown	230	0	0.0
55	29-36	Okuku (Mini-WTW)	Osun	Odo-Otin	Unknown	600	120	20.0
56	29-37	Igbaye (Mini-WTW)	Osun	Odo-Otin	Unknown	300	60	20.0
57	29-38	Inisa (Mini-WTW)	Osun	Odo-Otin	Unknown	600	120	20.0

SN	No.	Name	State	LGA	Water Source	Production (m3/day)		PEI[*1]
						Design	Present	(%)
58	29-39	Tootoo/Igere (Mini-WTW)	Osun	Ola-Oluwa	Unknown	200	40	20.0
59	29-40	Ajagunlase (Mini-WTW)	Osun	Ola-Oluwa	Unknown	600	0	0.0
60	29-41	Ikeji-Ile (WTW)	Osun	Oriade	Unknown	2,200	750	34.1
61	29-42	Esa-Oke (Mini-WTW)	Osun	Oriade	Unknown	200	40	20.0
62	29-43	Iwara/Igangan (Mini-WTW)	Osun	Oriade	Unknown	300	0	0.0
63	29-44	Ikeji-Arakeji (Mini-WTW)	Osun	Oriade	Unknown	300	0	0.0
64	29-45	Oke-Osun/Abere (Mini-WTW)	Osun	Osogbo	Unknown	200	40	20.0
65	30-1	Ibadan/Asejire (WTW)	Oyo	Egbeda	Asejire Dam	186,000	28,249	15.2
66	30-2	Ibadan/Osegere (WTW)	Oyo	Egbeda	Asejire Dam	13,500	0	0.0
67	30-3	Ibadan/Eleyele (WTW)	Oyo	Ibadan N.W.	Eleyele Dam	27,240	3,668	13.5
68	30-4	Eruwa (WTW)	Oyo	Ibarapa East	Eruwa Dam	3,300	914	27.7
69	30-5	Owode (WTW)	Oyo	Ido	Unknown	900	0	0.0
70	30-6	Kishi (WTW)	Oyo	Irepo	Kishi Dam	720	410	56.9
71	30-7	Iseyin (WTW)	Oyo	Iseyin	Unknown	1,200	240	20.0
72	30-8	Lalupon (P-WTW)	Oyo	Lagelu	Osun Riv.	436	0	0.0
73	30-9	Ogbomoso/Oba (WTW)	Oyo	Ogbomoso N.	Oba Dam	6,400	456	7.1
74	30-10	Igbetti/Afowose (P-WTW)	Oyo	Olorunsogo	Igbetti Dam	1,000	103	10.3
75	30-11	Igboho/Sanya (WTW)	Oyo	Orelope	Igboho Dam	1,000	26	2.6
76	30-12	Oyo/Erelu (WTW)	Oyo	Oyo East	Erelu Dam	7,500	754	10.1
77	30-13	Ago Amodu (P-WTW)	Oyo	Saki East	Ago Amodu Dam	500	32	6.4
78	30-14	Saki/Fofo (WTW)	Oyo	Saki West	Saki Dam	1,333	94	7.1

※1 PEI: Performance Efficiency Index
Source: JICA Project Team

(3-2) Water Supply Facilities using Groundwater

Public water supply facilities using groundwater (i.e. borehole) exist throughout the area regardless of their scale. In urban water supply, groundwater exists as a main water source or as a secondary or supplementary source for water supply facilities using surface water. Meanwhile, groundwater is definitely a main source for semi-urban, small town and rural water supply facilities, usually equipped with handpump or motorized pump.

Table 7-6 shows the number and operating ratio of existing boreholes by state through detail check and summarization of raw data of the National Water Supply and Sanitation Baseline Survey (NWSSBS), 2006 by the Federal Ministry of Water Resources. As a result, the total number of boreholes is just less than 3,000 in major four (4) states, and operating ratio is 54.7%.

Table 7-6 Number and Operating Ratio of Existing Boreholes by State in 2006

	State	Handpump			Motorized Pump			Total		
		No.	Function	(%)	No.	Function	(%)	No.	Function	(%)
	Nationwide	**25,470**	**14,748**	**57.9**	**12,421**	**5,836**	**47.0**	**37,891**	**20,584**	**54.3**
	4 states	**1,138**	**594**	**52.2**	**1,803**	**1,016**	**56.4**	**2,941**	**1,610**	**54.7**
24	Lagos	61	40	65.6	667	407	61.0	728	447	61.4
27	Ogun	82	22	26.8	489	296	60.5	571	318	55.7
29	Osun	389	144	37.0	367	165	45.0	756	309	40.9
30	Oyo	606	388	64.0	280	148	52.9	886	536	60.5

Source: National Water Supply and Sanitation Baseline Survey (NWSSBS), 2006. Reanalyzed by JICA Project Team

(5) Current Status of Sanitation

Sanitary facilities are typically flush toilet connected to sewerage system, flush toilet with septic tank and ventilation improved pit latrine. If not any sanitary facilities, people relieve themselves under unsanitary or primitive conditions.

Table 7-7 shows both sanitation coverage and sewerage coverage at the state level, sourced from National Demographic and Health Survey (NDHS), 2008 and Multiple Indicator Cluster Survey (MICS), 2007.

Sewerage systems probably have not proper treatment even if sewerage networks exist there.

Table 7-7 Sanitation and Sewerage Coverage by State (%)

	State	Sanitation (NDHS,2008)	Sewerage (MICS,2007)
	Nationwide	**27.0**	**3.9**
	4 states	**14.2**	**6.5**
24	Lagos	24.0	17.3
27	Ogun	13.0	4.3
29	Osun	13.0	0.0
30	Oyo	7.0	4.2

Source: National Demographic and Health Survey (NDHS), 2008
Multiple Indicator Cluster Survey (MICS), 2007

7.1.4 Basic Conditions of Development Planning

In view of the above current status, the Project will make a water supply and sanitation development plan based on the following design criteria.

(1) Water Supply

As mentioned in basic concept of Section 7.1.1, water supply development plan is composed of the following two major components:

- Rehabilitation of existing facilities
- New construction of facilities (including expansion)

(1-1) Per Capita Consumption

As mentioned in Section 3.2.2, the National Water Supply and Sanitation Policy, 2000 defines standard per capita consumption according to category of water supply and settlement type based on population size, as shown in Table 7-8.

Same as M/P2013, the Project conforms to this standard per capita consumption for sector development plan as well as basic conditions for water demand projection.

Table 7-8 Per Capita Consumption by Water Supply Category

	Water Supply Type	Per Capita Consumption (lit/cap/day)
1	Urban	120
2	Semi-Urban / Small Town	60
3	Rural	30

Source: Source: National Water Supply and Sanitation Policy, 2000, FMWR

(1-2) Designed Capacity and Yield of Water Sources

To make up a development plan of water supply against future growing water demand, capacity or yield of water source should be specified. For water supply facilities using surface water, water demand within available capacity of water source corresponds to designed capacity by considering surface water potential. Meanwhile, for water supply facilities using groundwater, designed yield is subject to hydrological features and pumping capacity.

(1-3) Rehabilitation Scheme of Existing Facilities

As to existing water supply facilities using surface water, the Project assumes that all the facilities have production efficiency at across-the-board 45.2% in 2010, the baseline year of the Project, which were obtained from nationwide efficiency of 2012, and also that the efficiency will be recovered to 80% by 2020 through rehabilitation and sustained until 2030. This water volume to be recovered by rehabilitation scheme becomes required development in both hydrological balance and facility planning.
On the other hand, as to existing water supply facilities using groundwater, out of groundwater development as remaining balance of total required water development after deduction of surface water development, the volume to be rehabilitated to the maximum extent possible is reactivated through rehabilitation scheme, based on Table 6-9 in Section 6.1.3, which varies from state to state. This water volume to be reactivated by rehabilitation scheme becomes required development in both hydrological balance and facility planning.

(1-4) New Construction Scheme of Facilities

As to the water supply facilities using surface water to be newly constructed, the Project assumes that water development is 80% of design capacity, as production efficiency, of newly planned water treatment works and sustained until 2030 in hydrological balance. Water development in facility planning is full design capacity of newly planned water treatment works.
On the other hand, as to the water supply facilities using groundwater to be newly constructed, the remaining balance of groundwater development after deduction of groundwater development by rehabilitation scheme is covered by newly construction in hydrological balance. Water development in facility planning is 125% (inverse of production efficiency at 80%) of water development in hydrological balance.

Table 7-9 Calculation of Required Development by Type of Water Source

Scheme		Development in Hydrological Balance	Development in Facility Planning
Rehabilitation	Surface	Recovered production of existing facilities to 80%	Recovered production of existing facilities to 80%
	G.W	Maximum volume to be rehabilitated, based on Table 6-9 in Section 6.1.3.	Maximum volume to be rehabilitated, based on Table 6-9 in Section 6.1.3.
New Construction	Surface	80% of capacity of newly planned water treatment works	100% of capacity of newly planned water treatment works
	G.W	Remaining balance of groundwater development after deduction of groundwater development by rehabilitation scheme	Multiplication of 125% (inverse of production efficiency at 80%) to remaining balance of groundwater development after deduction of groundwater development by rehabilitation scheme

Source: JICA Project Team

(1-5) Composition of Water Supply Facilities in Development Plan

The Project standardizes composition of water supply facilities by the categories mentioned in Table 7-10.

However, urban settlement and semi-urban/small town settlement are conveniently combined together because they cannot be distributed by category of water source.

Table 7-10 Composition of Water Supply Facilities in Development Plan of CMP

Category-1	Category-2	Category-3	Composition of Water Supply Facilities (Standard)
Rehabilitation or New Construction	Urban and Semi-Urban / Small Town	Surface W.	Water treatment works – Pumping main – Reservoir – Distribution – House connection and public standpipe
		Groundwater	Borehole equipped with motorized pump – Pumping main – Reservoir - House connection and/or public standpipe
	Rural	Groundwater	Borehole equipped with motorized pump – Reservoir - public standpipe
			Borehole equipped with handpump

Source: JICA Project Team

(2) Sanitation

(2-1) Sanitation Service Level

The National Water Sanitation Policy, 2004 defines standard sanitation service level guaranteed for all citizens according to settlement category based on population as well as water supply, as shown in Table 7-11.

The Project conforms to this standard sanitation level for sector development plan.

Table 7-11 Standard Sanitation Service Level

Category of Sanitation		Population	Service Level (at least)	Remarks
Urban	Urban	20,000 <	Pour-Flush Toilet	each household, using suitable and affordable water conveyance systems
	Semi-Urban / Small Town	5,000 - 20,000	SanPlat Latrine or equivalent	each household, improved latrine slab and superstructure harmonizing with surroundings
Rural		< 5,000	Upgraded Pit Latrine	each household, reduction of flies and odour, etc.

Source: National Water Sanitation Policy, 2004, FMWR

(2-2) Components of Sanitation Development Plan

Sanitation development projects are shown in Table 7-12.
Construction of domestic toilet or latrine is not regarded as public development because of privately-owned facility, but the Project calculates necessary development resulted from population forecasted by the Project and household size of each state sourced from Annual Abstract of Statistics (2009, National Bureau of Statistics), provided a toilet or latrine per household.
As a public sanitation development project, the Project plans construction of public toilets at public facilities such as market and bus terminal in order to improve urban sanitary environment in the area.
In terms of reduction of pollution load, the Project proposes disposal process of septage from individual septic tanks to final disposal facility and site through collection and transport as a common process of septage management in urban settlement, and also sewerage system in a part of urban settlement in some states at 50% sewerage coverage in household basis. For selection of the target areas of the sewerage system, in consideration of higher capital and operating costs, the Project sorts out the states of which average household income is more than 50,000 Naira per month. The Project concluded the target areas in four (4) states are Lagos Central in Lagos state, Osogbo in Osun state and Ibadan in Oyo state.
Furthermore, the Project plans hygiene promotion and education to be implemented by ministries, agencies or LGA, particularly in semi-urban, small town and rural areas. Community led total sanitation (CLTS) should be adopted in rural area.

Table 7-12 Components of Sanitation Development Plan

Project	Settlement Category	Description
Public toilet	Urban	in Market, bus terminal, etc. 4 places per 20,000 persons
	Semi Urban / Small Town	in Market, bus terminal, etc. 2 places per 20,000 persons
Final disposal facility/site	Urban	Disposal of septage/sludge collected and transported from septic tanks
Sewerage system	Urban	Sewerage treatment plant, sewer
Hygiene promotion	Semi Urban / Small Town	Conventional hygiene promotion and education
	Rural	Community-Led Total Sanitation Approach

Source: JICA Project Team

7.1.5 Water Supply and Sanitation Development Plans

(1) Water Supply Development Plan

To meet the future water demand projected in Section 4.2, the Project calculates water supply development for both hydrological balance and facility planning in the target year 2030, as shown in Table 7-13 and 7-14.
Both water supply development target demand growth for 20 years from 2011 to 2030 because baseline year of water demand projection is 2010. But water supply development plan targets demand growth from 2015 to 2030, which is also ground for project cost estimation. Assuming development projects have been implemented at the development pace expected by the CMP conforming to the M/P2013 from 2011 to 2014, water supply development by both rehabilitation and new construction projects proposed in the CMP is; 2,636 million liter per day (MLD) in hydrological balance and 3,167 MLD in facility planning under Scenario-A, and 5,000 MLD in hydrological balance and 6,122 MLD in facility planning under Scenario-B.
Annex-Table 7-1 and 7-2 show list of projects in four (4) states, and Figure 7-1 to 7-7 show demand and supply graph in water development plan in facility planning.

Table 7-13 Water Supply Development Plan for Hydrological Balance

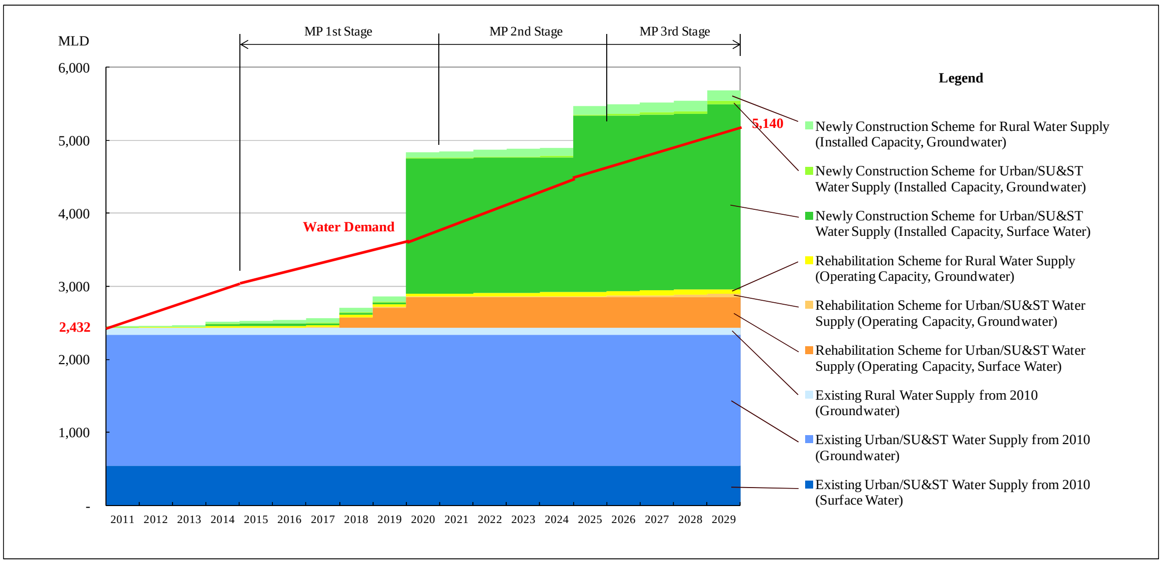
Scheme	Category	Existing Capacity (2010)	Pre-MP Period (2011-2014)	MP Period (2015-2030)	**Total (2030)**
4 States (Scenario A)					
Rehabilitation	Urban, SU/ST (SW)	546	-	421	**967**
	Urban, SU/ST (GW)	1,784	3	36	**1,823**
	Rural (GW)	102	15	55	**172**
	Sub-Total	**2,432**	**19**	**512**	**2,962**
Newly Construction	Urban, SU/ST (SW)		25	1,998	**2,023**
	Urban, SU/ST (GW)		3	36	**39**
	Rural (GW)		26	90	**116**
	Sub-Total		**54**	**2,124**	**2,178**
Total	**(MLD)**	**2,432**	**72**	**2,636**	**5,140**
4 States (Scenario B)					
Rehabilitation	Urban, SU/ST (SW)	546	-	421	**967**
	Urban, SU/ST (GW)	1,784	3	36	**1,009**
	Rural (GW)	102	14	51	**159**
	Sub-Total	**2,432**	**17**	**508**	**2,135**
Newly Construction	Urban, SU/ST (SW)		25	4,369	**4,394**
	Urban, SU/ST (GW)		3	36	**39**
	Rural (GW)		24	86	**110**
	Sub-Total		**52**	**4,492**	**4,544**
Total	**(MLD)**	**2,432**	**70**	**5,000**	**6,679**
Lagos (Scenario A)					
Rehabilitation	Urban, SU/ST (SW)	244	-	188	**433**
	Urban, SU/ST (GW)	1,145	-	-	**1,145**
	Rural (GW)	8	1	4	**13**
	Sub-Total	**1,397**	**1**	**192**	**1,591**
Newly Construction	Urban, SU/ST (SW)		15	1,323	**1,338**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		1	4	**6**
	Sub-Total		**16**	**1,327**	**1,343**
Total	**(MLD)**	**1,397**	**17**	**1,519**	**2,934**
Lagos (Scenario B)					
Rehabilitation	Urban, SU/ST (SW)	244	-	188	**433**
	Urban, SU/ST (GW)	1,145	-	(-814)	**331**
	Rural (GW)	8	-	(-8)	**-**
	Sub-Total	**1,397**	**-**	**188**	**763**
Newly Construction	Urban, SU/ST (SW)		15	3,694	**3,709**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		-	-	**-**
	Sub-Total		**15**	**3,694**	**3,709**
Total	**(MLD)**	**1,397**	**15**	**3,883**	**4,472**
Ogun					
Rehabilitation	Urban, SU/ST (SW)	79	-	61	**139**
	Urban, SU/ST (GW)	225	-	-	**225**
	Rural (GW)	15	3	9	**26**
	Sub-Total	**319**	**3**	**69**	**391**
Newly Construction	Urban, SU/ST (SW)		5	272	**277**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		9	30	**38**
	Sub-Total		**14**	**302**	**316**
Total	**(MLD)**	**319**	**17**	**371**	**707**
Osun					
Rehabilitation	Urban, SU/ST (SW)	110	-	84	**194**
	Urban, SU/ST (GW)	115	3	36	**154**
	Rural (GW)	33	5	19	**57**
	Sub-Total	**258**	**8**	**139**	**406**
Newly Construction	Urban, SU/ST (SW)		-	72	**72**
	Urban, SU/ST (GW)		3	36	**39**
	Rural (GW)		5	19	**24**
	Sub-Total		**8**	**127**	**135**
Total	**(MLD)**	**258**	**17**	**266**	**541**
Oyo					
Rehabilitation	Urban, SU/ST (SW)	113	-	87	**201**
	Urban, SU/ST (GW)	299	-	-	**299**
	Rural (GW)	45	6	24	**75**
	Sub-Total	**458**	**6**	**111**	**575**
Newly Construction	Urban, SU/ST (SW)		5	331	**336**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		10	38	**48**
	Sub-Total		**15**	**368**	**383**
Total	**(MLD)**	**458**	**21**	**479**	**959**

Source: JICA Project Team

Table 7-14 Water Supply Development Plan for Facility Planning (Installed Capacity)

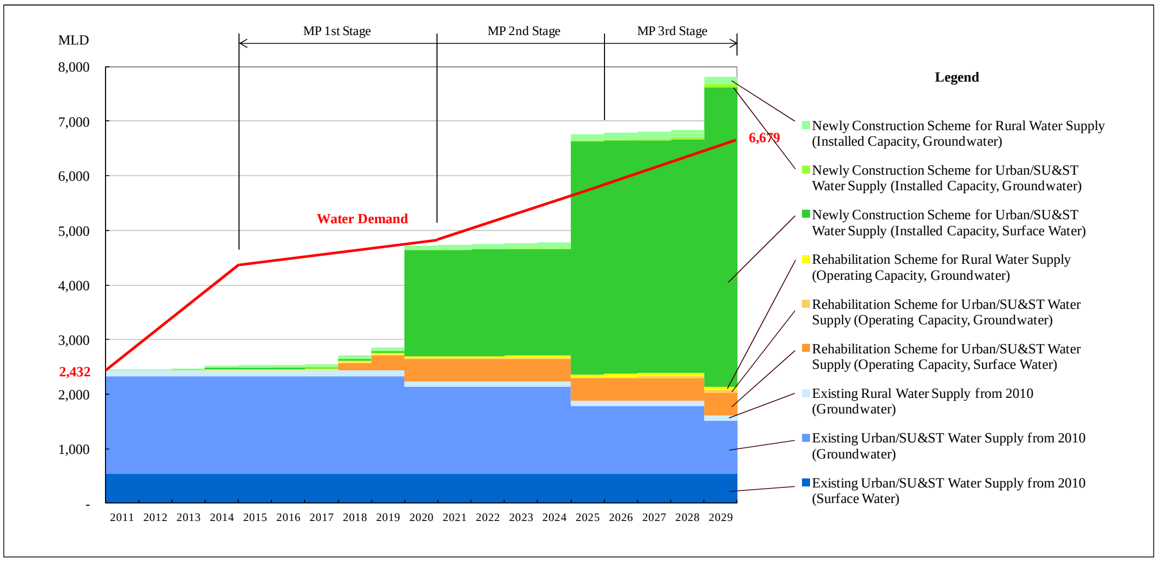
Scheme	Category	Existing Capacity (2010)	Pre-CMP Period (2011-2014)	CMP Period (2015-2030)	**Total (2030)**
4 States (Scenario A)					
Rehabilitation	Urban, SU/ST (SW)	546	-	421	**967**
	Urban, SU/ST (GW)	1,784	3	36	**1,823**
	Rural (GW)	102	15	55	**172**
	Sub-Total	**2,432**	**19**	**512**	**2,962**
Newly Construction	Urban, SU/ST (SW)		31	2,497	**2,528**
	Urban, SU/ST (GW)		4	45	**49**
	Rural (GW)		32	113	**145**
	Sub-Total		**67**	**2,655**	**2,722**
Total	**(MLD)**	**2,432**	**86**	**3,167**	**5,685**
4 States (Scenario B)					
Rehabilitation	Urban, SU/ST (SW)	546	-	421	**967**
	Urban, SU/ST (GW)	1,784	3	36	**1,009**
	Rural (GW)	102	14	51	**159**
	Sub-Total	**2,432**	**17**	**508**	**2,135**
Newly Construction	Urban, SU/ST (SW)		31	5,462	**5,493**
	Urban, SU/ST (GW)		4	45	**49**
	Rural (GW)		30	107	**138**
	Sub-Total		65	5,614	**5,680**
Total	**(MLD)**	**2,432**	**83**	**6,122**	**7,814**
Lagos (Scenario A)					
Rehabilitation	Urban, SU/ST (SW)	244	-	188	**433**
	Urban, SU/ST (GW)	1,145	-	-	**1,145**
	Rural (GW)	8	1	4	**13**
	Sub-Total	**1,397**	**1**	**192**	**1,591**
Newly Construction	Urban, SU/ST (SW)		18	1,654	**1,672**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		2	5	**7**
	Sub-Total		**20**	**1,659**	**1,679**
Total	**(MLD)**	**1,397**	**21**	**1,851**	**3,270**
Lagos (Scenario B)					
Rehabilitation	Urban, SU/ST (SW)	244	-	188	**433**
	Urban, SU/ST (GW)	1,145	-	(-814)	**331**
	Rural (GW)	8	-	(-8)	**-**
	Sub-Total	**1,397**	**-**	**188**	**763**
Newly Construction	Urban, SU/ST (SW)		18	4,618	**4,636**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		-	-	**-**
	Sub-Total		**18**	**4,618**	**4,636**
Total	**(MLD)**	**1,397**	**18**	**4,806**	**5,400**
Ogun					
Rehabilitation	Urban, SU/ST (SW)	79	-	61	**139**
	Urban, SU/ST (GW)	225	-	-	**225**
	Rural (GW)	15	3	9	**26**
	Sub-Total	**319**	**3**	**69**	**391**
Newly Construction	Urban, SU/ST (SW)		7	340	**347**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		11	37	**48**
	Sub-Total		**18**	**377**	**395**
Total	**(MLD)**	**319**	**20**	**446**	**786**
Osun					
Rehabilitation	Urban, SU/ST (SW)	110	-	84	**194**
	Urban, SU/ST (GW)	115	3	36	**154**
	Rural (GW)	33	5	19	**57**
	Sub-Total	**258**	**8**	**139**	**406**
Newly Construction	Urban, SU/ST (SW)		-	90	**90**
	Urban, SU/ST (GW)		4	45	**49**
	Rural (GW)		7	23	**30**
	Sub-Total		**11**	**159**	**169**
Total	**(MLD)**	**258**	**19**	**298**	**575**
Oyo					
Rehabilitation	Urban, SU/ST (SW)	113	-	87	**201**
	Urban, SU/ST (GW)	299	-	-	**299**
	Rural (GW)	45	6	24	**75**
	Sub-Total	**458**	**6**	**111**	**575**
Newly Construction	Urban, SU/ST (SW)		6	413	**419**
	Urban, SU/ST (GW)		-	-	**-**
	Rural (GW)		13	47	**60**
	Sub-Total		**19**	**460**	**479**
Total	**(MLD)**	**458**	**25**	**571**	**1,054**

Source: JICA Project Team



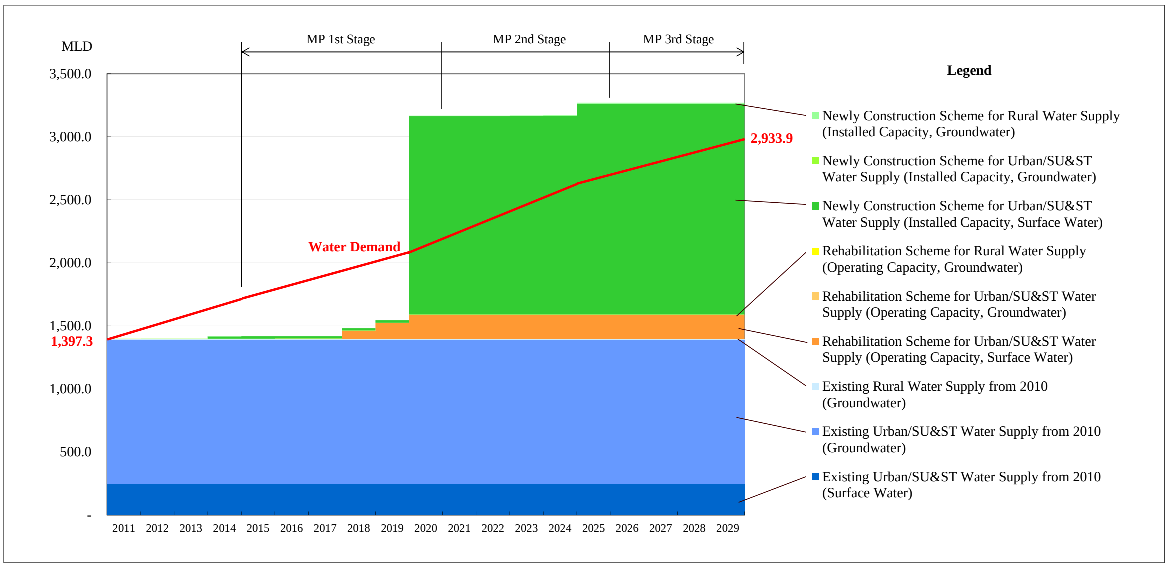
Source: JICA Project Team

Figure 7-1 Demand and Supply in Development Plan for Facility Planning (4 States, Scenario-A)



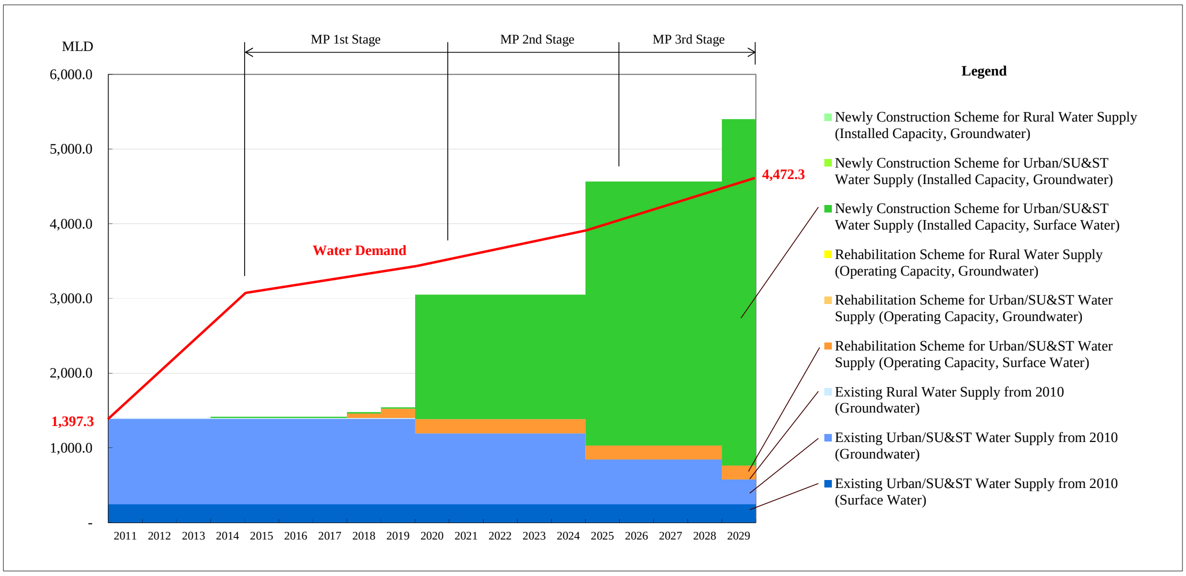
Source: JICA Project Team

Figure 7-2 Demand and Supply in Development Plan for Facility Planning (4 States, Scenario-B)



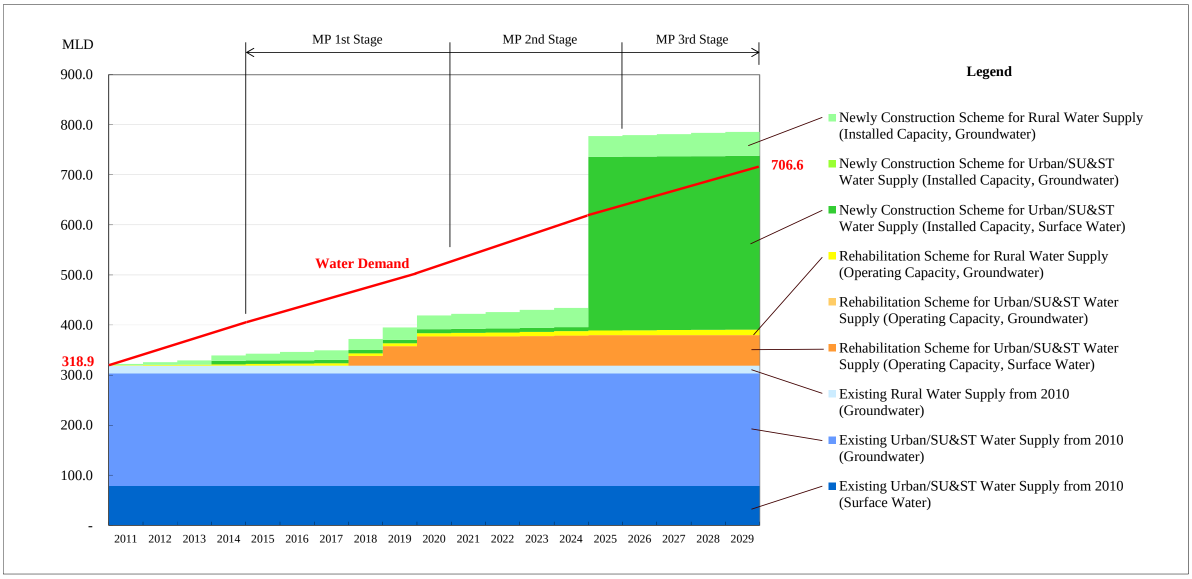
Source: JICA Project Team

Figure 7-3 Demand and Supply in Development Plan for Facility Planning (Lagos, Scenario-A)



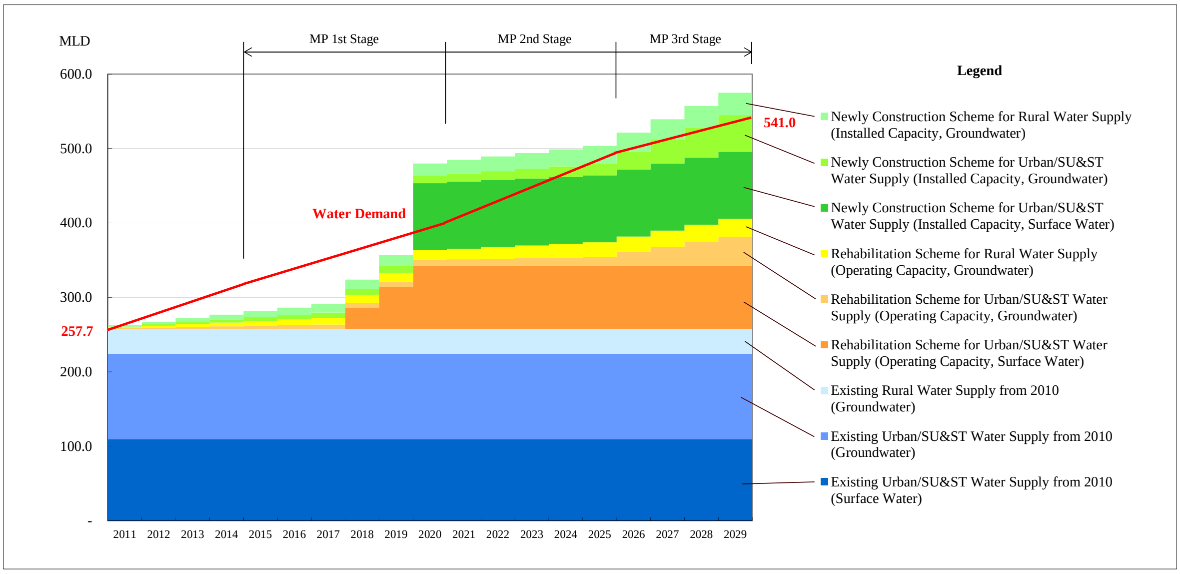
Source: JICA Project Team

Figure 7-4 Demand and Supply in Development Plan for Facility Planning (Lagos, Scenario-B)



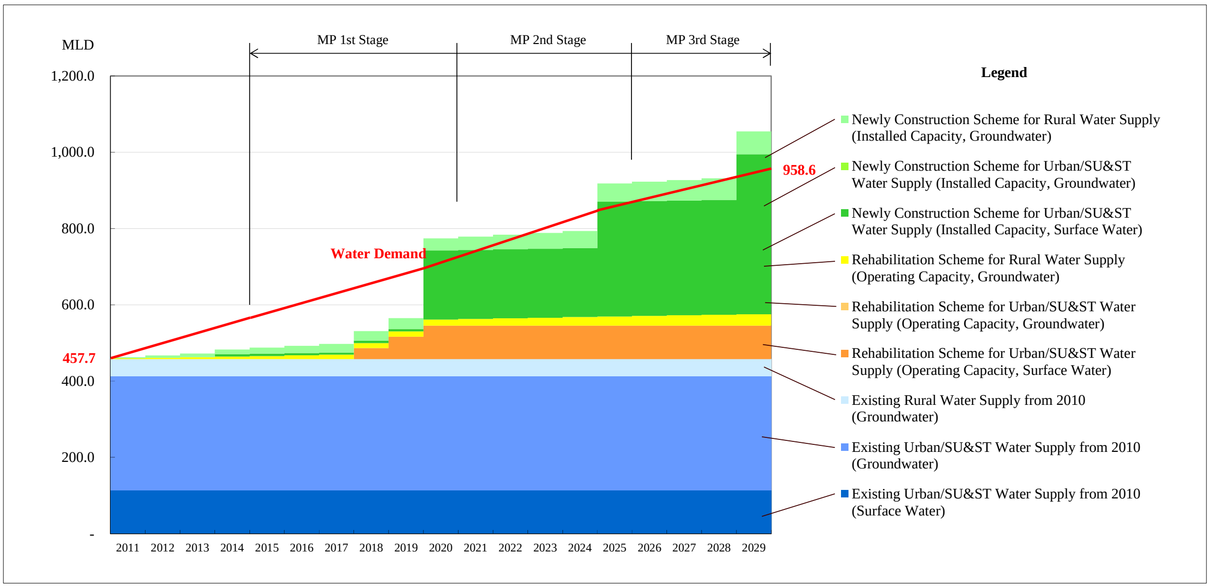
Source: JICA Project Team

Figure 7-5 Demand and Supply in Development Plan for Facility Planning (Ogun)



Source: JICA Project Team

Figure 7-6 Demand and Supply in Development Plan for Facility Planning (Osun)



Source: JICA Project Team

Figure 7-7 Demand and Supply in Development Plan for Facility Planning (Oyo)

(2) Sanitation Development Plan

Based on current sanitation coverage as of baseline year 2010, mentioned in Section 7.1.3(5), the Project formulates sanitation development plan to meet demand in the target year 2030, which sanitation coverage should reach 100%. But sanitation development plan targets demand growth from 2015 to 2030, which is also ground for project cost estimation. Assuming development projects have been implemented at the development pace expected by the CMP conforming to the M/P2013 from 2011 to 2014, sanitation development by the projects proposed in the CMP are shown in Table 7-15.

On the other hand, the Project estimates required development of domestic sanitation facilities (toilet or latrine) in the target period of sanitation development plan from 2015 to 2030, as shown in Table 7-16.

Table 7-15 Sanitation Development Plan (2015-2030)

Project	Category	Unit	Lagos	Ogun	Osun	Oyo	**4 states**
Scenario-A							
Public toilet	Urban	Nos	1,688	311	197	374	**2,570**
	S.U/S.T	Nos	763	324	253	446	**1,786**
Final septage disposal facility/site	Urban	Household	2,092,658	484,781	244,859	462,706	**3,285,004**
Sewerage system	Urban	m3	239,273	-	11,042	34,109	**284,424**
Hygiene promotion	S.U/S.T	Household	1,437,537	766,513	488,501	870,682	**3,563,233**
	Rural	Household	102,557	515,919	525,804	824,239	**1,968,518**
Scenario-B							
Public toilet	Urban	Nos	3,985	311	197	374	**4,867**
	S.U/S.T	Nos	1,949	324	253	446	**2,972**
Final septage disposal facility/site	Urban	Household	3,320,268	484,781	244,859	462,706	**4,512,614**
Sewerage system	Urban	m3	564,908	-	11,042	34,109	**610,059**
Hygiene promotion	S.U/S.T	Household	3,952,549	766,513	488,501	870,682	**6,078,244**
	Rural	Household	-	515,919	525,804	824,239	**1,865,962**

Source: JICA Project Team

Table 7-16 Required Development of Domestic Sanitation Facilities

Settlement	Existing (2010)	Pre-CMP Period (2011-2014)	CMP Period (2015-2030)	**Total (2030)**
4 States (Scenario A)				
Urban	411	533	2,480	**3,424**
Semi-Urban/Small-Town	462	754	3,563	**4,780**
Rural	181	411	1,969	**2,561**
Total	**1,054**	**1,698**	**8,012**	**10,765**
4 States (Scenario B)				
Urban	411	1,113	4,923	**6,446**
Semi-Urban/Small-Town	462	1,359	6,078	**7,900**
Rural	181	382	1,866	**2,429**
Total	**1,054**	**2,854**	**12,867**	**16,775**
Lagos (Scenario A)				
Urban	333	334	1,554	**2,220**
Semi-Urban/Small-Town	279	291	1,438	**2,007**
Rural	33	29	103	**164**
Total	**645**	**654**	**3,094**	**4,392**
Lagos (Scenario B)				
Urban	333	914	3,996	**5,242**
Semi-Urban/Small-Town	279	896	3,953	**5,127**
Rural	33	-26	-7	**-**
Total	**645**	**1,783**	**7,942**	**10,369**
Ogun				
Urban	35	76	374	**485**
Semi-Urban/Small-Town	79	166	767	**1,012**
Rural	52	109	516	**677**
Total	**166**	**351**	**1,657**	**2,173**
Osun				
Urban	21	41	189	**252**
Semi-Urban/Small-Town	54	106	489	**648**
Rural	56	111	526	**693**
Total	**131**	**258**	**1,204**	**1,593**
Oyo				
Urban	22	82	363	**467**
Semi-Urban/Small-Town	50	192	871	**1,113**
Rural	40	162	824	**1,026**
Total	**112**	**435**	**2,058**	**2,606**

Source: JICA Project Team

7.1.6 Operation and Maintenance Plan

(1) Current Status of Operation and Maintenance

As mentioned above, water supply facilities are categorized into urban, semi-urban and small town, and rural based on population size of settlement, so not only composition of facilities but also system and current status of operation and maintenance differ.

(1-1) Urban Water Supply

State water agencies (SWAs) are in charge of water supply services in urban settlement. Common status of these water supply services includes, more or less, inefficiency and high non-revenue water, for example, operation below design capacity, aged deterioration, poor maintenance, insufficient monitoring, water leakage, inadequate collection of water tariff (i.e. low cost recovery), and low water tariff and so on. These situations have led World Bank to give financial support to Lagos Water Corporation through the National Urban Water Sector Reform Programme (NUWSRP).

Besides, various conditions to be deal with exist, such as measures against private water vendors and low income households.

(1-2) Semi-Urban and Small Town Water Supply

In spite of smaller scale than urban water supply, a variety of problems and issues on operation and maintenance exist in semi-urban and small town water supply, and therefore time, effort and care are imperative. Although daily operation and maintenance has been commonly done by not government agencies or LGA but community organization, a great number of existing water supply facilities have not been operated and maintained appropriately and have resulted in being out of service and neglected in the wake of failure or malfunction of facility and equipment. This situation has caused low operational ratio of water supply using groundwater. To deal with its fact, small town water supply and sanitation projects, which aim to secure sustainability based on community ownership enhanced by various social intervention, have been implemented after 2000 in some states with assistance provided by World Bank and European Union, together with establishment of Small Town Water Supply and Sanitation Agency (STWSSA) in each target state and also with institutional arrangement, but no projects have been done in four (4) states.

(1-3) Rural Water Supply

Rural water supply is mainly borehole equipped with handpump or small scale facilities equipped with motorized pump, and community based organization such as WASHCOM and WATSAN committee is responsible for daily operation and maintenance. However, regular collection of usage charge for maintenance is not done everywhere, consequently, most LGA and RUWASSA have given financial and technical support when failure or malfunction of facility and equipment occurs. In case of not enough support, facility and equipment are to be neglected. This situation has caused low operational ratio of water supply using groundwater. So rural water supply projects assisted by Unicef, JICA, other donors and NGOs have included various social intervention such as community awareness raising and capacity development to deal with the issues.

(1-4) Sanitation

Low sanitation coverage shows many households have relied on unsanitary facility or primitive way, and sewerage system is not common at all except a part of urban area in Lagos city. Domestic toilet equipped with septic tank and pit latrine are common in most of urban areas, semi-urban areas and small towns, but there is no appropriate disposal system of septage. Poor coordination among relevant bodies on sanitation including federal ministries/agencies, state ministries/agencies and LGA has been pointed out, but they has recently set forward coordination with assistance of international donors.

(2) Recommendation on Appropriate Operation and Maintenance System

(2-1) Urban Water Supply

In order to secure high production efficiency and operating ratio of water supply facilities, state water agencies (SWAs) need to establish framework of appropriate monitoring, operation and maintenance. So, various measures should be taken for adequate budget allocation, appropriate personnel distribution and capacity development for operation and maintenance as well as properly-set water tariff and non-revenue water reduction. In addition, measures against low income households and ingenuity should be considered such as reduced water tariff by cross subsidy, community participation and job creation. And relevant bodies should aim to realize safe water supply without dealing negatively in private water vendors.

(2-2) Semi-Urban and Small Town Water Supply

State water agencies (SWAs) or small town water supply and sanitation agencies (STWSSAs) in some states are typically responsible for operation and maintenance, and they need to make sure of efficient and reasonable operation and maintenance of water supply together with community in semi-urban areas and small towns where will be inhabited area of future growing population. So, various measures should be taken for cost-cutting efforts, adoption of appropriate technology, community participation, empowerment and awareness raising, job creation, strengthening of monitoring and so on. To this end, STWSSA should be established nationwide in each state and developed in capacity, and existing small town and sanitation projects should be monitored and evaluated to improve system and strength implementation framework.

(2-3) Rural Water Supply

Appropriate institutional framework and distribution system are necessary so that operation and maintenance functions properly. For this, various measures should be taken for community awareness raising, capacity development of community based organization, LGA and RUWASSA, and rapid deployment. And, cooperation with private suppliers should be expanded to secure supply chain of spare parts in rural areas.

(2-4) Sanitation

Particularly in rural areas where people habitually have relied on unsanitary facility or primitive way, Community Led Total Sanitation (CLTS) should be promoted to boost sanitation coverage and reduce water-borne diseases. In urban areas and semi-urban areas and small towns if necessary, in order to establish appropriate process of septage disposal and also sewerage system, various measures should be taken for capacity development of implementing bodies, establishment of institutional framework, adoption and transfer of appropriate technology. Moreover, operation and maintenance based on beneficiaries-pay principle should be built up with awareness raising on sanitation through hygiene promotion and education to beneficiaries.

7.2 Irrigation and Drainage Development Plan

7.2.1 Current Condition of Operation and Maintenance in Irrigation Scheme

The operation and management of public irrigation schemes is mainly in charge of RBDAs and state. However the irrigation infrastructure are dilapidated in most of the irrigation schemes with many pumps in need of repair/replacement and conveyance structures damaged or deteriorated, weed infested and silted up. The causes of deterioration are as follows;

- **Management capacity of RBDA**: The RBDA have not been able to develop the full potential and maintain the areas originally developed for the schemes, due to poor maintenance and water delivery, weak technical and management capacity and technical deficiencies in the infrastructure. Irrigated agriculture has been ahead carried out at a part of completed developed area, however funding constraints have further contributed to the low capacity for operation and management and this has affected the difficulty of maintenance of irrigation facilities.
- **Irrigation Infrastructure**: Gravity irrigation system is effective compared with equipped irrigation system because of low operation and maintenance cost and few trouble with equipment. However a lot of public irrigation schemes have been using pump and suffer from deterioration, breakdown, repair/replacement of pumps and high cost of fuel. Also the farmers have not been able to adapt to the sprinkler system. The conveyance structures damaged or deteriorated, weed infested and silted up.
- **Inadequate water delivery:** Water delivery to secondary canal from main canal is mostly carried out through the cross regulators and the manual sluice gate type. Flow into secondary canals can be measured by using rating curves however; measuring gauges to determine water depth for measurement are missing or unreadable where they exist. Thus there are no records of actual flow into the canal systems. Also the farmers have not been able to adapt to the sprinkler system.
- **Water Users Associations(WUAs)**: The Water Users Associations (WUAs) rarely exist in most of the schemes, they are neither not effective nor active. The farmers believe that the water charge paid should cover the maintenance, thus farmer’s motivation to participate or collaborate is low in the maintenance work on scheme.
- **Cost-Recovery**: The water charge paid in most of public irrigation schemes is generally from 500 to 3000 Niara/ha・season. Most of farmers do not pay for water delivery and water charges are too low to meet the cost of water delivery. The inadequate pricing is responsible for the cycle of poor services leading to lack of willingness to pay by the user.
- **Equipments**: The equipment in use of the schemes is two main categories namely, one is water delivery equipment, and the another is agricultural equipment and machinery. The water delivery equipment mainly comprises pumps of various capacities used for water abstraction at the water source. Most of the pumps were purchased during the 1980s, and these spare parts are now no longer available. Most of the agricultural equipment and machinery are not being operated due to low maintenance such as a tractor, combined rice harvesters, and rice mill, etc. There are very few maintenance personnel working on schemes. Workshop at all RBDAs were run down, and poorly equipped and staffed. Spare parts were rarely stocked and records not kept.

◆ **Irrigation Scheme**

Public irrigation scheme is classified as planned irrigation area as follows;

Large scale irrigation	A≧ 500ha
Medium scale irrigation	50ha≦A＜ 500ha
Small scale irrigation	A＜ 50ha

Four irrigation schemes in below table have been under construction, however their progress are very slow due to lack of fund.

Table 7-17 Major Large Scale Irrigation Scheme

Scheme	State	River	Agency	Water Source Works	Irrigation Area (ha)		Service Area (ha)
					Planned	System developed	
Middlle Ogun	Oyo	Ogun	OORBDA	Dam	12,000	750	520
Lower Ogun	Ogun	Ogun	OORBDA	Dam	12,000	500	200
Owiwi	Ogun		OORBDA	Dam	302	45	45
Itoikin	Lagos	Aye	OORBDA	Intake	315	141	141

Source: JICA Project Team

Existing public irrigation schemes are shown as follows;

Table 7-18 Existing Large Scale Irrigation Project (HA-6 Ogun-Osun Basin) (1/2)

SN	No.	HA	On-going	Rehabili-tation	Expansion	Project Name	State	Longitude East	Latitude North	River	SHA	Agency
82	1	6				Upper Ogun	Oyo	3.30205	8.21856	Ofiki	604023_i	OORBDA
83	2	6				Ofiki(A)	Oyo	3.33872	8.46834	Ofiki	604023_i	OORBDA
84	3	6	○		E	Middle Ogun (I.G)	Oyo	3.72541	7.85447	Ogun	60403	OORBDA,DID
85	4	6				Sepeteri(A)	Oyo	3.65260	8.57964	Owutu	60405	OORBDA
86	5	6	○		E	Lower Ogun (Mokoloki)	Ogun	3.34892	6.92784	Ogun	60401	OORBDA,DID
87	6	6			E	Iwo	Osun	4.16447	7.74451	Orufu	608	OORBDA
88	7	6			E	Ilero	Oyo	3.32113	8.01052		604023_i	OORBDA
89	8	6				Otta	Ogun	3.23946	6.65463	Ore	603	OORBDA
90	9	6				Eyinwa	Ogun	3.80940	6.79970	Ondo	606	OORBDA
91	10	6				Oke-Odan	Ogun	2.90442	6.72066	Yelwa	602_i	OORBDA
92	11	6		R	E	Asa	Oyo	4.19306	8.16333	Oba	608	OORBDA
93	12	6		R	E	Okuku	Osun	4.67570	7.99350		608	OORBDA
94	13	6				Igbonla	Lagos	4.05585	6.63502	Osun	608	OORBDA
						Sub-total						
97	14	6		R	E	Esa Odo Dam	Osun	4.81272	7.74642		608	MANR
98	15	6		R	E	New Erinle	Osun	4.52171	7.85328		608	MANR
						Sub-total						
						Total						

Source: JICA Project Team

Table 7-19 Existing Large Scale Irrigation Project (HA-6 Ogun-Osun Basin) (2/2)

SN	No.	Project Name	Water Source Works	Name of Source	Irrigation Area (ha)			Irrigation Service Area (ha)		Remarks	Source	Future Irrigation Area in 2030 (ha)*1
					Planned Area	Area with Reliable Water Supply (*1)	System Developed	Service Area	Intensity (%)			
82	1	Upper Ogun	Dam	Igbojaye	2,000	600	10	5	0		OORBDA, 2020M/S	10
83	2	Ofiki(A)	Dam	Ofiki(A)	2,000	60	24	24	1	yam,maize,cassava	OORBDA	24
84	3	Middle Ogun (I.G)	Pump	Ogun R.	12,000	12,000	750	520	4	Under construction	OORBDA, UNRF	12,000
85	4	Sepeteri(A)	Dam	Sepeteri(A)	2,000	30	80	80	4	yam,maize,cassava	OORBDA, UNRF	30
86	5	Lower Ogun (Mokoloki)	Dam	Oyan	12,000	12,000	500	200	2	maize,water melon,cucumber	OORBDA, UNRF	12,000
87	6	Iwo	Wier	NF	1,000	0	0	0	0		OORBDA	0
88	7	Ilero	Dam	Okeho	2,000	70	0	0	0		OORBDA	70
89	8	Otta	Pump	NF	1,000	0	340	300	30		2020M/S	0
90	9	Eyinwa	Intake	NF	1,000	10	300	300	30		2020M/S	10
91	10	Oke-Odan	Dam	Oke-Odan	600	400	250	59	10	maize, cassava	2020M/S, ROPISIN	250
92	11	Asa	Dam	Oba	500	500	0	0	0		OORBDA	500
93	12	Okuku	Dam	Okuku	600	30	0	0	0		OORBDA	30
94	13	Igbonla	Intake	Osun R.	1,000	130	130	0	0	rice	OORBDA, 2020M/S	130
		Sub-total			**37,700**	**25,830**	**2,384**	**1,488**	**4**			**25,054**
97	14	Esa Odo Dam	Dam	Esa-Odo	800	800	800	0	0		2020M/S	800
98	15	New Erinle	Dam	Erinle	500	500	500	0	0		2020M/S	500
		Sub-total			**1,300**	**1,300**	**1,300**	**0**	**0**			**1,300**
		Total			**39,000**	**27,130**	**3,684**	**1,488**	**4**			**26,354**

Source: JICA Project Team

Table 7-20 Existing Medium and Small Scale Irrigation Project (HA-6 Ogun-Osun Basin) (1/2)

SN	No.	HA	On-going	Rehabilitation	Expansion	Project Name	State	Longitude East	Latitude North	River	SHA	Agency
1096	1	6				Ofiki(B)	Oyo			Ofiki	604023_i	OORBDA
1097	2	6				Sepeteri(B)	Oyo			Agbado	60405	OORBDA
1098	3	6				Eniosa	Oyo			Omi	606	OORBDA
1110	4	6	○			Owiwi	Ogun				60401	OORBDA,DID
1111	5	6	○			Itoikin	Lagos			Aye	606	OORBDA,DID
1112	6	6				missing						
1113	7	6		R	E	Oogi	Osun			Erinle	610	OORBDA
1114	8	6		R		Ipetu-Ijesha	Osun				610	OORBDA
						Sub-total						
1116	9	6		R		Orile Owu	Osun				610	MANR
1117	10	6		R		Old Erinle Dam	Osun				608	MANR
						Sub-total						
						Total						

Source: JICA Project Team

Table 7-21 Existing Medium and Small Scale Irrigation Project (HA-6 Ogun-Osun Basin) (2/2)

SN	No.	Project Name	Water Source Works	Name of Source	Irrigation Service Area (ha)		Irrigation Service Area (ha)		Remarks	Source	Future Irrigation Area in 2030 (ha)*1
					Planned Area	System Developed	Service Area	Intensity (%)			
1096	1	Ofiki(B)	Dam		100	10	10	10		OORBDA, 95M/S	10
1097	2	Sepeteri(B)	Dam		400	0	0	0		OORBDA, 95M/S	0
1098	3	Eniosa	Dam		250	10	10	4	vegetable, maize	OORBDA, 2020M/S	10
1110	4	Owiwi	Dam		302	45	45	15		OORDBA, DID	302
1111	5	Itoikin	Intake	NF	315	141	141	45	Rice	OORBDA	315
1112	6	missing									
1113	7	Oogi	Intake		400	0	0	0		OORBDA, 2020M/S	400
1114	8	Ipetu-Ijesha	Intake		250	0	0	0		OORBDA, 95M/S	250
		Sub-total			**2,017**	**206**	**206**	**10**			**1,287**
1116	9	Orile Owu			100	100	0	0		2020M/S	100
1117	10	Old Erinle Dam			150	150	0	0		2020M/S	150
		Sub-total			**250**	**250**	**0**	**0**			**250**
		Total			**2,267**	**456**	**206**	**9**			**1,537**

Sources:
- 95M/S: The Study on The National Water Resources Master Plan (NWRMP), JICA, March 1995
- DID: HANDOVERNOTE May 2011, Department of Irrigation and Drainage, FMWR
- OORBDA: Summary of Irrigation Projects by Ogun-Oshun RBDA, June 2013
- 2020M/S: Masterplan for Irrigation and Dam Development for 2009-2020, FMAWR

Note:
(*1) Evaluated by JICA Project Team with 1/5 Safety Level of Water Supply under the Assumed Cropping Pattern as well as Water Use Condition in Other Purpose such as Municipal Water Supply in 2030

7.2.2 Basic Policy for Development

(1) Basic Policy

The promotion of irrigation sector should be schemed in accordance with national development policy, regional feature such as climate, hydrology, terrain and habitant, economical efficiency, and situation of existing public irrigation scheme.

(2) Development policies

Development Policies of irrigation sector are follows and development will be extended step by step according to priority.

- To complete early on-going public irrigation schemes,
- To implement rehabilitation and expansion on public irrigation schemes which FMWR identifies as high priority,
- To develop new water resource for high priority public irrigation schemes,
- To utilize existing dams for public irrigation schemes and expand its system developed area,

- To develop new proposed irrigated farmland, and
- To formulate effective structure for operation and maintenance to run schemes.

(3) Category of Public Irrigation Scheme

The existing and proposed public irrigation schemes are categorized as follows, however the menus of No.2.1 and No.2.3 are not applied in target region.

Table 7-22 Category of Public Irrigation Scheme

No.	Category	Description
1.	Existing Irrigation Scheme	Scheme which is existing before M/P2013
1.1	Completion with No Extension Scheme	Scheme which has already completed or suspended, and which has no extension plan in future.
1.2	Ongoing Scheme	Scheme which has been on-going and has a sure plan to implement in future.
1.3	Extension Scheme	Scheme which is recommended to expand planned irrigation area more
2.	New Irrigation Scheme	New Scheme which is proposed after M/P2013
2.1	Supplementary Irrigation Scheme	Not applied at HA-6 (Ogun-Osun Basin) Scheme which comprises of land reclamation and supplementary irrigation. Scheme is specified in HA-5 and HA-7 owning much precipitation.
2.2	Dam Irrigation Scheme	Not applied at HA-6 (Ogun-Osun Basin)Scheme which has irrigation dam considered in M/P1995 and M/P2013 in order to assure full-year irrigated farmland.
2.3	Integration Scheme	Not applied at HA-6 (Ogun-Osun Basin)Scheme which is extensively developed by multipurpose dam, utilizing water and hydropower deriving from that dam

Source: JICA Project Team

8.2.2 Development Plan

(1) Completion with No Extension Scheme

Out of existing public irrigation scheme of 25 sites, there are 10 schemes which has already completed or suspended, and which has no extension plan in future. Subject to the proposed cropping pattern and safety level for water supply (1/5 years safety level), future irrigation area is evaluated by irrigation scheme. In case of insufficient water volume from water resources in general against planned irrigation areas or limitation utilizing to irrigation water due to prioritize to domestic water supply in future. As a result, system developed area 1,154ha developed so far by FMWR is evaluated at 474ha due to lack of water potential against water demand for irrigation.

Table 7-23 Completion with No Extension Scheme

HA	Number of Scheme			System Developed area(ha)			Planned Irrigation Area(ha)			Future Irrigation Area (ha)
	L	M	Total	L	M	Total	L	M	Total	
6	7	3	10	1,134	20	1,154	9,600	750	10,350	474

Note) L: Large Scale Scheme, M: Medium and Small Scale Scheme
・Future irrigation area means irrigable area subject to the proposed cropping pattern and safety level for water supply (1/5 years safety level), and Future irrigation area is identified with system developed area due to no expansion plan.
Source: JICA Project Team

(2) Ongoing Scheme

There are 4 sites of on-going irrigation scheme implemented by FMWR in the country, and those schemes should be completed early.

Table 7-24 Ongoing Scheme

No	HA	Class	Name of Scheme	State	System Developed Area (ha)	Planed Irrigation Area (ha)	Future irrigation Area (ha)
1	6	L	Middle Ogun (I.G)	Oyo	750	12,000	12,000
2	6	L	Lower Ogun (Mokoloki)	Ogun	500	12,000	12,000
3	6	M	Owiwi	Ogun	45	302	(302)
4	6	M	Itoikin	Lagos	141	315	(315)
Total					1,436	24,617	24,617

Note) L: Large Scale Scheme, M: Medium and Small Scale Scheme

・Future irrigation area means irrigable area subject to the proposed cropping pattern and safety level for water supply (1/5 years safety level)

・Value of ( ) in column of future irrigation areas evaluated are judged to be possible to expand FMWR planned areas despite water balance evaluation was not implemented by individual scheme about medium and small scale scheme which is difficult to specify the detailed location.

*1) It is possible to irrigate farmland up to 1,200ha, constructing new dam (No.2043 Lade Dam).

Source: JICA Project Team

Reference : 1) FMWR budget document 2) Utilization of Natural Resources Fund for Water Resources and Agricultural Development, FMWR, FMARD

(3) Extension Scheme

According to Proposed Master Plan for Irrigation and Dam Development for 2009-2020 (FMAWR), numbers of irrigation scheme for only rehabilitation and for expansion with partial rehabilitation are 3 sites and 7 sites respectively. According to the surface water potential evaluation, almost the scheme for rehabilitation only have plenty amount of water, and then it is possible to expand the system development area up to the planned irrigation areas. To expand the irrigated farmlands it is recommended to expand the development to 3 schemes not only that rehabilitation but the planned irrigation areas.

Table 7-25 Extension Scheme

No	HA	Class	Name of Scheme	State	Level of Development		System Developed Area (ha)	Planed Irrigation Area (ha)	Future irrigation Area (ha)
1	6	L	Iwo	Osun		E	0	1,000	0
2	6	L	Ilero	Oyo		E	0	2,000	70
3	6	L	Asa	Oyo	R	E	0	500	500
4	6	L	Okuku	Osun	R	E	0	600	30
5	6	L	Esa Odo Dam	Osun	R	E	800	800	800
6	6	L	New Erinle	Osun	R	E	500	500	500
7	6	M	Oogi	Osun	R	E	0	400	(400)
8	6	M	Ipetu-Ijesha	Osun	R	E	0	250	(250)
9	6	M	Orile Owu	Osun	R	E	100	100	(100)
10	6	M	Old Erinle Dam	Osun	R	E	150	150	(150)
Total							1,552	6,332	2,800

Note) L: Large Scale Scheme, M: Medium and Small Scale Scheme

In Level of development, R: Rehabilitation, E: Expansion

・Future irrigation area means irrigable area subject to the proposed cropping pattern and safety level for water supply (1/5 years safety level)

・Value of ( ) in column of future irrigation areas evaluated are judged to be possible to expand FMWR planned areas despite water balance evaluation was not implemented by individual scheme about medium and small scale scheme which is difficult to specify the detailed location.

*1) It is possible to irrigate farmland up to 2,900ha, utilizing existing dam (No.12 Swashi Dam).

Source: JICA Project Team

Reference : 1)Baseline studies for National Water Resources Draft Final Report, ENPLAN, 2009

2) Masterplan for Irrigation and Dam Development for 2009-2020, FMAWR

(4) Planned Irrigation Area by Hydrological Area

Future irrigation area on existing public irrigation scheme and planned irrigation area on new proposed public irrigation scheme are shown as follows.

Table 7-26 Planned Irrigation Area as of 2030

	HA-6
Existing Irrigation Scheme	27,891
1.1 Completion with No Extension Scheme	474
1.2 Ongoing Scheme	24,617
1.3 Extension Scheme	2,800
New Irrigation Scheme	0
2.1 Supplementary Irrigation Scheme	0
2.2 Dam Irrigation Scheme	0
2.3 Integration Scheme	0
Total	27,891

Source: JICA Project Team

(5) Planned Irrigation Area on Term

Two scenario of Irrigation development are set, considering the water demand of Lagos state.

Scenario A: Lower Ogun Irrigation Scheme (A=12,000ha) and Middle Ogun Irrigation Scheme (A=12,000ha) are completed by middle term in accordance with the implementation schedule of Master Plan.

Scenario B: Considering the water demand of Lagos state own, the first stage (A=3000ha respectively) of above-cited irrigation area are completed by middle term, and remaining stage (A=9000ha) are completed in long term.

The trends of above-cited irrigation area on term, which are corresponded with the Implementation Schedule after-mentioned Chapter-9 are shown as follows;

Table 7-27 Planned Irrigation Area on Term (Scenario-A)

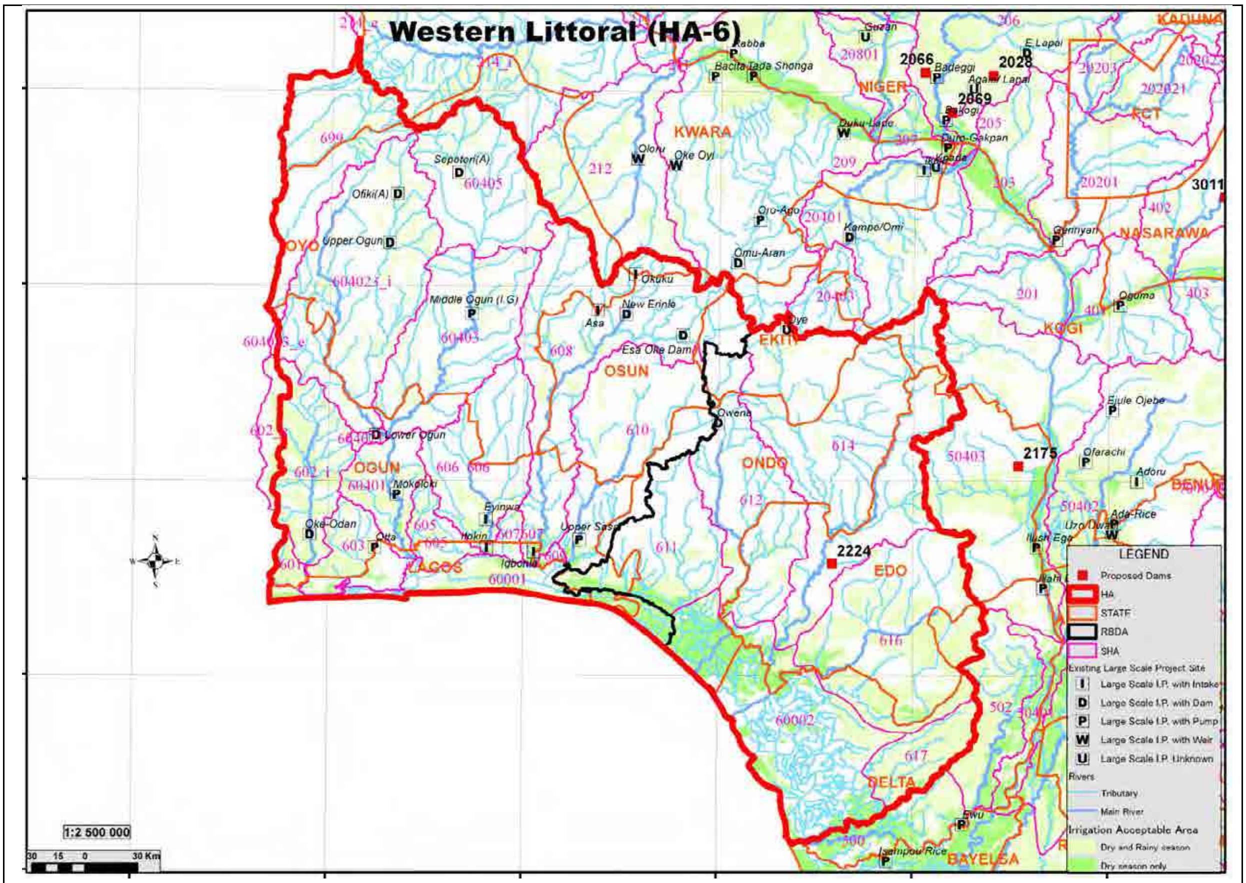
	Short term (2020)	Middle term (2025)	Long term (2030)
Existing Irrigation Scheme	16,329	27,891	27,891
1.1 Completion with No Extension Scheme	474	474	474
1.2 Ongoing Scheme	13,555	24,617	24,617
1.3 Extension Scheme	2,300	2,800	2,800
New Irrigation Scheme	0	0	0
2.1 Supplementary Irrigation Scheme	0	0	0
2.2 Dam Irrigation Scheme	0	0	0
2.3 Integration Scheme	0	0	0
Total	16,329	27,891	27,891

Source: JICA Project Team

Table 7-28 Planned Irrigation Area on Term (Scenario-B)

	Short term (2020)	Middle term (2025)	Long term (2030)
Existing Irrigation Scheme	9,391	9,891	27,891
1.1 Completion with No Extension Scheme	474	474	474
1.2 Ongoing Scheme	6.617	6,617	24,617
1.3 Extension Scheme	2,300	2,800	2,800
New Irrigation Scheme	0	0	0
2.1 Supplementary Irrigation Scheme	0	0	0
2.2 Dam Irrigation Scheme	0	0	0
2.3 Integration Scheme	0	0	0
Total	9,391	9,891	27,891

Source: JICA Project Team



Source: JICA Project Team

Figure 7-8 Irrigation Development Plan (HA-6)

7.3 Development Plan of Other Sub-Sectors

7.3.1 Hydropower Generation

Hydropower generation is a technology to convert the energy of falling or flowing water into electricity. The structure of hydropower stations is relatively simple and thus easier to install than thermal power stations, which require large-scale plant facilities. However, some cautions are needed, as hydroelectric plants often turn out not to be economically feasible in locations where the hydraulic head and stream flow are insufficient. Also, it is important to properly maintain the turbines, which are driven by a stream of water and thus are prone to breakage caused by debris in the water.

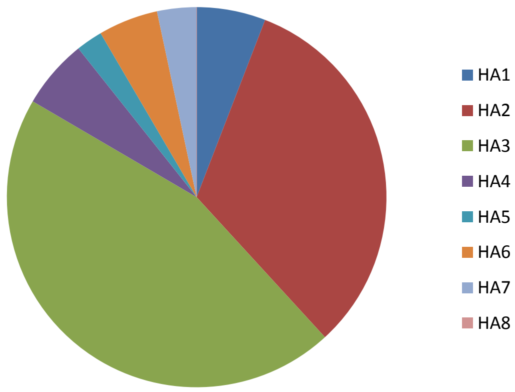
Considering the large environmental and social impacts of constructing a large-scale hydroelectric station, as well as the lack of suitable dam sites with large enough capacities, a more practical choice for the proposed dam sites would be to install small hydropower stations that are driven by water used primarily for irrigation purposes.

In regards to the large-scale hydroelectric dam development projects being planned by Nigeria's Federal Ministry of Power (FMP), it is important for FMWR as the administrator of the river environment to provide FMP appropriate guidance on a continuing basis such as, for instance, teaching them to check the existence of low-flow sections and, if necessary, discharge water to secure the predetermined minimum flow level.

(1) Evaluation of Hydroelectric Potential

We estimated the hydroelectric potential of each dam site based on the flow regime and dam height of each site, which were identified by our survey, to examine the possible introduction of hydroelectric stations, and sorted out the approximate results as follows.

HA	Annual Output (MWｈ)
HA-1	69,722
HA-2	383,971
HA-3	537,402
HA-4	69,929
HA-5	26,900
HA-6	60,359
HA-7	39,934
HA-8	0
Total	1,188,217



Source: JICA Project Team

Figure 7-9 Output (Potential) by HA

HA-2 and HA-3 have large potentials, as these areas are blessed with good stream flows and topographical advantages, whereas HA-6, one of the target areas of this Project, cannot expect to maintain stable output throughout the year due to topographical constraints, which make it difficult to create enough hydraulic head, along with relatively poor stream flow.

In addition, the hydropower station at Oyan Dam broke due to lack of maintenance and has stopped functioning all together despite the abundant stream flow. This is another indication that constructing hydropower stations in Nigeria would not be effective given the current dam operation and maintenance statuses. For the future, however, it is important to allocate sufficient budget and personnel to conduct periodic maintenance.

Photo 8-1 Oyan Dam

Photo 8-2: Hydropower Station at Oyan Dam (out of service)

(2) Considering the Installation of Low-Head Hydroelectric Stations

While dam-type hydroelectric stations have the advantage of relatively large output, they also have shortcomings such as high construction cost and large impact on the river environment. Low-head hydropower is drawing attention recently as a promising solution to such obstacles, as it generates electricity mostly by the use of river current without relying on a large head and therefore can minimize the alteration of the river environment.

Shown below are examples of low-head hydroelectric stations in Japan, the heads of which range from 3 to 9 meters. The Shichika Yosui Station is a turbine facility installed in an irrigation canal constructed for agricultural purposes. Some of the sites under the agricultural scheme of this Study may be suitable for this type of hydropower station.

River: Shichika Yousui
Effective head: 5.45m
Max. water use: 15.00m^3/s
Max. output: 630kW
Annual output: 4,011MWh

From the website of Tedori River Shichika Yousui Land Improvement District
http://www.shichika.or.jp/work/plant.html

Figure 7-10 Case of Low-Head Hydropower Generation in Japan

The above stations use large amounts of water to compensate the low heads, which means that this type of hydropower station does not function well in locations without abundant stream flow. Also, constructing a power station in areas with large river flow requires due consideration, as it involves some difficult works, such as building a cofferdam, etc.

Installing a power generation facility concurrently with the construction of an irrigation canal, as was the case with the Shichika Yousui, is a very rational approach, as it does not require large-scale cofferdam work. For this reason, we recommend that the future irrigation canal projects under the agricultural scheme with large stream flows should actively incorporate low-head hydropower. We presume that there are many potential sites, as low-head hydropower stations are not so much constricted by topographical features.

(3) Necessity of Trial Installation

The most important aspect of the maintenance of hydroelectric facilities is the removal of dust from the equipment, as it takes in water directly from the river, which naturally contains dust and debris that need to be removed properly. While the intake gates of dam-type hydropower stations are usually situated lower than the river surface, those of low-head stations are at about the same level as the river, which makes it easier for the debris floating on the river surface to flow into the turbines, causing breakage.

For this reason, it is desirable to install a turbine in a relatively small river or canal on a pilot basis to test and check the actual output and removal of debris before full-scale installation.

At Ogun-Oshun RBDA, which we surveyed this time, there is staff housing within the properties, for which a small dam has been constructed to supply water for daily use. The BRDA staff we interviewed expressed a desire to install a small hydropower system by exploiting the head and discharge flow of this dam.

The dam with a head of 5m or so takes in water at an approximate rate of $0.1m^3/s$, which translates to a small output up to 4kW and a generation capacity of 15,000kWh per year. This, however, will probably be enough to supply electricity to 5 to 10 households for daily use. It is important for the future to introduce these small hydro systems on a trial basis to test different daily maintenance methods and verify their effects toward introducing similar systems to wider areas.

Photo 7-3 Reservoir and Intake Facility in RBDA

Photo 7-4 Downstream Side of Spillway in RBDA

7.3.2 Flood and Erosion Control and Inland Waterway Transportation

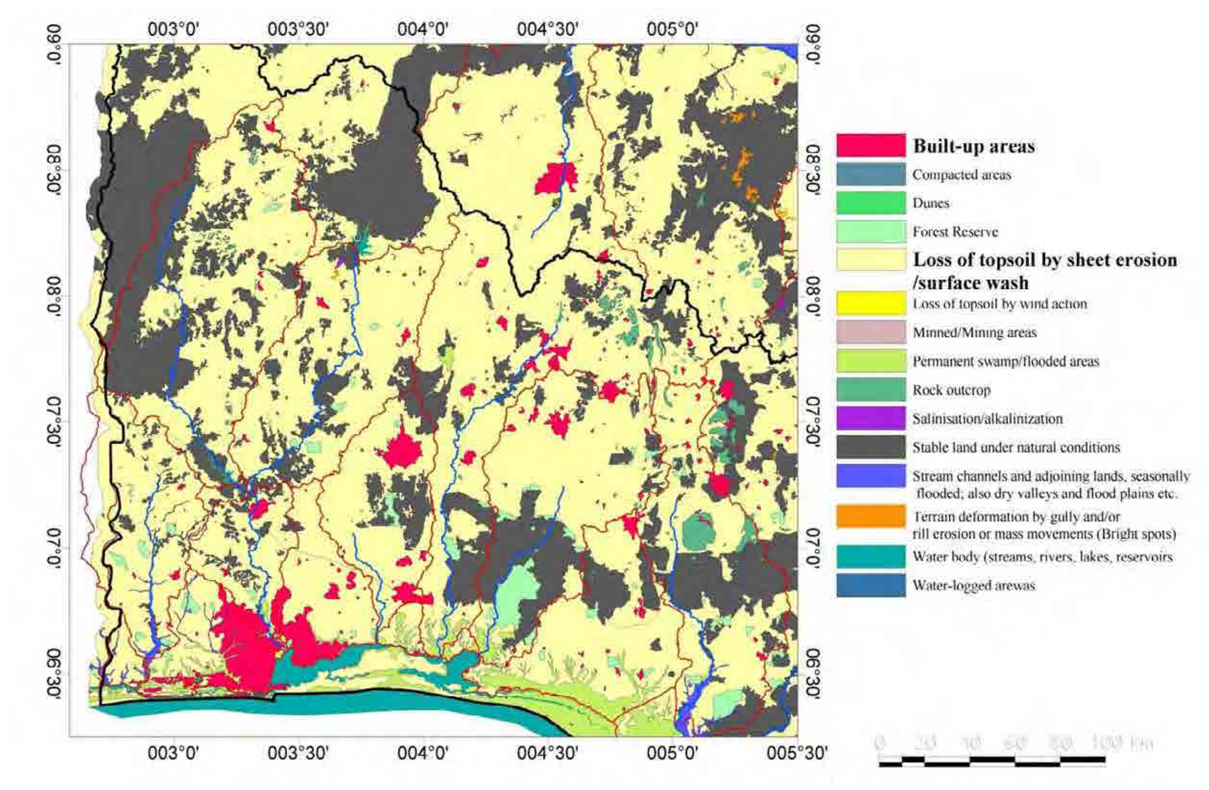
(1) Issues of Ogun-Oshun Basin

The main rivers in Ogun-Oshun Basin are the Ogun River and the Oshun River. The Ogun River, receiving tributaries from Oyo State, going through Abeokuta, empties Lagos lagoon in the Lagos State. The most downstream reach of the Ogun River has mild bed slope of 1:10,000 and its floodplain is submerged in rainy season. The Oshun River empties the Lagos lagoon.

Ogun-Oshun Basin has a long history on development in Nigeria. Lagos was given priority by British colonial government and became primary seaport for international trading and had connection to hinterland with railway. Urban areas have been developed along the railway lines such as present Lagos, Abeokuta and Ibadan. The usage of river as inland waterway transportation is limited to the area around the Lagos lagoon. In Ogun-Oshun Basin, only the area in and around Lagos is flood-prone so that the need for flood control was very high. But other areas have had less attention on enhancement of land use by flood control.

Past flood disasters in Ogun-Oshun Basin happened as rainwater drainage issues in middle and small rivers in urban areas such as Ibadan and Lagos. However in recent years in the situation of urban area growth in Lagos State and Ogun State, the floodplain of the Ogun River has been urbanized gradually to result into the flood damage occurrence

The land in Ogun-Oshun Basin, according to Land Degradation Map by FME, has character of loss of topsoil by rainfall and wind (Figure 7-11)



Source: prepared by JICA Project Team from GIS data of FME

Figure 7-11 Land Degradation Map in Ogun-Oshun Basin

Regarding inland waterway transportation in Ogun State, Ogun State Regional Plan 2005-2025 prepared in 2008 states that there is possibility of usage of river flowing from North to South. The navigation between Lagos and Abeokuta was already replaced by road and railway. However, under the national policy of multi modal transportation development, the State Government does not express the potential clearly.

(2) Challenges for Stakeholders

Figure 7-11 shows the present urban area (built-up area) too. In Ogun-Oshun Basin, it is expected a kind of greater metropolitan area covering Lagos and Ogun States in the future. Such metropolitan area will expand to overlap the most downstream reach of the Ogun River. The urban area in Lagos started from the higher ground apart from the Ogun river floodplain and the present drainage system relies on gravity. But the presently expanded urban area reached floodplain in the Ogun River, in the line of future urban area development, management of floodplain and inland waterway transportation will be important. Regarding other major urban area such as Ibadan, it is located on higher ground so local drainage improvement and soil erosion countermeasures shall be conducted continuously

For the following items, Federal Governments, especially FMWR (Dam Department and NIHSA) shall provide with hydrological monitoring data and technical support for flood hazard assessment.

- Management of Floodplain of Ogun River (RBDA, FME, Ogun State, Lagos State),
- Ibadan Urban Drainage (Oyo State),
- Lagos Urban Drainage Improvement (Lagos State),
- Erosion Control in urban area (each State), and
- Development of Inland Water Transportation in Ogun River, etc. (NIWA, each State, RBDA).

(3) Strategies

<u>River Management in Ogun River Catchment (Floodplain Management, Flood Forecast during Dam Release)</u>

In the dams in Ogun river basin, flood early warning system has been introduced by FME. According to Ogun State, the system is linked with the operation of Oyan Dam release. Also in the downstream city, Abeokuta, every time when flood happened in the Ogun River, the effect of Oyan Dam release is reported in newspaper, sometimes to cause discussion in society. Therefore, State Government and RBDA shall conduct topographical survey of the Ogun river floodplain and confirm the channel capacity (relation between water level and discharge) in order to study the flood hazard extent for assumed discharge. Moreover, RBDA which is in charge of upstream dam operation shall establish a framework to inform the dam release information to States (SEMA), LGA and relevant disaster prevention organizations located in downstream.

- RBDA shall conduct topographical survey for floodplain of the Ogun River in collaboration with Geological Survey.
- RBDA shall conduct mapping of floodplains of the Ogun River by scale 1:10,000 in collaboration with FME.
- RBDA shall conduct water level measurement (hourly) in the reservoirs and confirm the release discharge downstream in real time.
- FMWR and NIHSA shall develop flood runoff model for Ogun and Oshun Rivers and have capacity to analyze the flood hazard in the floodplain to use the information on dam release.
- RBDA shall have capacity to operate flood hazard assessment tool for floodplain to get technical support from FMWR-NIHSA.
- SEMA shall have institutional arrangement to receive information on flood hazard for floodplain and disseminate them to local people.
- The relevant State shall reflect the flood hazard assessment to their urban development plan.

Ibadan Urban Drainage Countermeasures

In Ibadan, September 2011, the spillway of water supply dam was collapsed to result into the instant increase of flood discharge downstream and causing flood damage. Oyo State organized a task force under the Governor to prepare the short, middle and long term countermeasures. In the future, the middle and long term measures shall be implemented.

Continuous implementation of Urban Drainage Improvement in Lagos

Lagos State is the area where there is the most progressed urban drainage improvement system in Ogun-Oshun Basin. There are four main sub drainage areas and WB and State Government funded the various projects. Such urban drainage improvement project as well as future waste water drainage plan shall be coordinate with management of floodplain in the downstream reach of the Ogun River.

Erosion Control in Urban Area

The erosion control projects implemented in Ogun State are the cleaning of channel, dredging and lining. Also ecological fund projects in Ogun State are the stabilization of steep slope and channel improvement (lining) and others. These shall be implemented continuously as part of Urban Environment Improvement Project. In terms of the planning and design of such facilities, it is important that hydrological monitoring data of FME and FMWR (NIHSA) and Geographical Information System shall support the State Government.

Study on Inland Waterway Transportation in Ogun River and Others

At present NIWA is in charge of the inland waterway transportation in Ogun River and other rivers. Ogun State and other relevant States shall coordinate with NIWA and FMWR who are in charge of river management organizations in order to study the potential feasibility of future inland transportation development in Ogun-Oshun Basin.

7.3.3 Inland Fishery

Inland fishery basically competes with irrigation sector in terms of water use. However, it is recommendable to apply fish farming in the field of irrigation in such ways as fish farming in dams and reservoirs for agricultural purpose. In particular, it will be possible for local people to create opportunities of subsidiary income sources without competing with water use by agriculture only if they introduce fish farming on the surface of lowland rice fields in such a way as observed in Japan and in China. In this case, they can utilize abattoirs' wastes and livestock droppings. In this way, as development frame of fisheries sub-sector and that of irrigation, agriculture and livestock sub-sectors are closely related each other, it is advisable to closely hold consultation among these sub-sectors for developing their activities by effectively utilizing water resources.

7.3.4 Livestock

The above policies do not include water resources development and management for promoting livestock industry. In practice, however, animal water at lakes, ponds, rivers, reservoirs, canals etc is indispensable for livestock maintenance including water spots for seasonal transhumant activities. Also, commercial livestock sub-sector may need means of water supply exclusively provided for livestock. Thus, livestock and irrigation sectors should closely be related mutually, it is necessary to produce efficient use of water resources through communication, coordination and collaboration between them

Annex-Table 7

Annex-Table 7-1 List of Water Supply Project (Scenario-A)

S/N	Code	State	Project Tyoe	Category	Water Source	Project Name	Implementing Agency	LGA	Design Capacity (m3/day)	Performance 2010 (m3/day)	Performance 2030 (m3/day)	Develop't (2010-30) Hydrological Balance (m3/day)	Develop't (2010-30) Facility Planning (m3/day)	Scope	Schedule
1	WS-24-1	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Adiyan Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ifako-Ijaye	318,220	143,794	254,576	110,782	110,782	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
2	WS-24-2	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Iju Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ifako-Ijaye	204,570	92,439	163,656	71,217	71,217	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
3	WS-24-3	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Isashi Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ojo	18,184	8,217	14,547	6,330	6,330	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
-	WS-24-4	Lagos	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	Lagos Water Corporation	-				-	-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface water development
4	WS-24-5	Lagos	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	-				3,344	3,344	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	
5	WS-24-6	Lagos	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	-				1,605	1,605	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
6	WS-24-7	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Yewa-1 Water Supply Project (Desalination)	Lagos Water Corporation	Badagry	227,300		171,380	171,380	214,224	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-24-8	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Yewa-2 Water Supply Project (Desalination)	Lagos Water Corporation	Badagry	227,300		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
-	WS-24-9	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Otta-Ikosi Water Supply Project	Lagos Water Corporation	Epe	18,184		14,547	14,547	18,184	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing
7	WS-24-10	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-1 Water Supply Project	Lagos Water Corporation	Epe	113,650		85,690	85,690	107,112	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
8	WS-24-11	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-2 Water Supply Project	Lagos Water Corporation	Epe	409,140		308,483	308,483	385,604	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-24-12	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-3 Water Supply Project	Lagos Water Corporation	Epe	431,870		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
9	WS-24-13	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Adiyan-2 Water Supply Project	Lagos Water Corporation	Ifako-Ijaye	318,220		239,931	239,931	299,914	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
10	WS-24-14	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Adiyan-3 Water Supply Project	Lagos Water Corporation	Ifako-Ijaye	318,220		239,931	239,931	299,914	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
11	WS-24-15	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Ibesha Water Supply Project (Desalination)	Lagos Water Corporation	Ikorodu	227,300		171,380	171,380	214,224	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
12	WS-24-16	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Isashi Expansion-1 Water Supply Project	Lagos Water Corporation	Ojo	36,368		27,421	27,421	34,276	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
13	WS-24-17	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Isashi Expansion-2 Water Supply Project	Lagos Water Corporation	Ojo	104,558		78,835	78,835	98,543	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-24-18	Lagos	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	Lagos Water Corporation	-				-	-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface water development
14	WS-24-19	Lagos	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	-				2,291	2,863	Boreholes, handpumps, rizer pipes and accessories, etc	
15	WS-24-20	Lagos	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	-				3,436	4,295	Boreholes, motorized pumps, rizer pipes and accessories, generator, overhead tanks, pipes and public taps, etc	
16	WS-27-1	Ogun	R	Urban, S.U./S.T.	S.W.	Abeokuta Main Water Supply Scheme / Old Rehabilitation Project	State Water Corporation	Abeokuta South	15,000	6,778	12,000	5,222	5,222	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
17	WS-27-2	Ogun	R	Urban, S.U./S.T.	S.W.	Abeokuta Main Water Supply Scheme / New Rehabilitation Project	State Water Corporation	Abeokuta South	82,000	37,053	65,600	28,547	28,547	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
18	WS-27-3	Ogun	R	Urban, S.U./S.T.	S.W.	Ota Old Water Supply Scheme Rehabilitation Project	State Water Corporation	Ado-Odo/Ota	2,450	1,107	1,960	853	853	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
19	WS-27-4	Ogun	R	Urban, S.U./S.T.	S.W.	Ota New Water Supply Scheme Rehabilitation Project	State Water Corporation	Ado-Odo/Ota	6,750	3,050	5,400	2,350	2,350	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
20	WS-27-5	Ogun	R	Urban, S.U./S.T.	S.W.	Ilaro Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbado South	240	108	192	84	84	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
21	WS-27-6	Ogun	R	Urban, S.U./S.T.	S.W.	Ifo Akinsede/Papalanto Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifo	12,000	5,422	9,600	4,178	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
22	WS-27-7	Ogun	R	Urban, S.U./S.T.	S.W.	Itele Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu East	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
23	WS-27-8	Ogun	R	Urban, S.U./S.T.	S.W.	Ijebu-Igbo/Apoje Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu North	18,500	8,360	14,800	6,440	6,440	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
24	WS-27-9	Ogun	R	Urban, S.U./S.T.	S.W.	Ijebu-Ode/Yemoji Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu Ode	18,000	8,134	14,400	6,266	6,266	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
25	WS-27-10	Ogun	R	Urban, S.U./S.T.	S.W.	Ogere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ikenne	6,700	3,028	5,360	2,332	2,332	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
26	WS-27-11	Ogun	R	Urban, S.U./S.T.	S.W.	Imeko Water Supply Scheme Rehabilitation Project	State Water Corporation	Imeko-Afon	2,400	1,084	1,920	836	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
27	WS-27-12	Ogun	R	Urban, S.U./S.T.	S.W.	Abigi Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun Waterside	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
28	WS-27-13	Ogun	R	Urban, S.U./S.T.	S.W.	Shagamu Water Supply Scheme Rehabilitation Project	State Water Corporation	Shagamu	6,500	2,937	5,200	2,263	2,263	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
-	WS-27-14	Ogun	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-				-	-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface water development
29	WS-27-15	Ogun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				764	764	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	
30	WS-27-16	Ogun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				10,356	10,356	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
31	WS-27-17	Ogun	N	Urban, S.U./S.T.	S.W.	Ota Old (Doubling) Water Supply Project	State Water Corporation	Ado-Odo/Ota	2,450		1,960	1,960	2,450	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-27-18	Ogun	N	Urban, S.U./S.T.	S.W.	Ota New (Doubling) Water Supply Project	State Water Corporation	Ado-Odo/Ota	6,750		5,400	5,400	6,750	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing
-	WS-27-19	Ogun	N	Urban, S.U./S.T.	S.W.	Yewa Regional Water Supply Project 1	State Water Corporation	Egbado South	100,000		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
-	WS-27-20	Ogun	N	Urban, S.U./S.T.	S.W.	Yewa Regional Water Supply Project 2	State Water Corporation	Egbado South	100,000		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
32	WS-27-21	Ogun	N	Urban, S.U./S.T.	S.W.	Apoje Regional Water Supply Project 1	State Water Corporation	Ijebu North	200,000		70,102	70,102	87,627	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-27-22	Ogun	N	Urban, S.U./S.T.	S.W.	Apoje Regional Water Supply Project 2	State Water Corporation	Ijebu North	200,000		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
33	WS-27-23	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 1	State Water Corporation	Obafemi-Owode	250,000		200,000	200,000	250,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-27-24	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 2	State Water Corporation	Obafemi-Owode	250,000		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
-	WS-27-25	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 3	State Water Corporation	Obafemi-Owode	200,000		-	-	-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030
-	WS-27-26	Ogun	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-				-	-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface water development
34	WS-27-27	Ogun	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				15,399	19,249	Boreholes, handpumps, rizer pipes and accessories, etc	
35	WS-27-28	Ogun	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				23,098	28,873	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	
36	WS-29-1	Osun	R	Urban, S.U./S.T.	S.W.	Orile-Owu Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedade	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
37	WS-29-2	Osun	R	Urban, S.U./S.T.	S.W.	Odeyinka Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
38	WS-29-3	Osun	R	Urban, S.U./S.T.	S.W.	Ile-Ogbo/Kuta Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedire	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
39	WS-29-4	Osun	R	Urban, S.U./S.T.	S.W.	Oluponna Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedire	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
40	WS-29-5	Osun	R	Urban, S.U./S.T.	S.W.	Iperindo Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa East	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
41	WS-29-6	Osun	R	Urban, S.U./S.T.	S.W.	Ifewara Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	420	190	336	146	146	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
42	WS-29-7	Osun	R	Urban, S.U./S.T.	S.W.	Ifewara/Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
43	WS-29-8	Osun	R	Urban, S.U./S.T.	S.W.	Osu/Ilesha Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
44	WS-29-9	Osun	R	Urban, S.U./S.T.	S.W.	Igbajo Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
45	WS-29-10	Osun	R	Urban, S.U./S.T.	S.W.	Otan/Iresi Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
46	WS-29-11	Osun	R	Urban, S.U./S.T.	S.W.	Igbajo/Oke-Irun Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
47	WS-29-12	Osun	R	Urban, S.U./S.T.	S.W.	Iree/Eripa Water Supply Scheme Rehabilitation Project	State Water Corporation	Boripe	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
48	WS-29-13	Osun	R	Urban, S.U./S.T.	S.W.	Ada Water Supply Scheme Rehabilitation Project	State Water Corporation	Boripe	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
49	WS-29-14	Osun	R	Urban, S.U./S.T.	S.W.	Ede/Old Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Ede North	9,000	4,067	7,200	3,133	3,133	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
50	WS-29-15	Osun	R	Urban, S.U./S.T.	S.W.	Ede/New Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Ede North	180,000	81,336	144,000	62,664	62,664	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
51	WS-29-16	Osun	R	Urban, S.U./S.T.	S.W.	Ejigbo Water Supply Scheme Rehabilitation Project	State Water Corporation	Ejigbo	2,400	1,084	1,920	836	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
52	WS-29-17	Osun	R	Urban, S.U./S.T.	S.W.	Ife-Odan Water Supply Scheme Rehabilitation Project	State Water Corporation	Ejigbo	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
53	WS-29-18	Osun	R	Urban, S.U./S.T.	S.W.	Mokuro Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife East	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
54	WS-29-19	Osun	R	Urban, S.U./S.T.	S.W.	Famia/Oyere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife North	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
55	WS-29-20	Osun	R	Urban, S.U./S.T.	S.W.	Alajue Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife North	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
56	WS-29-21	Osun	R	Urban, S.U./S.T.	S.W.	Ifetedo Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	3,700	1,672	2,960	1,288	1,288	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
57	WS-29-22	Osun	R	Urban, S.U./S.T.	S.W.	Aye-Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
58	WS-29-23	Osun	R	Urban, S.U./S.T.	S.W.	Omifunfun Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
59	WS-29-24	Osun	R	Urban, S.U./S.T.	S.W.	Mefoworade Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
60	WS-29-25	Osun	R	Urban, S.U./S.T.	S.W.	Ora Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifedayo	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
61	WS-29-26	Osun	R	Urban, S.U./S.T.	S.W.	Eko-Ende Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	12,000	5,422	9,600	4,178	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
62	WS-29-27	Osun	R	Urban, S.U./S.T.	S.W.	Dagbolu Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
63	WS-29-28	Osun	R	Urban, S.U./S.T.	S.W.	Iba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	150	68	120	52	52	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
64	WS-29-29	Osun	R	Urban, S.U./S.T.	S.W.	Ila/Orangun Water Supply Scheme Rehabilitation Project	State Water Corporation	Ila	2,200	994	1,760	766	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
65	WS-29-30	Osun	R	Urban, S.U./S.T.	S.W.	Ibodi/Oscoed Water Scheme	State Water Corporation	Ilesha East	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
66	WS-29-31	Osun	R	Urban, S.U./S.T.	S.W.	Asejire Water Scheme	State Water Corporation	Irewole	1,200	542	960	418	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
67	WS-29-32	Osun	R	Urban, S.U./S.T.	S.W.	Iwo/Ayiba Water Supply Scheme Rehabilitation Project	State Water Corporation	Iwo	9,080	4,103	7,264	3,161	3,161	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
68	WS-29-33	Osun	R	Urban, S.U./S.T.	S.W.	Esa-Odo Water Supply Scheme Rehabilitation Project	State Water Corporation	Obokun	5,000	2,259	4,000	1,741	1,741	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
69	WS-29-34	Osun	R	Urban, S.U./S.T.	S.W.	Oyan Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	230	104	184	80	80	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
70	WS-29-35	Osun	R	Urban, S.U./S.T.	S.W.	Okuku Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
71	WS-29-36	Osun	R	Urban, S.U./S.T.	S.W.	Igbaye Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
72	WS-29-37	Osun	R	Urban, S.U./S.T.	S.W.	Inisa Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
73	WS-29-38	Osun	R	Urban, S.U./S.T.	S.W.	Tootoo/Igere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ola Oluwa	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
74	WS-29-39	Osun	R	Urban, S.U./S.T.	S.W.	Ajagunlase Water Supply Scheme Rehabilitation Project	State Water Corporation	Ola Oluwa	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
75	WS-29-40	Osun	R	Urban, S.U./S.T.	S.W.	Ikeji-Ile Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	2,200	994	1,760	766	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
76	WS-29-41	Osun	R	Urban, S.U./S.T.	S.W.	Esa-Oke Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
77	WS-29-42	Osun	R	Urban, S.U./S.T.	S.W.	Iwara/Igangan Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
78	WS-29-43	Osun	R	Urban, S.U./S.T.	S.W.	Ikeji-Arakeji Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
79	WS-29-44	Osun	R	Urban, S.U./S.T.	S.W.	Oke-Osun/Abere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osogbo	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
80	WS-29-45	Osun	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-				39,417	39,417	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
81	WS-29-46	Osun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				2,079	2,079	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	
82	WS-29-47	Osun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				21,927	21,927	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
83	WS-29-48	Osun	N	Urban, S.U./S.T.	S.W.	Ilesha Water Supply Project	State Water Corporation	Atakumosa West	60,000		48,000	48,000	60,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
84	WS-29-49	Osun	N	Urban, S.U./S.T.	S.W.	Ife Water Supply Project	State Water Corporation	Ife Central	30,000		24,000	24,000	30,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
85	WS-29-50	Osun	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-				39,417	49,271	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
86	WS-29-51	Osun	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				9,602	12,002	Boreholes, handpumps, rizer pipes and accessories, etc	
87	WS-29-52	Osun	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				14,403	18,003	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	
88	WS-30-1	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Asejire Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbeda	186,000	84,047	148,800	64,753	64,753	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
89	WS-30-2	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Osegere Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbeda	13,500	6,100	10,800	4,700	4,700	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
90	WS-30-3	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Eleyele Water Supply Scheme Rehabilitation Project	State Water Corporation	Ibadan North West	27,240	12,309	21,792	9,483	9,483	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
91	WS-30-4	Oyo	R	Urban, S.U./S.T.	S.W.	Igboora-Eruwa-Lanlate/Eruwa Water Supply Scheme Rehabilitation Project	State Water Corporation	Ibarapa East	3,300	1,491	2,640	1,149	1,149	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
92	WS-30-5	Oyo	R	Urban, S.U./S.T.	S.W.	Owode Water Supply Scheme Rehabilitation Project	State Water Corporation	Ido	900	407	720	313	313	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
93	WS-30-6	Oyo	R	Urban, S.U./S.T.	S.W.	Kishi Water Supply Scheme Rehabilitation Project	State Water Corporation	Irepo	720	325	576	251	251	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
94	WS-30-7	Oyo	R	Urban, S.U./S.T.	S.W.	Iseyin Water Supply Scheme Rehabilitation Project	State Water Corporation	Iseyin	1,200	542	960	418	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
95	WS-30-8	Oyo	R	Urban, S.U./S.T.	S.W.	Lalupon Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Lagelu	436	197	349	152	152	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
96	WS-30-9	Oyo	R	Urban, S.U./S.T.	S.W.	Ogbomoso-Ikoyi Ile/Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogbomosho North	6,400	2,892	5,120	2,228	2,228	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
97	WS-30-10	Oyo	R	Urban, S.U./S.T.	S.W.	Igbetti /Afowose Water Supply Scheme Rehabilitation Project	State Water Corporation	Olorunsogo	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
98	WS-30-11	Oyo	R	Urban, S.U./S.T.	S.W.	Igboho/Sanya Water Supply Scheme Rehabilitation Project	State Water Corporation	Orelope	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
99	WS-30-12	Oyo	R	Urban, S.U./S.T.	S.W.	Oyo//Erelu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo East	7,500	3,389	6,000	2,611	2,611	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
100	WS-30-13	Oyo	R	Urban, S.U./S.T.	S.W.	Ago Amodu Water Supply Scheme Rehabilitation Project	State Water Corporation	Saki East	500	226	400	174	174	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
101	WS-30-14	Oyo	R	Urban, S.U./S.T.	S.W.	Saki/Fofo Water Supply Scheme Rehabilitation Project	State Water Corporation	Saki West	1,333	602	1,066	464	464	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
-	WS-30-15	Oyo	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-				-	-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface water development
102	WS-30-16	Oyo	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				5,096	5,096	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	
103	WS-30-17	Oyo	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				25,069	25,069	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	
104	WS-30-18	Oyo	N	Urban, S.U./S.T.	S.W.	Afijio Water Supply Project	State Water Corporation	Afijio	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
105	WS-30-19	Oyo	N	Urban, S.U./S.T.	S.W.	Akinyele Water Supply Project	State Water Corporation	Akinyele	6,000		4,800	4,800	6,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
106	WS-30-20	Oyo	N	Urban, S.U./S.T.	S.W.	Ago-Are/Tede Water Supply Project	State Water Corporation	Atigbo	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-30-21	Oyo	N	Urban, S.U./S.T.	S.W.	Ayete-Tapa-Idere Water Supply Project	State Water Corporation	Ibarapa North	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing
107	WS-30-22	Oyo	N	Urban, S.U./S.T.	S.W.	Ido Water Supply Project	State Water Corporation	Ido	5,000		4,000	4,000	5,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
108	WS-30-23	Oyo	N	Urban, S.U./S.T.	S.W.	Iganna Water Supply Project	State Water Corporation	Iwajowa	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-30-24	Oyo	N	Urban, S.U./S.T.	S.W.	Ilero Water Supply Project	State Water Corporation	Kajola	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing
109	WS-30-25	Oyo	N	Urban, S.U./S.T.	S.W.	Okeho Water Supply Project	State Water Corporation	Kajola	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
110	WS-30-26	Oyo	N	Urban, S.U./S.T.	S.W.	Lagelu Water Supply Project	State Water Corporation	Lagelu	8,000		6,400	6,400	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
111	WS-30-27	Oyo	N	Urban, S.U./S.T.	S.W.	Ogo Otuwa Water Supply Project	State Water Corporation	Ogo Oluwa	2,000		1,600	1,600	2,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
112	WS-30-28	Oyo	N	Urban, S.U./S.T.	S.W.	Oluyole Water Supply Project	State Water Corporation	Oluyole	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
113	WS-30-29	Oyo	N	Urban, S.U./S.T.	S.W.	Ona-Ara Water Supply Project	State Water Corporation	Ona-Ara	8,000		6,400	6,400	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
114	WS-30-30	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 1	State Water Corporation	Ona-Ara	120,000		96,000	96,000	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
115	WS-30-31	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 2	State Water Corporation	Ona-Ara	120,000		96,000	96,000	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
116	WS-30-32	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 3	State Water Corporation	Ona-Ara	120,000		94,768	94,768	118,460	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
117	WS-30-33	Oyo	N	Urban, S.U./S.T.	S.W.	Oriowo-Owode Water Supply Project	State Water Corporation	Oyo West	7,000		5,600	5,600	7,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
118	WS-30-34	Oyo	N	Urban, S.U./S.T.	S.W.	Surulere/Oko Water Supply Project	State Water Corporation	Surulere	4,000		3,200	3,200	4,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	
-	WS-30-35	Oyo	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-				-	-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface water development
119	WS-30-36	Oyo	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				19,090	23,863	Boreholes, handpumps, rizer pipes and accessories, etc	
120	WS-30-37	Oyo	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				28,635	35,794	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	

Source: JICA Project Team

Annex-Table 7-2 List of Water Supply Project (Scenario-B)

S/N	Code	State	Project Tyoe	Category	Water Source	Project Name	Implementing Agency	LGA	Design Capacity (m3/day)	Performance 2010 (m3/day)	Performance 2030 (m3/day)	Develop't (2010-30) Hydrological Balance (m3/day)	Develop't (2010-30) Facility Planning (m3/day)	Scope	Schedule 1st Stage 14	15	16	17	18	19	2nd Stage 20	21	22	23	24	3rd Stage 25	26	27	28	29	30 ★
1	WS-24-1	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Adiyan Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ifako-Ijaye	318,220	143,794	254,576	110,782	110,782	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
2	WS-24-2	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Iju Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ifako-Ijaye	204,570	92,439	163,656	71,217	71,217	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
3	WS-24-3	Lagos	R	Urban, S.U./S.T.	S.W.	Lagos/Isashi Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Ojo	18,184	8,217	14,547	6,330	6,330	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
-	WS-24-4	Lagos	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	Lagos Water Corporation	-					-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface watetr development																
-	WS-24-5	Lagos	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	-					-	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	No more groundwater development because of large surface watetr development																
-	WS-24-6	Lagos	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	-					-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface watetr development																
4	WS-24-7	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Yewa-1 Water Supply Project (Desalination)	Lagos Water Corporation	Badagry	227,300		181,840	181,840	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
5	WS-24-8	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Yewa-2 Water Supply Project (Desalination)	Lagos Water Corporation	Badagry	227,300		181,840	181,840	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
-	WS-24-9	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Otta-Ikosi Water Supply Project	Lagos Water Corporation	Epe	18,184		14,547	14,547	18,184	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing																
6	WS-24-10	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-1 Water Supply Project	Lagos Water Corporation	Epe	113,650		90,920	90,920	113,650	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
7	WS-24-11	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-2 Water Supply Project	Lagos Water Corporation	Epe	409,140		327,312	327,312	409,140	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
8	WS-24-12	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Odomola-3 Water Supply Project	Lagos Water Corporation	Epe	431,870		345,496	345,496	431,870	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
9	WS-24-13	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Adiyan-2 Water Supply Project	Lagos Water Corporation	Ifako-Ijaye	318,220		254,576	254,576	318,220	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
10	WS-24-14	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Adiyan-3 Water Supply Project	Lagos Water Corporation	Ifako-Ijaye	318,220		254,576	254,576	318,220	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
11	WS-24-15	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Ilesha Water Supply Project (Desalination)	Lagos Water Corporation	Ikorodu	227,300		181,840	181,840	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
12	WS-24-16	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Isashi Expansion-1 Water Supply Project	Lagos Water Corporation	Ojo	36,360		29,094	29,094	36,360	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
13	WS-24-17	Lagos	N	Urban, S.U./S.T.	S.W.	Lagos/Isashi Expansion-2 Water Supply Project	Lagos Water Corporation	Ojo	104,558		83,646	83,646	104,558	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
14	WS-24-21	Lagos	N	Urban, S.U./S.T.	S.W.	Additional Water Supply Project(s) 1	Lagos Water Corporation	-	1,102,093		881,674	881,674	1,102,093	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
15	WS-24-22	Lagos	N	Urban, S.U./S.T.	S.W.	Additional Water Supply Project(s) 2	Lagos Water Corporation	-	1,102,093		881,674	881,674	1,102,093	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc												**	##	##	##	##	
-	WS-24-18	Lagos	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	Lagos Water Corporation	-					-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface watetr development																
-	WS-24-19	Lagos	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	-					-	Boreholes, handpumps, rizer pipes and accessories, etc	No more groundwater development because of large surface watetr development																
-	WS-24-20	Lagos	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	-					-	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	No more groundwater development because of large surface watetr development																
16	WS-27-1	Ogun	R	Urban, S.U./S.T.	S.W.	Abeokuta Main Water Supply Scheme / Old Rehabilitation Project	State Water Corporation	Abeokuta South	15,000	6,778	12,000	5,222	5,222	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
17	WS-27-2	Ogun	R	Urban, S.U./S.T.	S.W.	Abeokuta Main Water Supply Scheme / New Rehabilitation Project	State Water Corporation	Abeokuta South	82,000	37,053	65,600	28,547	28,547	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
18	WS-27-3	Ogun	R	Urban, S.U./S.T.	S.W.	Ota Old Water Supply Scheme Rehabilitation Project	State Water Corporation	Ado-Odo/Ota	2,450	1,107	1,960	853	853	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
19	WS-27-4	Ogun	R	Urban, S.U./S.T.	S.W.	Ota New Water Supply Scheme Rehabilitation Project	State Water Corporation	Ado-Odo/Ota	6,750	3,050	5,400	2,350	2,350	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
20	WS-27-5	Ogun	R	Urban, S.U./S.T.	S.W.	Ilaro Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbado South	240	108	192	84	84	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
21	WS-27-6	Ogun	R	Urban, S.U./S.T.	S.W.	Ifo Akinsede/Papalanto Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifo	12,000	5,422	9,600	4,178	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
22	WS-27-7	Ogun	R	Urban, S.U./S.T.	S.W.	Ilese Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu East	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
23	WS-27-8	Ogun	R	Urban, S.U./S.T.	S.W.	Ijebu-Igbo/Apoje Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu North	18,500	8,360	14,800	6,440	6,440	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
24	WS-27-9	Ogun	R	Urban, S.U./S.T.	S.W.	Ijebu-Ode/Yemoji Water Supply Scheme Rehabilitation Project	State Water Corporation	Ijebu Ode	18,000	8,134	14,400	6,266	6,266	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
25	WS-27-10	Ogun	R	Urban, S.U./S.T.	S.W.	Ogere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ikenne	6,700	3,028	5,360	2,332	2,332	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##				##	##						
26	WS-27-11	Ogun	R	Urban, S.U./S.T.	S.W.	Imeko Water Supply Scheme Rehabilitation Project	State Water Corporation	Imeko-Afon	2,400	1,084	1,920	836	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
27	WS-27-12	Ogun	R	Urban, S.U./S.T.	S.W.	Abigi Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun Waterside	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
28	WS-27-13	Ogun	R	Urban, S.U./S.T.	S.W.	Shagamu Water Supply Scheme Rehabilitation Project	State Water Corporation	Shagamu	6,500	2,937	5,200	2,263	2,263	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##				##	##						
-	WS-27-14	Ogun	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-					-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface watetr development																
29	WS-27-15	Ogun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				764	764	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
30	WS-27-16	Ogun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				10,356	10,356	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
31	WS-27-17	Ogun	N	Urban, S.U./S.T.	S.W.	Ota Old (Doubling) Water Supply Project	State Water Corporation	Ado-Odo/Ota	2,450		1,960	1,960	2,450	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
32	WS-27-18	Ogun	N	Urban, S.U./S.T.	S.W.	Ota New (Doubling) Water Supply Project	State Water Corporation	Ado-Odo/Ota	6,750		5,400	5,400	6,750	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing																
-	WS-27-19	Ogun	N	Urban, S.U./S.T.	S.W.	Yewa Regional Water Supply Project 1	State Water Corporation	Egbado South	100,000				-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030																
-	WS-27-20	Ogun	N	Urban, S.U./S.T.	S.W.	Yewa Regional Water Supply Project 2	State Water Corporation	Egbado South	100,000				-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030																
33	WS-27-21	Ogun	N	Urban, S.U./S.T.	S.W.	Apoje Regional Water Supply Project 1	State Water Corporation	Ijebu North	200,000		70,102	70,102	87,627	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
-	WS-27-22	Ogun	N	Urban, S.U./S.T.	S.W.	Apoje Regional Water Supply Project 2	State Water Corporation	Ijebu North	200,000				-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030																
34	WS-27-23	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 1	State Water Corporation	Obafemi-Owode	250,000		200,000	200,000	250,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
-	WS-27-24	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 2	State Water Corporation	Obafemi-Owode	250,000				-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030																
-	WS-27-25	Ogun	N	Urban, S.U./S.T.	S.W.	Mokoloki Regional Water Supply Project 3	State Water Corporation	Obafemi-Owode	200,000				-	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	After 2030																
-	WS-27-26	Ogun	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-					-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface watetr development																
35	WS-27-27	Ogun	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				15,399	19,249	Boreholes, handpumps, rizer pipes and accessories, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
36	WS-27-28	Ogun	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				23,098	28,873	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
37	WS-29-1	Osun	R	Urban, S.U./S.T.	S.W.	Orile-Owu Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedade	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
38	WS-29-2	Osun	R	Urban, S.U./S.T.	S.W.	Odeyinka Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
39	WS-29-3	Osun	R	Urban, S.U./S.T.	S.W.	Ile-Ogbo/Kuta Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedire	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
40	WS-29-4	Osun	R	Urban, S.U./S.T.	S.W.	Oluponna Water Supply Scheme Rehabilitation Project	State Water Corporation	Aiyedire	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
41	WS-29-5	Osun	R	Urban, S.U./S.T.	S.W.	Iperindo Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa East	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
42	WS-29-6	Osun	R	Urban, S.U./S.T.	S.W.	Ilewara Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	420	190	336	146	146	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
43	WS-29-7	Osun	R	Urban, S.U./S.T.	S.W.	Ilewara/Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
44	WS-29-8	Osun	R	Urban, S.U./S.T.	S.W.	Osu/Ilesha Water Supply Scheme Rehabilitation Project	State Water Corporation	Atakumosa West	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
45	WS-29-9	Osun	R	Urban, S.U./S.T.	S.W.	Igbajo Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	1,800	813	1,440	627	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
46	WS-29-10	Osun	R	Urban, S.U./S.T.	S.W.	Otan/Iresi Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
47	WS-29-11	Osun	R	Urban, S.U./S.T.	S.W.	Igbajo/Oke-Irun Water Supply Scheme Rehabilitation Project	State Water Corporation	Boluwaduro	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
48	WS-29-12	Osun	R	Urban, S.U./S.T.	S.W.	Iree/Eripa Water Supply Scheme Rehabilitation Project	State Water Corporation	Boripe	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
49	WS-29-13	Osun	R	Urban, S.U./S.T.	S.W.	Ada Water Supply Scheme Rehabilitation Project	State Water Corporation	Boripe	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
50	WS-29-14	Osun	R	Urban, S.U./S.T.	S.W.	Ede/Old Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Ede North	9,000	4,067	7,200	3,133	3,133	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
51	WS-29-15	Osun	R	Urban, S.U./S.T.	S.W.	Ede/New Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Ede North	180,000	81,336	144,000	62,664	62,664	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
52	WS-29-16	Osun	R	Urban, S.U./S.T.	S.W.	Ejigbo Water Supply Scheme Rehabilitation Project	State Water Corporation	Ejigbo	2,400	1,084	1,920	836	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
53	WS-29-17	Osun	R	Urban, S.U./S.T.	S.W.	Ile-Odan Water Supply Scheme Rehabilitation Project	State Water Corporation	Ejigbo	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
54	WS-29-18	Osun	R	Urban, S.U./S.T.	S.W.	Mokuro Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife East	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
55	WS-29-19	Osun	R	Urban, S.U./S.T.	S.W.	Fama/Oyere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife North	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
56	WS-29-20	Osun	R	Urban, S.U./S.T.	S.W.	Alajue Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife North	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
57	WS-29-21	Osun	R	Urban, S.U./S.T.	S.W.	Ifetedo Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	3,700	1,672	2,960	1,288	1,288	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
58	WS-29-22	Osun	R	Urban, S.U./S.T.	S.W.	Aye-Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
59	WS-29-23	Osun	R	Urban, S.U./S.T.	S.W.	Omifunfun Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
60	WS-29-24	Osun	R	Urban, S.U./S.T.	S.W.	Mefoworade Water Supply Scheme Rehabilitation Project	State Water Corporation	Ife South	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
61	WS-29-25	Osun	R	Urban, S.U./S.T.	S.W.	Ora Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifedayo	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
62	WS-29-26	Osun	R	Urban, S.U./S.T.	S.W.	Eko-Ende Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	12,000	5,422	9,600	4,178	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
63	WS-29-27	Osun	R	Urban, S.U./S.T.	S.W.	Dagbolu Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
64	WS-29-28	Osun	R	Urban, S.U./S.T.	S.W.	Iba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ifelodun	150	68	120	52	52	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
65	WS-29-29	Osun	R	Urban, S.U./S.T.	S.W.	Ila/Orangun Water Supply Scheme Rehabilitation Project	State Water Corporation	Ila	2,200	994	1,760	766	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
66	WS-29-30	Osun	R	Urban, S.U./S.T.	S.W.	Ibodi/Oscoed Water Scheme	State Water Corporation	Ilesha East	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
67	WS-29-31	Osun	R	Urban, S.U./S.T.	S.W.	Asejire Water Scheme	State Water Corporation	Irewole	1,200	542	960	418	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
68	WS-29-32	Osun	R	Urban, S.U./S.T.	S.W.	Iwo/Ayiba Water Supply Scheme Rehabilitation Project	State Water Corporation	Iwo	9,080	4,103	7,264	3,161	3,161	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
69	WS-29-33	Osun	R	Urban, S.U./S.T.	S.W.	Esa-Odo Water Supply Scheme Rehabilitation Project	State Water Corporation	Obokun	5,000	2,259	4,000	1,741	1,741	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
70	WS-29-34	Osun	R	Urban, S.U./S.T.	S.W.	Oyan Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	230	104	184	80	80	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
71	WS-29-35	Osun	R	Urban, S.U./S.T.	S.W.	Okuku Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
72	WS-29-36	Osun	R	Urban, S.U./S.T.	S.W.	Igbaye Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
73	WS-29-37	Osun	R	Urban, S.U./S.T.	S.W.	Inisa Water Supply Scheme Rehabilitation Project	State Water Corporation	Odo-Otin	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
74	WS-29-38	Osun	R	Urban, S.U./S.T.	S.W.	Tootoo/Igere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ola Oluwa	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
75	WS-29-39	Osun	R	Urban, S.U./S.T.	S.W.	Ajagunlase Water Supply Scheme Rehabilitation Project	State Water Corporation	Ola Oluwa	600	271	480	209	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
76	WS-29-40	Osun	R	Urban, S.U./S.T.	S.W.	Ikeji-Ile Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	2,200	994	1,760	766	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
77	WS-29-41	Osun	R	Urban, S.U./S.T.	S.W.	Esa-Oke Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
78	WS-29-42	Osun	R	Urban, S.U./S.T.	S.W.	Iwara/Igangan Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
79	WS-29-43	Osun	R	Urban, S.U./S.T.	S.W.	Ikeji-Arakeji Water Supply Scheme Rehabilitation Project	State Water Corporation	Oriade	300	136	240	104	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
80	WS-29-44	Osun	R	Urban, S.U./S.T.	S.W.	Oke-Osun/Abere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osogbo	200	90	160	70	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
81	WS-29-45	Osun	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-				39,417	39,417	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
82	WS-29-46	Osun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				2,079	2,079	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
83	WS-29-47	Osun	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				21,927	21,927	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
84	WS-29-48	Osun	N	Urban, S.U./S.T.	S.W.	Ilesha Water Supply Project	State Water Corporation	Atakumosa West	60,000		48,000	48,000	60,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
85	WS-29-49	Osun	N	Urban, S.U./S.T.	S.W.	Ife Water Supply Project	State Water Corporation	Ife Central	30,000		24,000	24,000	30,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
86	WS-29-50	Osun	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-				39,417	49,271	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
87	WS-29-51	Osun	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				9,602	12,002	Boreholes, handpumps, rizer pipes and accessories, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
88	WS-29-52	Osun	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				14,403	18,003	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
89	WS-30-1	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Asejire Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbeda	186,000	84,047	148,800	64,753	64,753	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
90	WS-30-2	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Osegere Water Supply Scheme Rehabilitation Project	State Water Corporation	Egbeda	13,500	6,100	10,800	4,700	4,700	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
91	WS-30-3	Oyo	R	Urban, S.U./S.T.	S.W.	Ibadan/Eleyele Water Supply Scheme Rehabilitation Project	State Water Corporation	Ibadan North West	27,240	12,309	21,792	9,483	9,483	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
92	WS-30-4	Oyo	R	Urban, S.U./S.T.	S.W.	Igboora-Eruwa-Lanlate/Eruwa Water Supply Scheme Rehabilitation Project	State Water Corporation	Ibarapa East	3,300	1,491	2,640	1,149	1,149	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
93	WS-30-5	Oyo	R	Urban, S.U./S.T.	S.W.	Owode Water Supply Scheme Rehabilitation Project	State Water Corporation	Ido	900	407	720	313	313	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
94	WS-30-6	Oyo	R	Urban, S.U./S.T.	S.W.	Kishi Water Supply Scheme Rehabilitation Project	State Water Corporation	Irepo	720	325	576	251	251	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
95	WS-30-7	Oyo	R	Urban, S.U./S.T.	S.W.	Iseyin Water Supply Scheme Rehabilitation Project	State Water Corporation	Iseyin	1,200	542	960	418	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
96	WS-30-8	Oyo	R	Urban, S.U./S.T.	S.W.	Lalupon Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Lagelu	436	197	349	152	152	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
97	WS-30-9	Oyo	R	Urban, S.U./S.T.	S.W.	Ogbomoso-Ikoyi Ile/Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogbomosho North	6,400	2,892	5,120	2,228	2,228	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
98	WS-30-10	Oyo	R	Urban, S.U./S.T.	S.W.	Igbetti /Afowose Water Supply Scheme Rehabilitation Project	State Water Corporation	Olorunsogo	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
99	WS-30-11	Oyo	R	Urban, S.U./S.T.	S.W.	Igboho/Sanya Water Supply Scheme Rehabilitation Project	State Water Corporation	Orelope	1,000	452	800	348	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
100	WS-30-12	Oyo	R	Urban, S.U./S.T.	S.W.	Oyo//Erelu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo East	7,500	3,389	6,000	2,611	2,611	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
101	WS-30-13	Oyo	R	Urban, S.U./S.T.	S.W.	Ago Amodu Water Supply Scheme Rehabilitation Project	State Water Corporation	Saki East	500	226	400	174	174	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
102	WS-30-14	Oyo	R	Urban, S.U./S.T.	S.W.	Saki/Fofo Water Supply Scheme Rehabilitation Project	State Water Corporation	Saki West	1,333	602	1,066	464	464	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc				**	##	##											
-	WS-30-15	Oyo	R	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	-				-	-	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	No more groundwater development because of large surface watetr development																
103	WS-30-16	Oyo	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	-				5,096	5,096	Replacement of handpump, rizer pipes, accessories, repair of platform, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
104	WS-30-17	Oyo	R	Rural	G.W.	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				25,069	25,069	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
105	WS-30-18	Oyo	N	Urban, S.U./S.T.	S.W.	Afijio Water Supply Project	State Water Corporation	Afijio	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
106	WS-30-19	Oyo	N	Urban, S.U./S.T.	S.W.	Akinyele Water Supply Project	State Water Corporation	Akinyele	6,000		4,800	4,800	6,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
107	WS-30-20	Oyo	N	Urban, S.U./S.T.	S.W.	Ago-Are/Tede Water Supply Project	State Water Corporation	Atigbo	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
108	WS-30-21	Oyo	N	Urban, S.U./S.T.	S.W.	Ayete-Tapa-Idere Water Supply Project	State Water Corporation	Ibarapa North	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing																
109	WS-30-22	Oyo	N	Urban, S.U./S.T.	S.W.	Ido Water Supply Project	State Water Corporation	Ido	5,000		4,000	4,000	5,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
110	WS-30-23	Oyo	N	Urban, S.U./S.T.	S.W.	Iganna Water Supply Project	State Water Corporation	Iwajowa	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
111	WS-30-24	Oyo	N	Urban, S.U./S.T.	S.W.	Ilero Water Supply Project	State Water Corporation	Kajola	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	Ongoing																
112	WS-30-25	Oyo	N	Urban, S.U./S.T.	S.W.	Okeho Water Supply Project	State Water Corporation	Kajola	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
113	WS-30-26	Oyo	N	Urban, S.U./S.T.	S.W.	Lagelu Water Supply Project	State Water Corporation	Lagelu	8,000		6,400	6,400	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
114	WS-30-27	Oyo	N	Urban, S.U./S.T.	S.W.	Ogo Otuwa Water Supply Project	State Water Corporation	Ogo Oluwa	2,000		1,600	1,600	2,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
115	WS-30-28	Oyo	N	Urban, S.U./S.T.	S.W.	Oluyole Water Supply Project	State Water Corporation	Oluyole	3,000		2,400	2,400	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
116	WS-30-29	Oyo	N	Urban, S.U./S.T.	S.W.	Ona-Ara Water Supply Project	State Water Corporation	Ona-Ara	8,000		6,400	6,400	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
117	WS-30-30	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 1	State Water Corporation	Ona-Ara	120,000		96,000	96,000	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
118	WS-30-31	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 2	State Water Corporation	Ona-Ara	120,000		96,000	96,000	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc							**	##	##	##	##						
119	WS-30-32	Oyo	N	Urban, S.U./S.T.	S.W.	Ibadan/Odedele Water Supply Project 3	State Water Corporation	Ona-Ara	120,000		94,768	94,768	118,460	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc											**	##	##	##	##		
120	WS-30-33	Oyo	N	Urban, S.U./S.T.	S.W.	Oriowo-Owode Water Supply Project	State Water Corporation	Oyo West	7,000		5,600	5,600	7,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
121	WS-30-34	Oyo	N	Urban, S.U./S.T.	S.W.	Surulere/Oko Water Supply Project	State Water Corporation	Surulere	4,000		3,200	3,200	4,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	**	##	##	##	##	##											
-	WS-30-35	Oyo	N	Urban, S.U./S.T.	G.W.	Urban/Small-Town Water Supply Projects	State Water Corporation	-				-	-	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	No more groundwater development because of large surface watetr development																
122	WS-30-36	Oyo	N	Rural	G.W.	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	-				19,090	23,863	Boreholes, handpumps, rizer pipes and accessories, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	
123	WS-30-37	Oyo	N	Rural	G.W.	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	-				28,635	35,794	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc	**	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	

Source: JICA Project Team

CHAPTER 8 WATER RESOURCES MANAGEMENT PLAN

8.1 General

This section discusses the objectives and strategy of Water Resource Management. Then, the framework of water resources monitoring is discussed as the monitoring of the quantity and quality of water resources is important to manage many items, clarifying water resources monitoring in accordance with the administrator or management items of water resources management.

Water Resources Management Plan shows the methodology how to Water Resources Management is implemented based on the following Strategies:

(1) Objectives of Water Resources Management

The objective of water resources management is to provide the water services based on 3S&2E (Sufficiency, Safety, Sustainability, Efficiency and Equitability) to the water users who expect "Effective Use of Water", "Mitigation of Flood Damage" and "Conservation of Water Quality", by using the facilities and operation systems installed on the basis of Water Resources Development Plan. The Water Resources Management Plan compiles the methods to achieve the objectives

(2) Strategy of Water Resources Management

Water resources management is implemented based on the following strategies.

- **Strategy-1: Organization and Institution for Water Resources Management**

  As results of the analysis of current organization and institution for water resources development and management, it is clarified that improvement and strengthening of current organization and institution are necessary. Section 8.2 proposes plans according to four (4) policies for improvement and strengthening of organization and institution. Namely, 1) Cooperative Institutional Arrangement, 2) Participatory Management Administration, 3) Fair Regulatory Institutional Framework, 4) Decentralization and Coordination

- **Strategy-2: Operation and Maintenance for Provision of Water Services**

  Provision of proper water services is most important item of water resources management. The CMP proposes proper operation and maintenance regarding water resources development facilities such as dam, well, water supply facility and irrigation facility. Chapter 7 proposes operation and maintenance for water supply facility (Section 7.1.6) and for irrigation facility (Section 7.2.3). In this Chapter 8, Section 8.3 proposes proper operation and maintenance for water source development facilities (dam and well) and discusses the routine process of Monitoring - Prediction (Judgment) - Operation for operation and maintenance.

  Regarding this strategy, Hydrological Monitoring (Section 8.4), Water Resources Data and Information Database (Section 8.5), Consideration of Risk Associated with Climate Change and Trans-boundary Water (Section 8.6) and Water Environment Management (Section 8.7) are discussed in detail.

- **Strategy-3: Allocation and Regulation of Water Resources Quantity and Quality**

  Allocation and regulation are important mandate of NIWRMC newly established. It is necessary to establish necessary institutions and systems required for licensing and regulation of water intake for new users. Section 8.8 carries out analysis of current situation and framework related to water allocation and regulation, and proposes projects.

- **Strategy-4: Facilitation and Improvement for Water Resources Management**

  This plan includes such action plans as action plan to support and improve human resources and technology for water resources development / utilization / management, and action plan to promote effectively water projects. Regarding this strategy, Public Relations on Water Resources (Section 8.9), Public-Private Partnership (Section 8.10), Man Power Development (Section 8.11) and Monitoring and Evaluation (Section 8.12) are discussed in detail.

In order to achieve proper water resources management, in the CMP, it is proposed to consider the improvement plan and method analyzing the current issues relating to management items shown in Figure 8-1.

Objectives of Water Resources Management

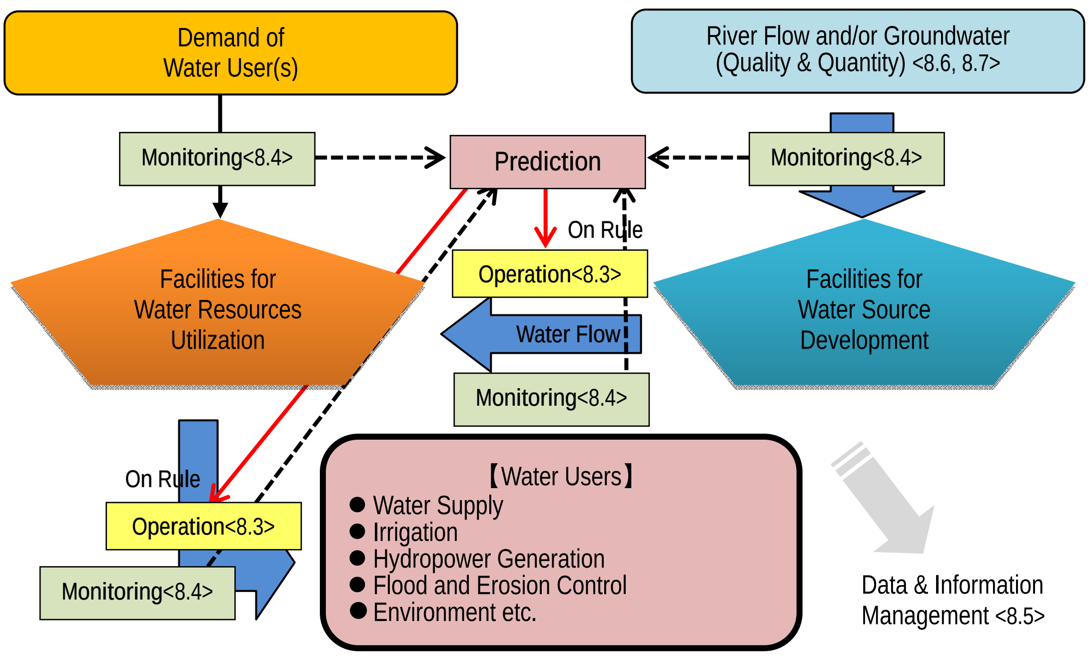
Targets of Water Resources Management in Nigeria, i.e. “Effective Use of Water Resources”, “Mitigation of Flood and Sediment Disaster” and “Conservation of Water Quality” will be achieved on the basis of “Sufficiency, Efficiency, Equitability, Safety and Sustainability”.

▼

Strategy-1 Organization and Institution for Water Resources Management

Management Item: 8.2 Organization and Institution for Public Water Services

Strategy-2 Operation and Maintenance for Provision of Water Services



Management Item:
8.3 Operation and Maintenance for Water Resources Development Facilities
8.4 Hydrological Monitoring
8.5 Data and Information Management
8.6 Consideration of Risk Associated with Climate Change and Trans-boundary Water
8.7Water Environment Management

Strategy-3 Allocation and Regulation of Water Resources Quantity and Quality

Management Item: 8.8 Water Allocation and Regulation

Strategy-4 Facilitation and Improvement for Water Resources Management

Management Item:
8.9 Public Relations
8.10 Public-Private Partnership (PPP)
8.11 Manpower Development and Capacity Building
8.12 Monitoring and Evaluation

Source: JICA Project Team

Figure 8-1 Targets of Water Resources Management

8.2 Institutional Framework of Water Resources Management

8.2.1 Current Situation

The institutional key issues and challenges for the basin institutions which were identified through the workshops, etc. are classified in terms of category of issue mentioned below, and summarized as shown in Table 8-1.

- Federal - State - LGAs Relationship
- Inter-State Issues
- Multi-Sector Issues
- Water Resources Monitoring and Data Management
- Stakeholders' Involvement in Decision-Making Process
- Capacity Development
- Other Issues such as communications, PPP, etc.

Table 8-1 Key Institutional Issues and Challenges by Category

Category	Issue
a. Federal – State – LGAs Relationship	● Centralized water resources management ● Multiplicity of agencies at all tiers of government pursuing uncoordinated water agenda individually ● Bureaucratic approach of management ● Inconsistency and fragmentation in policies and strategies ● Lack of state water policy and insufficient legislation ● Lack of decentralization at the CMOs level ● Weak legal and policy framework for the basin management
b. Inter-State Issues	● Different water polices within a single river basin, e.g., for pollution control, watershed management, etc. ● Lack of cooperation among the basin states in the catchment area ● Uncertainty of water regulation (riparian rights, etc.) ● Absence of a statutory basin-wide organization to coordinate implementation of catchment strategies and to harmonize state policy
c. Multi-Sector Issues	● Lack of inter-sector coordination among stakeholders ● Overlapping of responsibility in the existing laws across the different institutions, e.g., grant licenses for water abstractions by RBDAs, NIWA and FMWR ● Overlap and fragmentation of functions among the institutions due to unclear mandates, etc. ● Uncertainty for regulatory institutional framework ● Lack of proper coordination of water resources for different uses ● Stiff tariff (flat rate) for different uses and lack of proper pricing mechanism in state edicts, etc.
d. Water Resources Monitoring and Data Management	● Lack of data and data management ● Lack of cooperation and coordination among NIHSA, NWRI, NIWRMC and other relevant institutions.
e. Stakeholders' Involvement in Decision-Making Process	● Poor public participation ● Lack of women participation in rural water supply and sanitation activities ● Lack of coordination and collaboration among various stakeholders ● Top-down approach by the government leading to negative stakeholders participation in decision-making process ● Weakness of Rural Water and Sanitation Department (RWSS Dept.) of LGAs. ● Lack of involvement of academic institutions including university in formulation of CMP
f. Capacity Development	● Lack of training programs ● Low capacity for maintenance of water facilities ● Poor capacity for hydrological and meteorological aspects and data analysys ● Lack of IWRM capacity at catchment level ● Lack of legal instrument and institutional capacity of NIWRMC and CMOs
g. Other Issues such as communications, PPP, etc.	● Lack of on water-related awareness such as health, poverty, etc. ● Inadequate planning and funding ● Poor implementation of project and program by RWSS Dept. of LGAs. ● Lack of funds for operation and maintenance at community level ● Inadequate systems to mobilize funds for investment and operation and maintenance of water infrastructure ● Underdeveloped PPP in all sub-sectors of water, especially in rural water supply and sanitation ● Accountability on performance of mandated functions of RBDAs

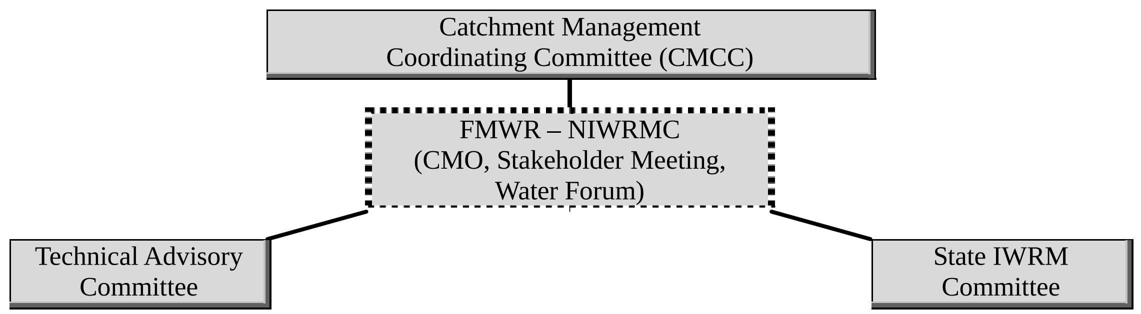
Source: FMWR

8.2.2 Suggestion

(1) Basic Approach for Strengthening of Institutional Framework

(1-1) Establishment of Comprehensive Institutional Arrangement Based on Participatory Approach of Management

For attaining the objectives of the CMP, it is critically important to enhance a participatory approach of management which is one of central principles of IWRM. The M/P 2013 set the basic policies for institutional development and strengthening; Cooperative Institutional Arrangement, Participatory Management Administration, Fair Regulatory Institutional Framework and Decentralization and Coordination. Of all policies for institutional strengthening, it is important to focus on the Participatory Approach of Management in the basin. It implies that of particular importance is to create a basin-wide comprehensive institutional arrangement involving all stakeholders in the basin for implementation of adequate catchment management plan. It will be composed of Catchment Management Coordinating Committee, Technical Advisory Committee (CMCC), and State IWRM Committee. NIWRMC including CMOs shall act as secretariat body for promotion and coordination within its management systems. The following figure provides an image of comprehensive basin institutional arrangement.



Source: FMWR/NIWRMC

Figure 8-2 Framework of Basin Institutional Arrangement

(1-2) Institutional Strengthening Considering Regional Issues and Gaps in Ogun-Oshun Basin

To strengthen the institutional framework, it is highly required to consider the regional issues and gaps identified in the area including the followings.

- Increasing demands for water infrastructure associated with continuation of increasing in population, especially in Lagos State
- Water contamination problems in urbanized areas
- Land subsidence problems due to excessive amount of groundwater drawing in urbanized areas
- Accountability of RBDA’s area of operation in terms of management at river basin status
- Promotion of PPP to improve funding sources from private sector for implementation of projects and programs in water sector

(2) Proposals for Institutional Framework in Water Resources Management

We suggest the proposals for institutional improvement as presented in Tables 8-2. The outline of these proposals is summarized as given in in Table 8-3.

Table 8-2 Summary of Proposals by Issue

<table>
<tr><th>Issue</th><th colspan="2">Proposal</th></tr>
<tr><td>a. Federal - State Relationship</td><td rowspan="4">IF01: Creation of Comprehensive Institutional Arrangement Responsible for Implementation of the CMP
IF02: Strengthening of Institutional Capacity of NIWRMC and CMOs</td><td>IF03: Decentralization and Integration of Federal Functions to State MDAs</td></tr>
<tr><td>b. Inter-State Water Issue</td><td>IF04: Promotion of Joint Meetings and Practices for Inter-State Issues</td></tr>
<tr><td>c. Multi-Sector Water Issue</td><td>IF05: Setting of Regulatory Institutional Framework for Basin Management</td></tr>
<tr><td>d. Stakeholder Participation</td><td>IF06: Creation and Strengthening of CBOs for Participatory Management</td></tr>
<tr><td>e. Water Supply and Sanitation</td><td colspan="2">IF07: Strengthening of RUWASSA for Rural Water Supply and Sanitation at State level for Achieving MDGs</td></tr>
<tr><td>f. Irrigation and Drainage</td><td colspan="2">IF08: Institutional Reform for Public Irrigation Management Authority</td></tr>
<tr><td>g. Monitoring and Data Management</td><td colspan="2">IF09: Establishment of New Department or Unit within the Basin States
IF10:Development of Data Sharing Protocol among the Basin States</td></tr>
</table>

Source: JICA Project Team

Table 8-3 Outline of Proposals

<table>
<tr><th>No</th><th>Description</th></tr>
<tr><td>IF01</td><td>Project Title: Creation of Comprehensive Institutional Arrangement Responsible for Implementation of the CMP
Objectives, etc.: The overall objective is to promote the cooperation and collaboration among all stakeholders including the Basin States and to coordinate the relationship of the Basin States for achieving the purpose of the CMP which is under the consideration of FMWR and NIWRMC. Following Institutional arrangement is presumed:
● <u>Catchment Management Coordinating Committee (CMCC)</u>: To determine major policy and common issues in the basin to the member of the Basin States
● <u>Technical Advisory Committee</u>: To initiate and advise the CMCC on policies, strategies, programs, etc.
● <u>State IWRM Committee</u>: To organize and manage all state-level technical and political meetings with all stakeholders in the Basin States
Lead Institutions: FMWR/NIWRMC/RBDAs/State MDAs
Legislations: Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)</td></tr>
<tr><td>IF02</td><td>Project Title: Strengthening of Institutional Capacity of NIWRMC and CMOs
Objectives, etc.: It is critical for realization of Integrated Basin Management System. The specific objectives are;
● To promote sustainable use of water and environmental conservation in the basin
● To manage water allocation, water use licensing, charges, conflicts among stakeholders, etc.
● To monitor the impact on project activities in water sector
● To promote public awareness and advocacy
● To expand the manpower of CMOs to deliver appropriate services along with the Basin States
Lead Institutions: NIWRMC/FMWR/NIHSA/NWRI/RBDAs/State MDAs
Legislations:
● Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)
● President’s Assent to the Bill for an Act to Establish NIWRMC</td></tr>
<tr><td>IF03</td><td>Project Title: Decentralization and Integration of Federal Functions to State MDAs
Objectives, etc.:
● To increase the benefits to the beneficiaries with such projects and programs that match the capacity as well as willingness and wish of the communities
● To facilitate an efficient and effective institutional structure with clear and rational definitions of roles and responsibilities by each ministry and agency and the relationship of sector institutions
Lead Institutions: FMWR/NCWR/RBDAs/State MDAs/LGAs
Legislations: Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)</td></tr>
<tr><td>IF04</td><td>Project Title: Promotion of Joint Meetings and Practices for Inter-State Issues
Objectives, etc.: To enlarge and evolve collaborative arrangement among the Basin States through promotion of periodic meetings/practices to address common issues in the basin
Lead Institutions: FMWR/NIWRMC/RBDAs/State MDAs, etc.</td></tr>
</table>

No	Description
	Legislations: Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)
IF05	**Project Title**: Setting of Regulatory Institutional Framework for Basin Management **Objectives, etc.**: To deliver adequately the powers and functions related to regulatory aspect of water resources management. **Lead Institutions**: FMWR/NIWRMC/RBDAs **Legislations**: President's Assent to the Bill for an Act to Establish NIWRMC
IF06	**Project Title**: Creation and Strengthening of CBOs for Participatory Management **Objectives, etc.**: Through development CBOs such as WASHCOM, etc., it is expected for the communities to take on the ownership and obligations for proper operation and maintenance of completed water infrastructure. **Lead Institutions:** CBOs/LGAs/State MDAs **Legislations**: State edicts and acts, etc.
IF07	**Project Title**: Strengthening of RUWASSA for Rural Water Supply and Sanitation at State level for achieving MDGs **Objectives, etc.**: To enhance sustainability and performance in water supply and sanitation sector considering decentralization to State Agencies and LGAs. Main discussion points are: ● Top-down approach (Bureaucracy) and supply-driven approach in various levels of decision-making for RWSS programs ● Implementation of community-based and LGA-based projects ● Underdeveloped private sector participation **Lead Institutions**: RUWASSA/LGAs/State MDAs/FMWR **Legislations**: ● Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft) ● Review and revise the State edicts and acts
IF08	**Project Title**: Institutional Reform for Public Irrigation Management Authority **Objectives, etc.**: To optimize powers and functions of RBDAs in irrigation and drainage sector. Main discussion points are: ● Separation of responsibilities for water regulation and services delivery functions ● Promotion of PPP **Lead Institutions**: : RBDAs/FMWR/NIWRMC **Legislations**: Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)
IF09	**Project Title**: Establishment of New Department or Unit within the Basin States **Objectives, etc.**: To improve information gathering, analysis and dissemination on water resources characteristics and parameters of the basin so as to promote sustainable use and to support informed regulation of water exploitation in the basin **Lead Institutions**: State MDAs/State IWRM Committee (proposed)/NIWRMC/NIHSA/RBDAs. etc. **Legislations**: Review and revise the State edicts and acts
IF10	**Project Title**: Development of Data Sharing Protocol among the States **Objectives, etc.**: To improve information gathering, analysis and dissemination on water resources characteristics and parameters of the basin so as to promote sustainable use and to support informed regulation of water exploitation in the basin **Lead Institutions**: State MDAs/State IWRM Committee (proposed)/NIWRMC/NIHSA/RBDAs, etc. **Legislations**: Review and revise the State edicts and acts

Source: JICA Project Team

(3) Plan for Future Stakeholder Meetings

In order to implement the CMP (First Draft) adequately, it is important for FMWR, NIWRMC and other relevant institutions to evolve the stakeholders meeting (SHM) after acknowledgement of the first draft of the CMP. It is therefore significant to proceed to the followings in order to achieve the objectives of the CMP to be carried out based on the IWRM principles. Outline of the schedule for Future Stakeholder Meetings is as follows:

- Phase-1 (2014) : Targeting at Plan-1 and Plan-2
- Phase-2 (2014&15) : Targeting at Plan-2 and Plan-3
- Phase-3 (after 2015) : Targeting at Plan-4, Plan-5 and Plan-6

Table 8-4 Contents of Plan in Future Stakeholder Meetings

Plan	Contents
Plan-1	● To organize SHMs/Workshops across the Basin States in Ogun-Oshun Basin for promoting the M/P2013 ● To organize SHMs/Technical Consulting Meetings in Ogun-Oshun Basin for finalizing the CMP for the basin ● To make a plan for formation of Catchment Management Coordinating Committee (CMCC), Technical Advisory Committee, and State IWRM Committee as well as any other committees or forum such as Stakeholders Water Forum, etc.
Plan-2	● To mobilize, in liaison with relevant institutions such as RBDAs, CMOs, etc., the state MDAs in Ogun-Oshun Basin to form the above-stated basin committees.
Plan-3	● To hold SHMs/Workshops to discuss streamlining the water resources development plans to be made at different levels of governments (Federal, States and LGAs) and for facilitating intervention of other stakeholders such as CBOs, NGOs, etc. in the basin.
Plan-4	● To materialize the capacity development programs for State MDAs in Ogun-Oshun Basin based on the result of capacity assessment or audit.
Plan-5	● To organize SHMs to approve an agreement or charter among the Basin States on the implementation of the CMP ● To plan and promote, through State IWRM Committee, preparation of guidelines, etc. with respect to the following: - Licensing system for water abstractions and allocation - Establishing partnerships and collaboration on information sharing on water resources development and management - Monitoring and evaluation on implementation of the CMP - Revision or updating of the CMP
Plan-6	● To plan and promote any programs for the purpose of normalization of flow in the River System in Ogun-Oshun Basin through State IWRM Committee ● To strengthen the capacities of the institutions for multiple use of water ● To establish robust partnerships and collaboration for sustainable use and regulation of water resources

Source: JICA Project Team

8.3 Operation and Maintenance of Water Resources Development Facilities

8.3.1 Operations and Maintenance of Surface Water Development Facilities

Dams are important facilities for the development of surface water resources and serve diverse purposes, including flood control, water supply, irrigation, and power generation. Regardless of the purpose, dams need to be managed with respect to the following basic aspects (see also Table 8-5).

- Dam structures and facilities
- Reservoirs
- Reservoir water level control (high water/low water-level operations)

Table 8-5 Configuration of Dam Management

Contents	Item	Dam management situation
Management of the facility of the dam body	Dam body, Administrative road, Discharge facilities, Water intake facilities, Private power generation facilities	Almost management has not been done. Kainji, Jebba, and Shiroro dam and some other dams have been managed, but it is still not completed.
Management of dam reservoir	Sedimentation; Water quality; Lakeshore	Almost management has not been done
Controlling and operation of the dam reservoir	Reservoir observation and recording; inflow observation and recording; other hydrological observation and recording; recording of gate operation; Transmission of information to downstream	Except Kainji, Jebba, and Shiroro dam, most of dams have not been managed and recorded.

Source: JICA Project Team

Principally speaking, organizational structures and facilities that allow prompt and proper implementation of the above management activities must be in place at the same time when the dams are completed. As the management statuses of the existing dams are extremely poor, we propose to improve the management system starting with high priority dams, such as a dam with large capacity. “Dam Management Manual” is nonexistent in all of the dams, which is one of the reasons for the poor management/maintenance status (in other words, no one knows or understands how to manage the dams). All dams in Nigeria should be obligated to establish their own respective “Dam Management Manuals”, and each administrator properly manages their dam on a daily basis in line with the Manuals. The items that should be included in the dam management manual are tentatively proposed as shown in Table 8-6

For Ogun-Oshun Basin, in particular, new dams are in operation or to be constructed along Ogun or Osun rivers. The operation of these dams in an efficient and sophisticated manner is crucial for development of limited water resources. The operation of these dams in an efficient and sophisticated manner is crucial for development of limited water resources. “To operate dams in an efficient and sophisticated manner” means sophistication of communication related to water-discharging (communication capacity of administrators); sure water-discharging operation and monitoring of water intake. On-the-spot administrators of the existing dams are particularly poor at communicating with each other despite of the recent improvement in the Internet technologies and widespread of mobile telephones, both of which can certainly help them provide information and communicate with each other much more efficiently than they used to.

Table 8-6 Proposed items that should be included in Dam Management Manual

Major items	Small items	Contents	Remarks
Definition of the dam managerial responsibilities	Division of roles of dam administrative staff	【Content】Stipulating the positions and responsibility of dam administrative staff (division of roles, responsibilities) 【Remark】Responsibilities (division of roles and responsibilities) shall be assumed for each state in normal, flood, abnormal, emergency and inspection	
Controlling and operation of the dam reservoir	Hydrological observation	【Content】Defining the types of hydrological data and its contents that should be managed in dam. Furthermore, measurement frequency and responding in case of failure. 【Remark】Determine the compiling style of hydrological data. Unifying the style on all dam in Nigeria.	
	Hydrological record	【Contents】Defining the types of hydrological data, its contents and measurement frequency that should be recorded in dam 【Remark】Determine the compiling style of hydrological data and dam body information. Unifying the style on all dam in Nigeria.	
	Operation record of valve and gate	【Content】Defining the recording method of the operation of valve and gate 【Remark】Determine the recording style of gate opening. Unifying the style on all dam in Nigeria.	
	Dam operation rules (Flood control) (Supplemental irrigation)	【Content】Defining the operation rules of reservoir in rain season and dry season 【Remark】Stipulating the operation rules like the ones as a case study shown in Shiroro, Kainji, Jebba Dam.	
	Means for transmitting information to the downstream	【Content】Defining the communication method and content to the downstream residents and related organizations during discharge, emergency and abnormal of dam	
Dam body facility	Observation and recording of dam body information	【Content】Defining the type of measurement data of leakage and deformation, measurement frequency, the recording method for verifying the safety of the dam body 【Remark】Determining the compiling style of data. Unifying the style on all dam in Nigeria.	
	Inspection, maintenance	【Content】Defining the item and frequency for inspection and maintenance the content of dam body and accessory equipment 【Remark】Determining the record style of content for inspection and maintenance. Unifying the style on all dam in Nigeria. Here, the content of the inspection and maintenance including dam body, managing road, gate, electrical equipment and all relative facilities.	
Dam reservoir	Water quality	【Content】Defining the types of water quality data and its contents that should be managed in dam 【Remark】Determining the compiling style of data. Unifying the style on all dam in Nigeria	
	Sedimentation	【Content】Defining the method and frequency of measuring the sediment yield in dam 【Remark】Determining the compiling style of data. Unifying the style on all dam in Nigeria	
	Lakeshore	【Content】Defining the item and frequency for inspection and maintenance the content to the reservoir shore 【Remark】Determining the record style of content for inspection and maintenance. Unifying the style on all dam in Nigeria	

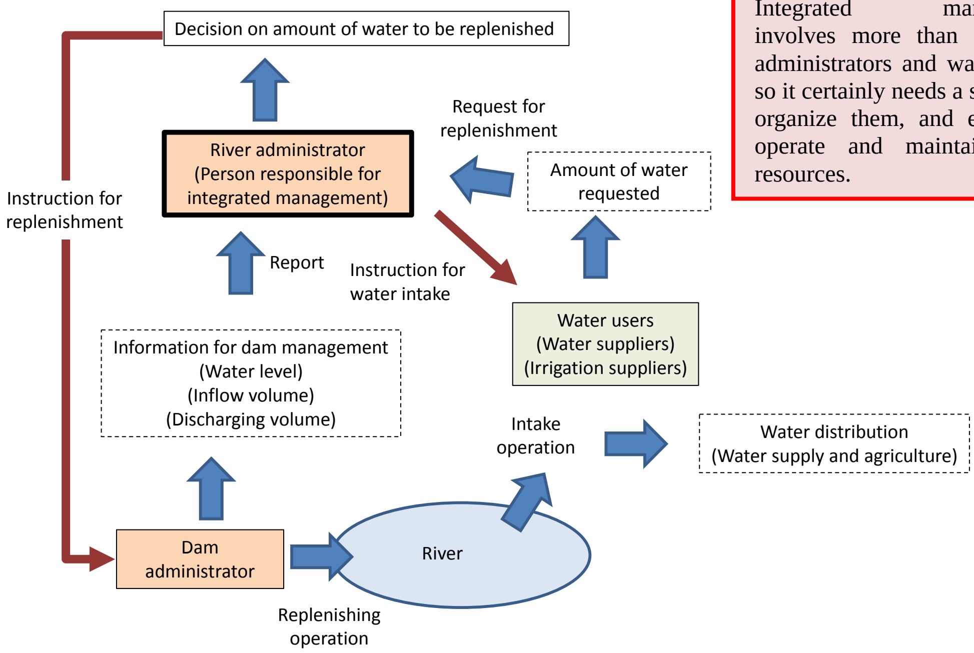
Table 8-7 Issues of Nigeria for More Sophisticated Dam Management

Item	Contents
Communication related to water-discharging from dams	The dam administrators have little communication with water users (parties taking the water).
Sure water-discharging operation	The dam administrators even fail to record dates and amount of water discharged from the dams.
Monitoring of water intake	Water users scarcely record the intake amounts. The river administrators fail to monitor the intake amounts, either.

Source: JICA Project Team

For dam integrated management, persons responsible are required, as in Figure 8-3, to understand information about (on-the-spot) dam administrators; comprehensively consider requests from water users and give instructions on dam operations such as resupply and retention of water; and give water users instructions on water intake operations. Table 8-8 shows matters to be developed to realize the integrated management.

Integrated management involves more than one dam administrators and water users, so it certainly needs a scheme to organize them, and efficiently operate and maintain water resources.



Source: JICA Project Team

Figure 8-3 Ideal Form of Dam Integrated Management (Smooth communication between water users and river administrators)

Table 8-8 Infrastructure and Non-Infrastructure Development Necessary for IWRM

Parties concerned	Infrastructure Development	Non-infrastructure development
Integrated administrators	Infrastructures to obtain real-time information about water levels, flows, etc. from dams, rivers and water facilities are be required.	A management scheme clarifying segmentation of duties between water users and (on-the-spot) dam administrators, and the scopes of their responsibilities must be built. The scope of authorities must also be clarified.
Dam administrators	Information-communication management facilities are required for sound management of dam bodies and related facilities, and accumulation of data on dam management and information transmission.	Dam operation rules and a scheme where workers take responsibility for operation and management under clear standards must be created.
River facilities	A system to measure water levels and flows and transmit such data to dam administrators and integrated administrates on a real-time basis must be built.	Analyses and research must be carried out on water-discharging operation according to the water level of rivers and other themes for sophisticated dam operation based on accumulated data.
Water users	Facilities to accurately take the predetermined amount of water and information-communication systems to obtain and tranmit information about intake water and the status of water distribution must be built.	Manuals clarifying the standards for consideration of the water amount requested to integrated administrators and managing water intake and distribution must be created.

Source: JICA Project Team

Ogun-Oshun Basin, where the field survey was conducted, engages in activities similar to integrated management. The following photo shows an intake weir in the downstream basin, where water for water supply is developed. According to local water users, they request to replenish water to the dam in the higher course when the amount of water at the intake weir falls under a certain level. In other words, one form of integrated management is conducted in the interest of water users. Still, it should desirably be shifted to a true form of integrated management in future, whereby integrated administrators are appointed to organize water users and dam administrators and make decisions on the necessity of replenish water to the dam in light of opinions of water uses and the status of the reservoir dam.

Source: JICA Project Team

Photo 8-1 Intake Weir in the Downstream in Ogun-Oshun Basin (managed with a standard water level to request replenishment of water to the dam)

At any rate, the dam concerned must be sound enough and functions effectively for dam integrated management, for which, most importantly, safety of the dam body must be secured. In Nigeria, there are many earth dams but most of their bodies are seriously damaged: in particular, dams in HA-1 tend to be damaged seriously partly due to the dry weather in the northern part. What are necessary in future are to conduct surveys to find out seriousness of the damages, conduct maintenance and repair work on, first, particularly important dams and then less important ones, and conduct appropriate maintenance work.

Source: JICA Project Team

Photo 8-2 Erosions of Gari Dam Body

8.3.2 Operations and Maintenance of Groundwater Development Facilities

Ten (10) items are explained below on current situation and issues on operation and maintenance of facilities for groundwater management and development of Ogun-Oshun Basin.

- Aquifer management
- Operation and management of borehole facilities
- Pumping capacity of boreholes
- Borehole construction system
- Groundwater lowering by over pumping
- Sea water intrusion
- Land subsidence
- Groundwater contamination

- Improvement of borehole successful rate
- Groundwater monitoring against drought

(1) Aquifer management

Issues of aquifer management and development of Ogun-Oshun Basin are summarized in Table 8-9.

Table 8-9 Issues of Aquifer Management and Development of Ogun-Oshun Basin

Combination of climate and hydrogeology	Aquifer scale	Available yield of boreholes	Issues in Management and Development	
			Cause	example
High precipitation-sedimentary rocks	Large	Large	・Over pumping ・Urban drainage	・Land subsidence ・seawater intrusion ・groundwater contamination
High precipitation – basement rocks	Small	Small	Drought	Water shortage in dry season

Source: JICA Project Team

(2) Operation and Maintenance of Borehole Facilities

There are around 5,741 boreholes currently in Ogun-Oshun Basin, and most of those boreholes are for water supply of rural and small urban/town. Most of the boreholes are operated and managed by communities. However, only one fifth of the entire rural communities might have special organizations for operation and maintenance of rural water supply facilities. As a result, boreholes were left non-operational without any repair after hand pump were broken, even though it is simple breakdown. Such situation is repeated again and again. Proposal for improvement of this issues are as below:

- Adequate selection of prioritized community for borehole construction
- Hygiene and sanitation education for communities
- Establishment of system for water fee collection within communities
- Strengthening of supporting system for LGA
- Provision for spear part

(3) Pumping capacity of borehole and promotion of change of pump type from hand pump to motorized pump

There are many boreholes for rural water supply. Boreholes are usually installed with hand pumps. Pumping capacity of hand pump is small. Consequently, it cannot be said that groundwater potential is fully utilized by use of hand pump. Groundwater potential can be fully utilized by shifting pump type from hand pump to motorized pump. Pumping capacity of 50-150m^3/day is necessary in case of motorized pump though pumping capacity of 10m^3/day is enough in case of hand pump. According to records on pumping capacity, most of the boreholes have pumping capacity of more than 80m^3/day in Ogun-Oshun Basin, which means that many boreholes in Ogun-Oshun Basin can be installed with motorized pumps. JICA Project Team proposed conversion from hand pumps into motorized pumps by setting ratio of motorized pump and hand pump as 6:4 for rural water supply development in the CMP.

Number of boreholes to meet future water demand can be considerably reduced by conversion of pump type from hand pumps to motorize pumps, so that cost of borehole construction can also be considerably reduced. On the other hands, operation and maintenance of motorized pump is more complicated than hand pumps. Moreover, operation cost of motorized pumps is more expensive than hand pumps. Measures are necessary to solve problems that community will face by increased technical and cost aspects.

(4) Issues of Current Borehole Construction System and Basic Policy to solve it

Many organizations implement borehole construction for rural water supply. They are State Ministry, RUWASSA, RBDA, MDG Office and others. They implement their projects without coordination with the other organizations. Consequently, inefficiency of their projects is pointed out. Issues below should be examined for better implementation of the project.

- It should be abolished that many organizations implement borehole construction for rural water supply independently. Implementation agency should be unified to one organization, State RUWASSA.
- Implementation agency will formulate long term plan for borehole construction for efficient

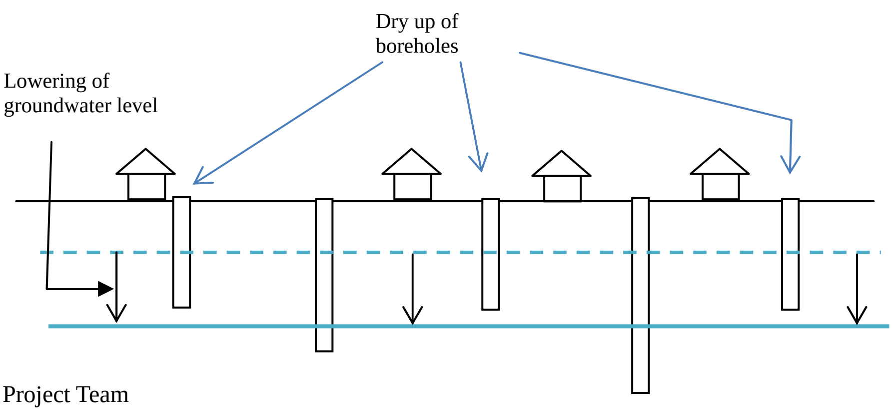
project implementation.

For more efficient groundwater development, matters below should be examined.

- To improve technical and institutional capacity of State Agency.
- To strengthen capacity and function of State Agency as main responsible organization for rural water supply.
- To improve capacity of private drilling companies under direction of State Agency.
- To make cooperation with Federal Organization such as NIWRMC and NIHSA for establishment of i) registration system of private borehole companies and ii) technical transfer system for new groundwater development.

(5) Groundwater lowering due to over pumping

Cretaceous to Quaternary sedimentary rocks are distributed in southern part of Ogun-Oshun Basin. Sandstone of the sedimentary rocks forms excellent aquifer. Large amount of groundwater can be pumped up from the sandstone for the purpose of urban and industrial water supply. However, there is possibility of regional groundwater lowering due to over pumping. Regional groundwater lowering will affect other groundwater use. Groundwater development within groundwater recharge was planned in the CMP, which can be called as sustainable development. Large scale groundwater lowering will not occur if development plans follow the rule above mentioned. However, there is possibility that groundwater will be developed exceeding groundwater recharge by too many borehole drilling and pumping without control. As a result, regional groundwater lowering will occur, and shallow wells will dry up gradually from shallower ones to deeper ones as shown in Figure 8-4. To prevent such a situation, it is necessary to control groundwater resources by groundwater management organization.

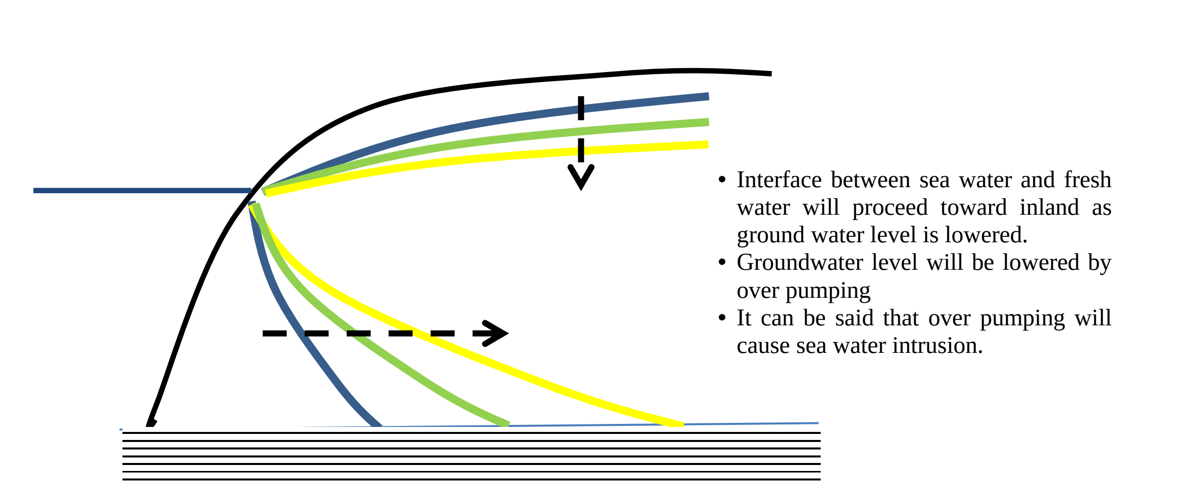


Source: JICA Project Team

Figure 8-4 Lowering of Groundwater Level

(6) Sea water intrusion

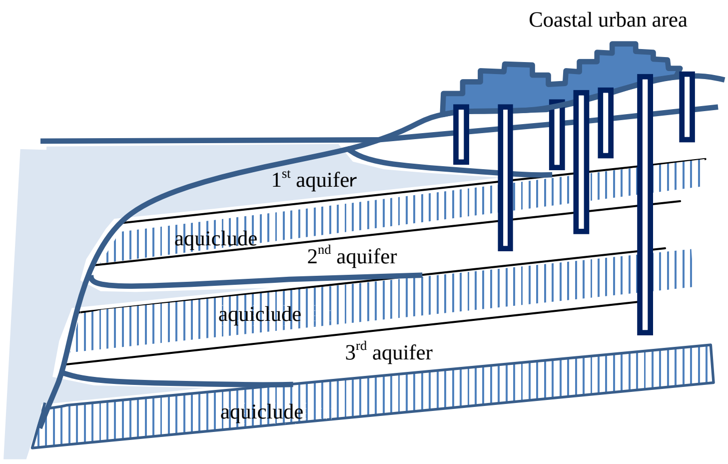
Sea ater intrusion into aquifer is taking place due to lowering of groundwater level in the coastal aquifers. Excellent aquifers of high permeable sand layer are distributed along the coastal line of southern part of Nigeria where Ogun-Oshun Basin is located. Over pumping of city will cause lowering of groundwater level as shown in Figure 8-5. It is said that sea water intrusion is proceeding in large urban area. It is necessary that NIHSA will implement continuous monitoring on groundwater level and salt concentration of groundwater to predict behavior of sea water intrusion from now on for formulation of measures against sea water intrusion.



Source: JICA Project Team

Figure 8-5 Relationship between Sea Water Intrusion and Groundwater Level

Geological section of the coastal plain represented by Lagos is shown in Figure 8-6. Groundwater is likely to be pumped up for water supply. Aquifer is Quaternary to Tertiary formation: groundwater is pumped up from several formations forming confined aquifers. Sea water is intruding into aquifer. However, degree of sea water intrusion is not same among the aquifers. Groundwater level is lowered by pumping, and degree of sea water intrusion depends on degree of lowering of groundwater level of each aquifer. Sea water intrusion is serious in the aquifer near the ground from which a great deal of groundwater is pumped up. On the other hand, sea water intrusion is not serious in deep aquifer from which groundwater has not yet been pumped up.



Source: JICA Project Team

Figure 8-6 Situation of Sea Water Intrusion into Aquifer of Coastal City in Ogun-Oshun Basin

<u>Measure against sea water intrusion</u>

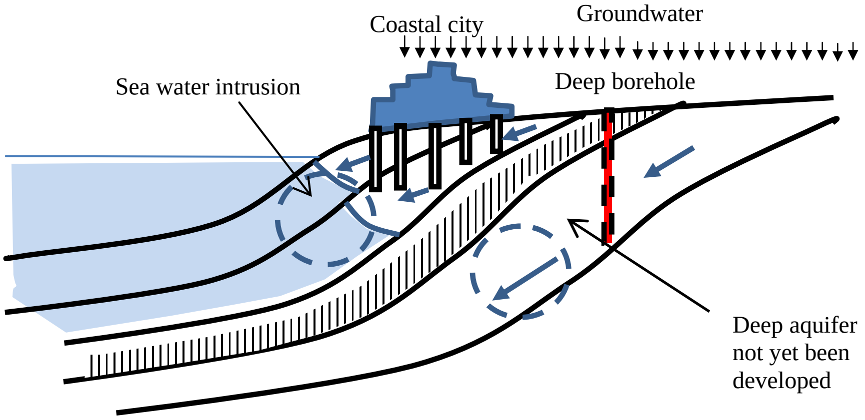
Methods below can be proposed as measures against sea water intrusion.

- Pumping control
- Development of deep aquifer

Pumping control will be implemented for the aquifer that is already developed. Sea water intrusion is caused by lowering of groundwater. Consequently groundwater level should be recovered by pumping control to prevent sea water intrusion.

On the other hand, deep aquifer that has not yet been developed is promising for new groundwater development. Aquifer structure in Ogun-Oshun Basin is shown Figure-8-7. There is groundwater recharge area in the north of urban areas along the coast, which has enough groundwater recharge leading to high development potential. Groundwater development should be implemented by deep boreholes in the north of urban area. Items below should be taken into account.

- Geological survey is necessary to know depth of deep aquifer before selection of borehole drilling points.
- Measure against groundwater quality is necessary because groundwater of deep aquifer usually has high concentration of minerals originating from geology such as manganese (Mn) and magnesium (Mg).
- Sea water intrusion will be progressed by development of deep aquifer. Groundwater recharge to deep aquifer must be carefully analyzed to set adequate pumping rate.
- Careful geological survey and plan is necessary on geological structure of deep aquifer which will affect other aquifers which were already developed.



Source: JICA Project Team

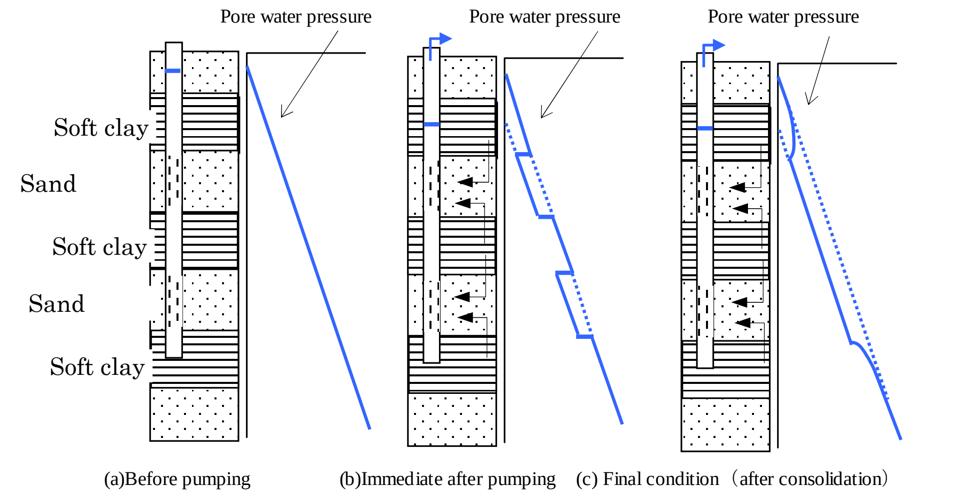
Figure 8-7 Deep Aquifer Development

(7) Land Subsidence

Sand formation of Quaternary is distributed in the coastal plain of Ogun-Oshun Basin, which is excellent aquifer. Huge amount of groundwater is pumped up for urban and industrial use in large urban area such as Lagos. It is pointed out that lowering of groundwater level is taking place in regional level. Lowering of groundwater level will affect groundwater pumping of many users. Moreover, it will bring about regional land subsidence.

Aquifer of the coastal plain of Ogun-Oshun Basin is usually alternation of sand and soft clay layer, water will be squeezed from clay layer when large amount of groundwater is pumped up from sand layer underlain or overlain the clay layer. As a result, clay layer will be consolidated to cause land subsidence (see Figure 8-8).

Land subsidence caused by over pumping is called as “regional land subsidence”. It is not easy to recognize whether or not land subsidence is occurring because large part of the ground surface subsides at the same speed, and any deformation cannot be recognized on the ground surface. It is reported that regional land subsidence is taking place in Lagos Metropolitan area and other large cities in the southern part of Nigeria. However, there is no monitoring to judge occurrence of land subsidence. There is possibility that effect of land subsidence will appear from now on, so that measures against land subsidence are necessary now. Symptom, monitoring method and measures on land subsidence are explained below.



Source: Land subsidence and measures for it, Department of Environment of Japan, 1989.

Figure 8-8 Mechanism of Land Subsidence (Squeeze of Water from Soft Clay)

<u>Symptom of land subsidence</u>

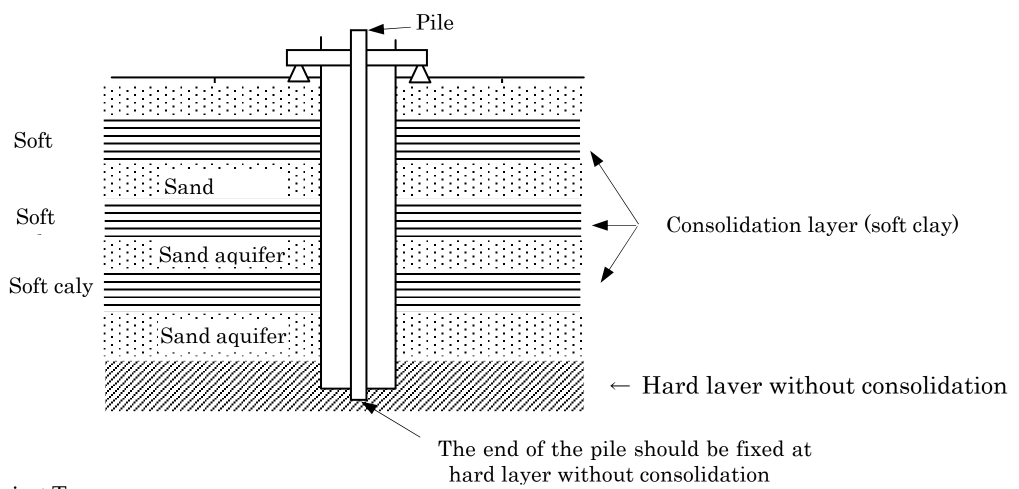
Land level will be lowered by land subsidence, so that frequency and damage of inland inundation will be increased/worsened more than before. Degree of land subsidence is different place by place because of difference of thickness of clay layer to be consolidated. As a result, inland inundation is more serious in some areas than the other area.

Head of piles of building foundation will appear as a result of land subsidence. Connection between building and underground pipe will also appear as well.

<u>Monitoring method</u>

Monitoring method for land subsidence is explained below.

- Levering survey should be implemented from fixed leveling point without settlement where rock is outcropped.
- Monitoring well for land subsidence should be constructed (see Figure 8-9).
- Groundwater level must be observed with progress of land subsidence to obtain relation between them.



Source : JICA Project Team

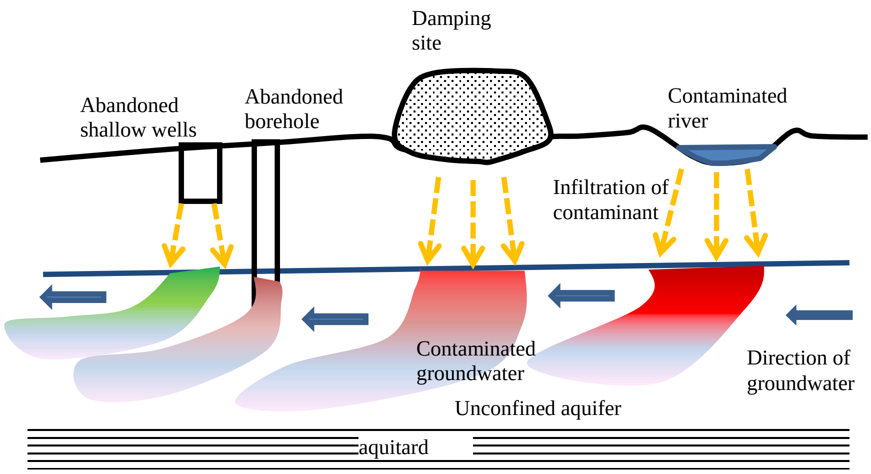
Figure 8-9 Example of Land Subsidence Monitoring Well

<u>Measures against land subsidence</u>

There are no other measures except pumping control against subsidence.

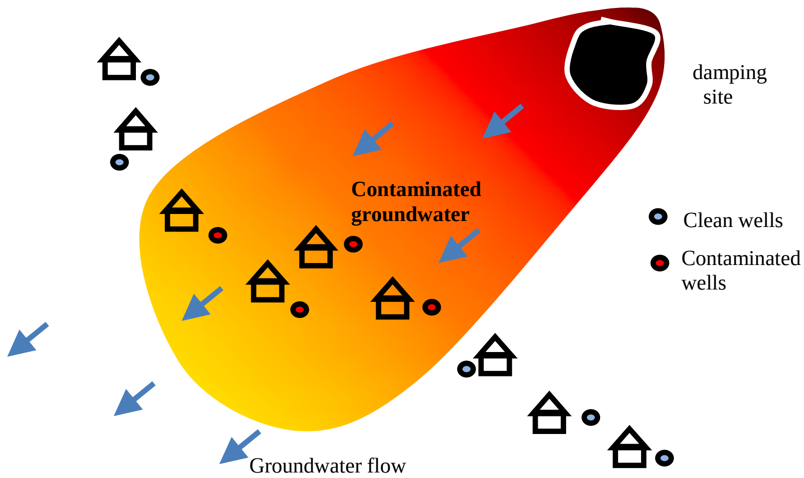
(8) Groundwater contamination

There is high possibility in urban areas of Ogun-Oshun Basin that contaminated water infiltrate into aquifer from damping sites and rivers, which cause groundwater contamination. As shown in Figures 8-10 and 11, there are many potential sources of groundwater contamination from which contaminant will easily infiltrate into shallow unconfined aquifer to contaminate it.



Source: JICA Project Team

Figure 8-10 Potential Groundwater Contaminant

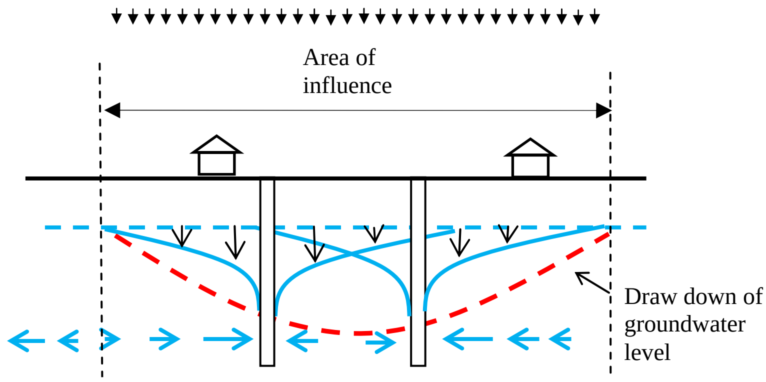


Source: JICA Project Team

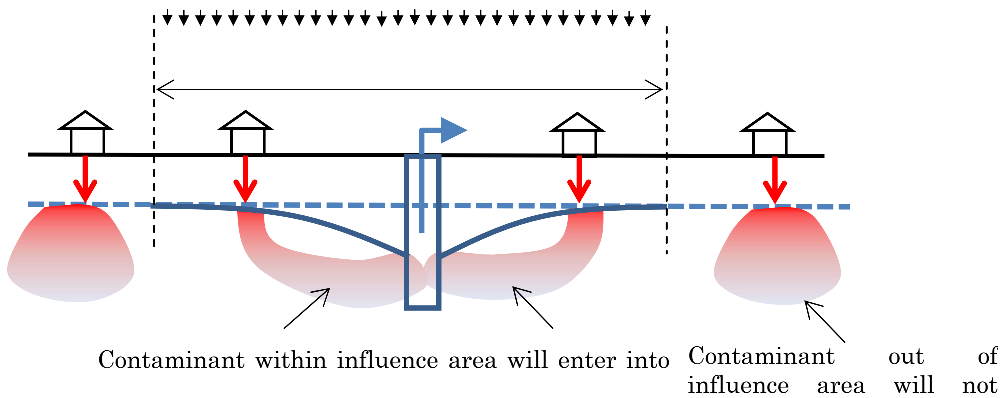
Figure 8-11 Concept of Expansion of Groundwater Contamination

Mechanism of groundwater contamination

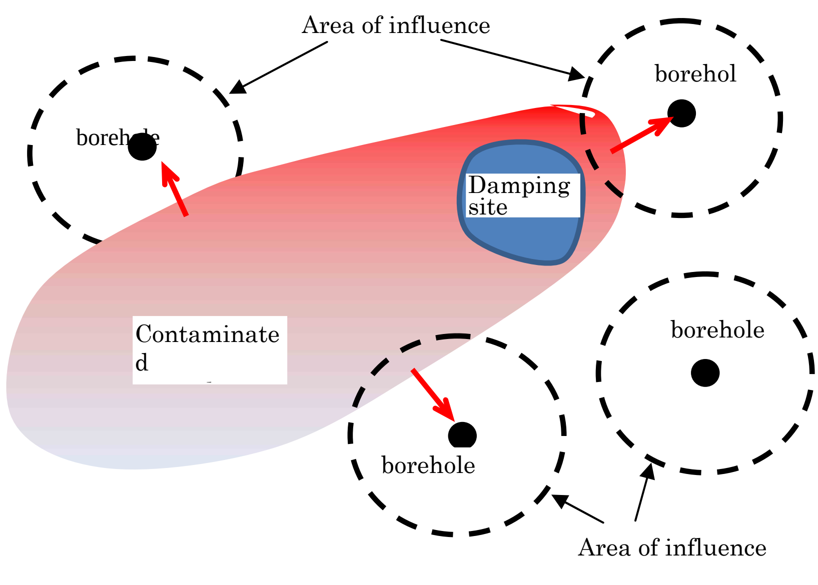
Each borehole has area of influence and collecting groundwater within the area of influence as shown in Figure 8-12(a). Borehole will pump up contaminant within the area of influence. To understand this mechanism is important in formulation of measures against groundwater contamination.



(a) Area of influence of boreholes



(b) Geological section of Contaminant to Enter Borehole



(c) Plain of Contaminant to Enter Boreholes

Source: JICA Project Team

Figure 8-12 Mechanism of Groundwater Contamination within Area of Influence

Measure against groundwater contamination

Most important rule against groundwater contamination is to get rid of potential contaminant from influence area of boreholes. There are two methods below:

1) To put enough distance between borehole and potential contaminant
2) To replace shallow hand dug well into borehole

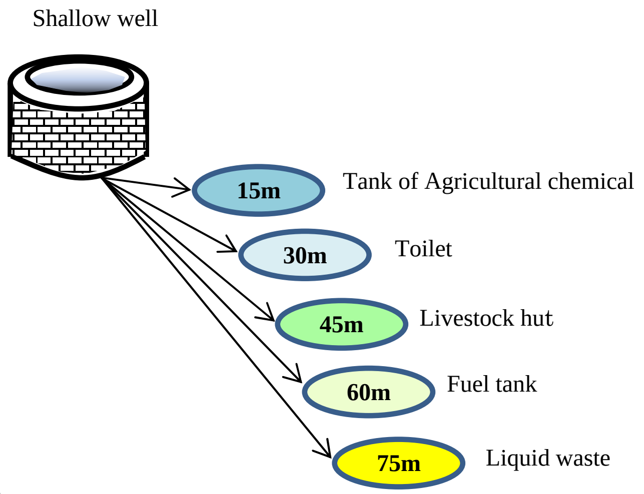
1) To put enough distance between borehole and potential contaminant

Groundwater contamination will be avoided by putting enough distance between borehole and potential contaminant.

- Potential contaminant should be out of area of influence from the existing boreholes
- New boreholes should be planned to locate far enough from potential contaminant

Area of influence of borehole must be known before taking method above. Area of influence is decided by three parameters, i) permeability of aquifer, ii) yield of borehole, iii) characteristics of contaminant.

- Area of influence becomes lager as aquifer permeability become higher. Consequently, area of influence will become smaller as permeability of aquifer become low.
- Area of influence becomes large as pumping rate (m^3/day) become lager. Consequently, area of influence becomes smaller as pumping rate become smaller.
- Area of influence become lager as contaminant is easy to be transported within aquifer. Consequently, area of influence become smaller as contaminant is difficult to be transported as shown in Figure 8-13.

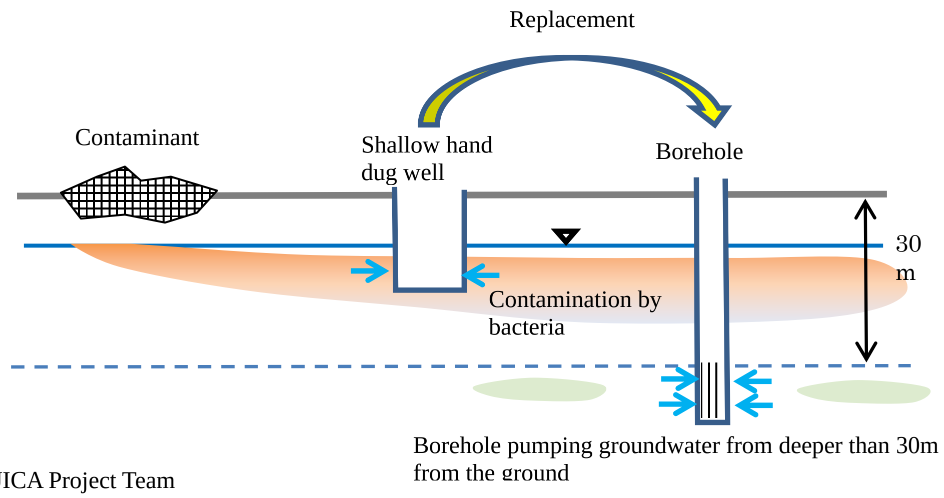


Source: JICA Project Team

Figure 8-13 Example of Distance between Contaminant and Wells to Prevent Groundwater

2) To replace shallow wells into boreholes

Regarding measures against groundwater contamination, the JICA guideline on groundwater development indicates that bacteria cannot survive in deeper than 30m from the ground surface. Therefore, borehole will not suffer from contamination by bacteria if groundwater is pumped from the aquifer located in deeper than 30 m from the ground surface. On the other hand, shallow wells are constructed by human power, so that it is impossible to dig the aquifer below groundwater table. Shallow wells are actually very shallow where groundwater table is high, and it is vulnerable by contaminant from ground surface. See Figure 8-14.

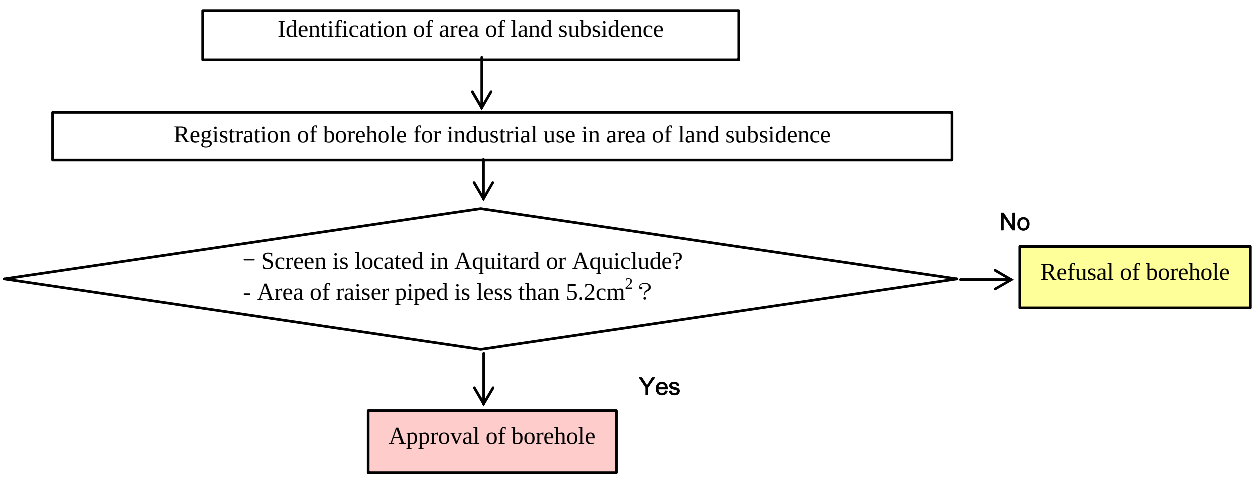


Source: JICA Project Team

Figure 8-14 Mechanism of Groundwater Contamination

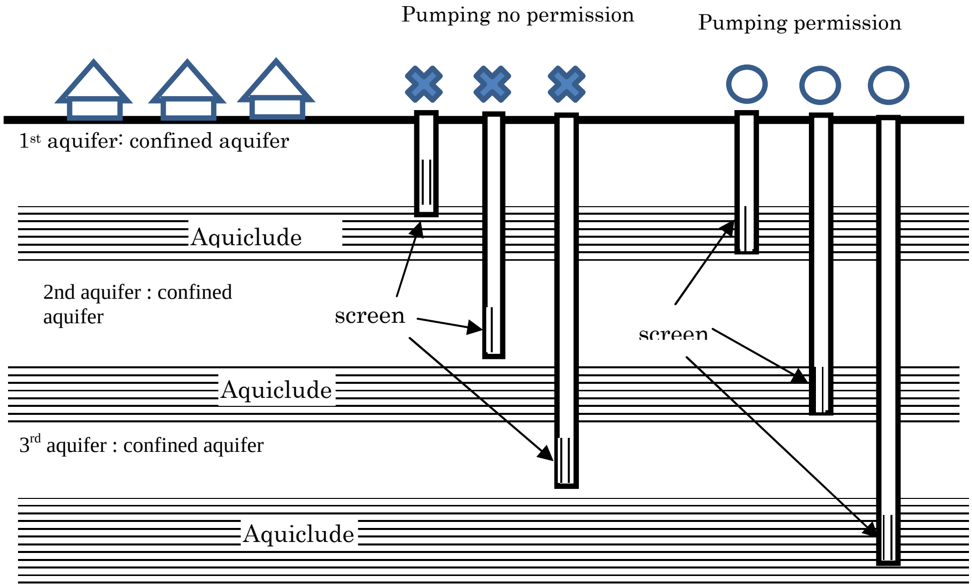
Pumping control

There are many stakeholders in groundwater development and use, so that it is practically impossible for stakeholders to coordinate with each other in direct manner. Instead of individual stakeholders, organization in charge of management and coordination of groundwater development and use has to control groundwater development and use. Serious land subsidence took place in Japan in 1970s by over pumping in industrial area along the coast. To stop land subsidence the Government of Japan controlled groundwater pumping. The way the Government took is as follows (see Figures 8-15 and 16):



Source: JICA Project Team

Figure 8-15 Procedure of Pumping Control

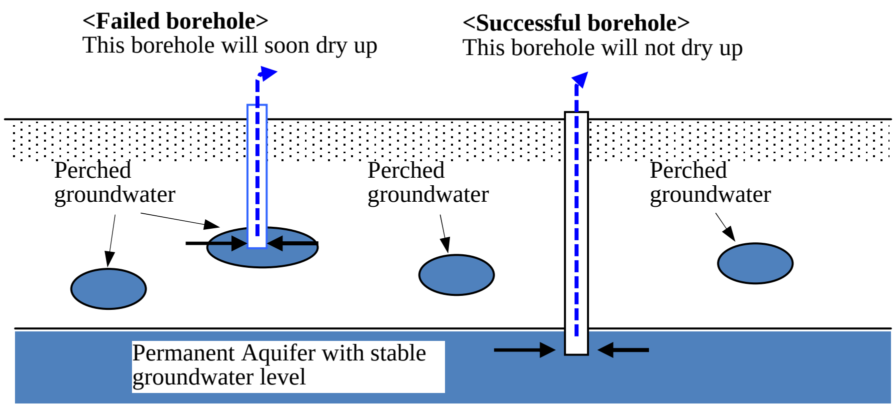


Source: JICA Project Team

Figure 8-16 Concept of Aquifer Control

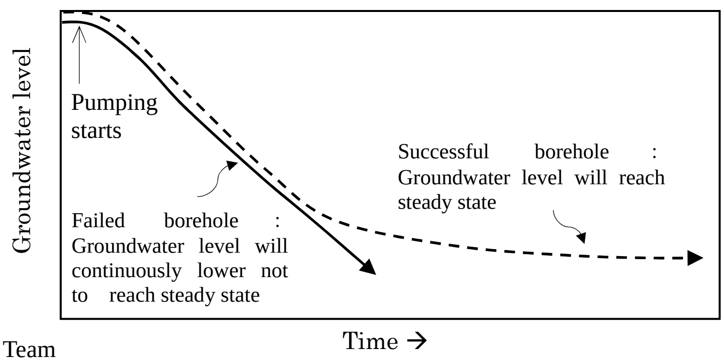
(9) Improvement of borehole successful rate

Groundwater is extracted for rural water supply in the Basement Complex area which is distributed in the central and northern part of Ogun-Oshun Basin. Borehole successful rate is as low as 50%-70%, so that survey technique must be improved to raise successful rate. Example of failed borehole is shown in Figure 8-17. Some boreholes were drilled to pump up groundwater from perched aquifer, which were mistaken as large suitable aquifer. Such mistakes can be avoided by implementation of adequate pumping test as shown in Figure 8-18.



Source: JICA Project Team

Figure 8-17 Reason of Borehole Failure in Basement Complex Area

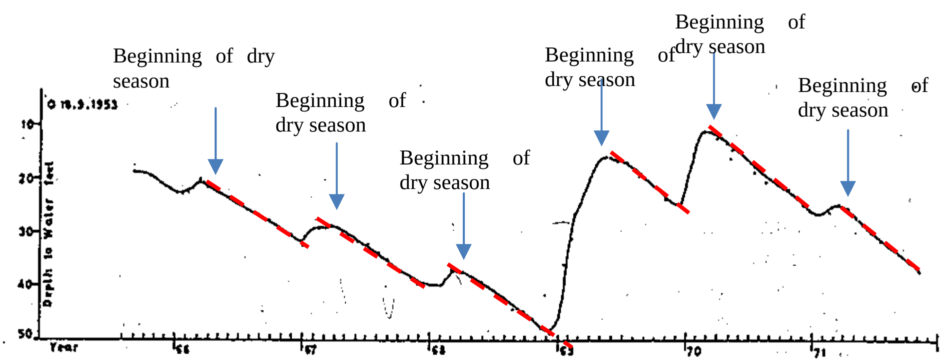


Source: JICA Project Team

Figure 8-18 Example of Result of Pumping Test of Successful and Failed Borehole

(10) Groundwater Monitoring against Drought

Pattern of groundwater level fluctuation responding to rainfall is different place by place as shown in Figure 8-19. Groundwater fluctuation is sensitive in some area but not sensitive on other area. It is desirable to know vulnerability against drought by obtaining individual pattern of groundwater fluctuation responding to rainfall at each site to formulate measures against drought by long term groundwater monitoring.



Source: JICA Project Team

Figure 8-19 Pattern of Seasonal Groundwater Fluctuation

8.4 Hydrological Monitoring

8.4.1 Hydrological Monitoring for Surface Water

(1) Strategy and Proposed Projects in M/P2013

In the M/P2013, the strategy on improvement of surface water monitoring is set as shown in Table 8-10.

Table 8-10 Strategy on Improvement of Surface Water Monitoring in M/P2013

Item	Strategy
Classification and layout planning of monitoring stations based on primary purpose and importance	− The monitoring should have clear objective for those usage. Accordingly, methodology of observation, necessary quality of data, timing of data reading/transferring etc. would be decided. − Layout plan is prepared by categorizing the observation stations into i) primary stations, ii) secondary stations, and iii) tertiary stations. − The budget for establishing, operating and maintaining the monitoring stations are limited. The priority stations should be kept in good condition in order to keep continuous long-term observation, even in the limited budget condition.
Securing sustainability of stations	− Collaboration with local people as a gauge keeper should be introduced as a back -up observation system even if automatic device is introduced when establishing, rehabilitating the stations. − Any other possible measures to secure the sustainability should be considered.
Establishing and maintaining good rating curve	− The rating curve should be prepared urgently and be updated periodically. − The establishment of the rating curve should start from the priority stations. − The discharge measurement during flood events should be conducted. − The capacity development for discharge measurement and preparing the rating curve are also important.
Simultaneous observation on hydrological and meteorological data	− The responsible organization for meteorological data is NIMET in Nigeria. However, the number of their synoptic stations managed by NIMET is very limited, which may not be enough for proper hydrological service combined with hydrological data. − It is recommended that the key meteorological data such as precipitation be monitored simultaneously at the same place where hydrological station is set. It will supplement to the data provided by NIMET. The data exchange mechanism between NIMET and NIHSA should also be considered in future.
Simultaneous observation with sediment and water quality	− From the viewpoints of management of rivers and floodplains, the simultaneous monitoring with water quantity and sediment transport should be conducted when periodical discharge measurement at primary stations is executed, in order to grasp the overall dynamics of sediment and water quality. NIHSA is responsible for sediment measurement, whereas water quality and sanitation dept. of FMWR is responsible for water quality measurement.
Establishment of quality assurance mechanism	− NIHSA should establish the proper mechanism of data management such as collecting, processing, storing and disseminating. Necessary capacity development should also be considered.
Developing capacity for hydrological modeling	− The hydrological modeling can supplement to the observed data for water resources assessment. During the process of the modeling, the quality checking of the observed data are also available. − To disseminate the information related to hydrology such as flood warning, long-term predication of surface flow condition is a fundamental hydrological service. The hydrological modeling is necessary tool for it − NIHSA should develop the capability of the hydrological modeling.
Establishing collaborating mechanism on water resources monitoring	− Although NIHSA's primary responsibility is the monitoring for water resources assessment, the contribution to the activities on water resources monitoring is also necessary hydrological service. The collaborating mechanism to the other organizations such as RBDAs, NIWRMC and water quality dept. of FMWR should be established. − The reservoir operation data should be integrated to surface water monitoring data.
Information and Education Campaign on Hydrological Monitoring	− Importance of hydrological data should be recognized and understood by public. − Information and education campaign related to hydrology should be conducted by NIHSA staff. It will eventually support the proper water resources monitoring.

Source: JICA Project Team

On the basis of the strategy, the following projects are proposed to be implemented by NIHSA in the M/P2013.

Table 8-11 Proposed Projects on Improvement of Hydrological Monitoring for Surface Water in M/P2013

Proposed Project	Description
Improvement of Surface Water Monitoring Network	The monitoring network on surface water is setup step by step. Depending on the main purpose of monitoring, the monitoring stations are categorized into four types: primary (18), priority secondary (22), secondary (35) and tertiary (93).
Enhancement of Data Management Capacity in NIHSA	This project is to enhance the data management of hydrological monitoring. Phase-1 is to enhance the capacity of the following items in a pilot area. In phase-2, the activities conducted in Phase-1 will be expanded continuously by NIHSA with more proactive manner.
Establishment of Hydrological Modeling Center within NIHSA	In order to make use of hydrological monitoring data and assure high quality of those data, it is proposed that Nigerian Government establish Hydrological Modeling Center within NIHSA. The capacity development project related to hydrological modeling is proposed, in order to consolidate the related activities.
Enhancement of Awareness on Importance of Hydrological Monitoring	This project is to promote awareness on importance of hydrological monitoring by NIHSA staffs.

Source: JICA Project Team

(2) Improvement of Surface Water Monitoring Network in Ogun-Oshun Basin

The monitoring network on surface water is setup step by step. Considering the existing Niger-Hycos network, the monitoring stations are categorized into four types. The main objectives and fundamental specifications ate summarized in Table 8-12.

Table 8-12 Classification, Main Objectives and Fundamental Specifications on Surface Water Monitoring Satiations

Type	Objectives	Criteria and number of stations	Fundamental specifications				
			Method of water level observation	Method of data transfer, frequency	Manual observation and gauge reader	Meteorological observation	Sediment and water quality
Primary	To evaluate overall water movement across the country	The most important locations in HA (one to a few stations in HA)* Total num.=2	Pressure gauge	DCP, Frequency of data transfer= hourly	Yes	Built in DCP	Together with discharge measurement
Priority Secondary	To enhance water management within HA and flood management	Important locations for water management*, especially with past experience of flood disaster Total num.=3	Pressure gauge	DCP, Frequency of data transfer= hourly	Yes	Built in DCP	No
Secondary	To enhance water management within HA	Important locations for water management* Total num.=4	Pressure gauge	Short term(2020): Recorded by logger, Collected once a month Mid-long term(2030)：DCP, Frequency of data transfer= hourly	Yes	Short term (2020): No Mid-long term(2030)：Built in DCP	No
Tertiary	To assess water resources potential in long term	At least one station in a SHA Total num.=6	Staff gauge (manual reading)	Collected once a month	Yes	No	No

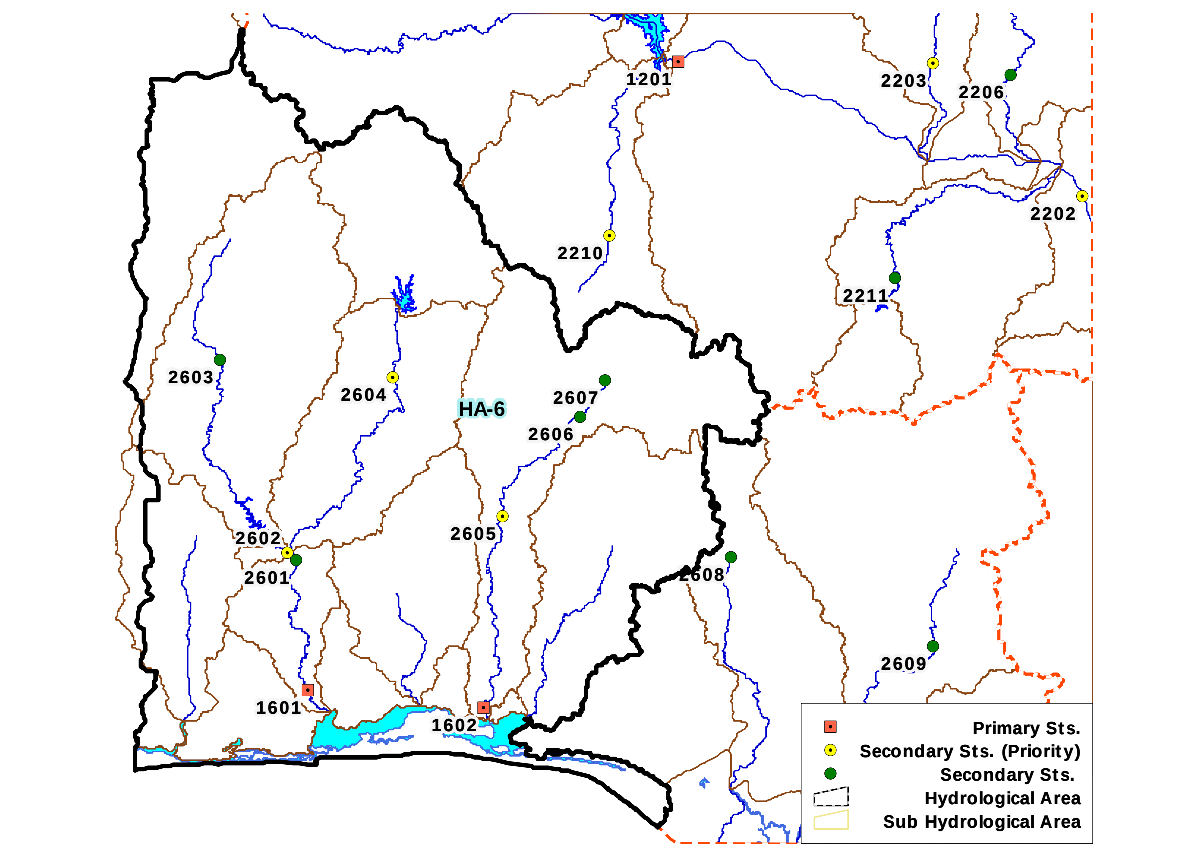
Remarks: *There are cases that the existing Niger-Hycos stations are utilized.
DCP=Data Collection Platform (Generic data collection and transfer system with satellite-based data transfer)
Source: JICA Project Team

These monitoring stations are basically different from the monitoring of inflow and outflow of reservoir by dam owners. When dams exist at important points for water management, the monitoring stations would be located at appropriated locations at downstream reach of the dam. The locations of the monitoring stations are tentatively set by discussion with NIHSA as shown in Table 8-13 and Figure 8-20. It should be noted that the detail location would be confirmed by field survey.

Table 8-13 List of Proposed Surface Water Monitoring Stations in Ogun-Oshun Basin

SN	Code	Type	Name	ExistingType	River	Remarks	Lon	Lat
13	1601	1	Akute	No	Ogun	US of Akute Intake	3.3757	6.6827
14	1602	1	Odomola	No	Osun	US of Intake for Odomola WTW	4.0558	6.6152
52	2601	2B	Abeokuta	AR	Ogun	US of Intake for Abeokuta WTW	3.3314	7.1896
53	2602	2A	Alamutu	AR	Oyan	DS of Oyan Dam	3.2961	7.2177
54	2603	2B	Ilaji-Ile Road	HS	Oyan		3.0390	7.9691
55	2604	2A	Iseyin	AR	Ogun	US of Intake for Middle Ogun Irrigation Scheme	3.7081	7.9012
56	2605	2A	Asejire	No	Osun	DS of Asejire Dam	4.1319	7.3581
57	2606	2B	Ede	AR	Osun	DS of EDE Dam	4.4363	7.7484
58	2607	2B	Erinle	No	Osun	DS of Erinle Dam	4.5367	7.8879

Type: 1- Primary, 2A-Secondary (Priority), 2B-Secondary
Existing Type: NH=Niger Hycos, AR=Automatic Recording by pressure logger, HS=Histrical station, No=No previous station
Source: JICA Project Team



Source: JICA Project Team

Figure 8-20 Proposed Surface Water Monitoring Stations in Ogun-Oshun Basin

The scenario of the improvement is proposed as follows.

<u>Phase-1 (Urgent) (2014-2016)</u>

- Rehabilitation of the existing Niger-Hycos network
- Setting-up of primary stations
- Integrated management of data for Niger-Hycos and primary stations
- Setting-up of discharge measurement devices for each HA
- Establishment of rating curve for primary stations
- Grasping sediment load at primary stations

<u>Phase-2 (2017-2020)</u>

- Setting-up of secondary stations and their integration to primary station network
- Integrated management of data for primary and secondary stations and operation data of major dams
- Rehabilitation of tertiary stations if there are existing stations

- Expansion of discharge measurement devices for each HA
- Refinement of rating curve for primary stations
- Establishment of rating curve for secondary stations
- Grasping sediment load at primary stations

Phase-3 (2021-2030)

- Introduction of DCP to non-priority secondary stations
- Setting-up of tertiary stations
- Establishment of rating curve for tertiary stations
- Refinement of rating curve for primary and secondary stations
- Grasping sediment load at primary stations
- Renewal of monitoring equipment, maintenance of equipment

(3) Recommendation on Surface Water Monitoring by RBDA and State Government

According to interview to Ogun-Oshun RBDA and State Government as well as to information obtained in stakeholder meeting, functional monitoring systems by RBDA and State government in Ogun-Oshun Basin are quite limited. This could be mainly because of lack of budget for the hydrological monitoring activities.

Considering the current situation, the followings are recommended on surface water monitoring by RBDA and State Government.

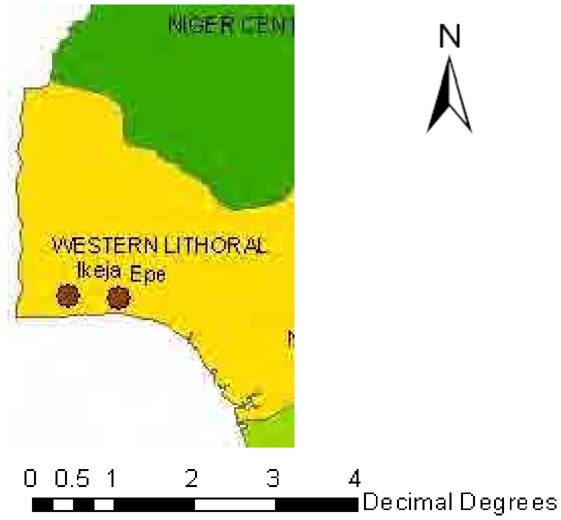
- Active involvement in operation and maintenance of the proposed surface water monitoring stations in the M/P2013, especially for tertiary stations
- Promotion of sharing and usage of the monitoring data obtained by the proposed surface water monitoring stations in the M/P2013
- Observation of water level, intake/release volume in dams and intakes operated by RBDA and State Government; estimation of inflow volume in order to assess water resources
- Observation of water level and discharge at the proposed dam sites in Section 6.2
- In Ogun and Oshun Rivers, there are large storage dams operated by RBDA in upstream reach and intake facilitates operated by State Government in downstream reach. Since, it is expected that more water will be utilized for municipal water supply in these rivers, it is very important to effectively operate the related facilities with well-coordinated. It is recommended to promote coordinated monitoring and data sharing for the coordinated operation of the related facilities.
- The fact is that Water Corporation of Lagos State is planning to use the lagoon as a water source in the future; however, according to the Lagos State Ministry of Environment, no holistic study was conducted in the lagoon to determine its suitability, therefore, it is recommended to implement a comprehensive research of the water quality and quantity of the lagoon to decide its potentiality and proper alternatives of treatment for its use

8.4.2 Hydrological Monitoring for Groundwater

8.4.2 Groundwater Monitoring

(1) Current groundwater monitoring in Ogun-Oshun Basin

NIHSA is in charge of groundwater monitoring in Ogun-Oshun Basin. NIHSA has installed groundwater automatic recorders into monitoring boreholes in Ikeja and Epe and is implementing groundwater level observation. Those boreholes were drilled in sedimentary rock areas observing confined groundwater level. The purpose of monitoring is to know the groundwater fluctuation in aquifers that are the important water sources for urban water supply of Ikeja and Epe. Data accumulation is still not enough to analyze the tendency of long term groundwater fluctuation. It is expected that this monitoring should continue, and new monitoring boreholes should also be established.



Source：NIHSA

Figure 8-21 Groundwater Monitoring Site of NIHSA

(2) Expected Groundwater Monitoring System in Ogun-Oshun Basin

(2-1) Clarification of Purpose and method of monitoring

Purpose of monitoring is defined as below:

- To assess groundwater development potentials
- To judge whether groundwater environmental problems is taking place or not, and to examine its cause and measures against it.
- To monitor groundwater quality

Content of above three (3) types of monitoring is explained below.

Groundwater environmental problem in urban area

Groundwater environmental problem in urban area of Ogun-Oshun Basin will be caused by lowering of groundwater level by over pumping. Groundwater environmental problem and monitoring method is shown in Table 8-14.

There is high possibility that over pumping will occur in entire Ogun-Oshun Basin area as shown in Table-8-14. On the other hand, land subsidence and sea water intrusion is likely to happen in the coastal area of the southern part of Ogun-Oshun Basin. NIHSA is currently implementing groundwater monitoring in the coastal area, which is not enough in quantity and quality. Monitoring system should be strengthened from now on.
There are many large cities facing Guinean Gulf, where groundwater is pumped up as main water sources for water supply. Recently it is pointed out that sea water intrudes into boreholes, so that groundwater is being contaminated by sea water. Responding to it, groundwater monitoring must be strengthening in Ogun-Oshun Basin as urgent problems. Groundwater environmental problem (over pumping, land subsidence, sea water intrusion) is likely to happen in sedimentary rock area. So it must be paid attention in the southern part of Ogun-Oshun Basin where sedimentary rock is distributed.

Sedimentary rock of Cretaceous to Quaternary age is distributed with complicated structure in large scale in western half of Ogun-Oshun Basin. Deep monitoring borehole of depth of 200 to 300m should be drilled in representative site of Ogun-Oshun Basin to make clear of hydrogeological structure, which will contribute for new groundwater development and solution of groundwater environmental problem.

Table 8-14 Groundwater Environmental Problem and Monitoring Method in Ogun-Oshun Basin

Type of problems	Monitoring points	Monitoring method/period
Over pumping	Serious Over pumping is likely to take place where huge amount of groundwater is being extracted from excellent aquifer in sedimentary rock area such as in Lagos. Groundwater monitoring should be implemented in borehole field which are used for urban water supply.	**Monitoring method** Groundwater level monitoring by automatic recorder **Motoring period** Continuous observation
Sea water intrusion	Sea water will proceed toward inland area to intrude into aquifer. This will be caused by lowering of groundwater level due to over pumping. Sea water will flow into boreholes to contaminate groundwater.	**Monitoring method** - Groundwater level monitoring by automatic recorder - Monitoring of salt concentration of groundwater Geological survey below should be implemented together with monitoring above. **Motoring period** - Geological survey on layer structure comprising sand aquifer and clay layer(Aquitard)
Land subsidence	Land subsidence is likely to take place by consolidation of soft clay of Quaternary aquifer area. Large pumping and thick soft clay will cause land subsidence more serious. There is high possibility that land subsidence is taking place by over pumping in large cities along the coast in southern Ogun-Oshun Basin. Monitoring should be implemented in above area.	**Monitoring method** - Levering survey - Observation well for land subsidence - Groundwater level monitoring at above sites Soil investigation bellow should be implemented together with monitoring above. - Soil investigation on layer structure comprising sand aquifer and soft clay - Soil investigation on consolidation parameter of soft clay **Monitoring period** Continuous observation

Source: JICA Project Team

Assessment for groundwater development Potential

Fluctuation of groundwater level should be observed for a long period of time to assess groundwater development potential. The result for the monitoring will be analyzed with meteorological data to estimate groundwater recharge (see Table 8-15).

Table 8-15 Monitoring for Assessment of Groundwater Recharge

Monitoring points		Monitoring method/ period
Basement rock area	Monitoring points should be scattered in wide area. Groundwater monitoring should be continued in 15 monitoring sites that were established in Ogun-Oshun Basin by the Project.	**Monitoring method** Monitoring by automatic recorder is desirable. However, maintenance of recorders in remote area is difficult. So in principle observers should patrol monitoring points regularly to collect data. **Monitoring period** Twice a month
Sedimentary rock area	Same as above.	

Source: JICA Project Team

JICA project Team constructed 15 shallow wells for groundwater monitoring in Ogun-Oshun Basin area and implemented groundwater level monitoring. It is expected that Nigerian side will continue the monitoring work even after this Project is completed. Moreover, area of the groundwater monitoring should be expanded to the other area.

Evaluation of Water quality

Sea water intrusion into aquifer is progressing in the coastal cities of Ogun-Oshun Basin area, causing groundwater to become salty. It is predicted that sea water intrusion will continue to progress from now on with population growth. Therefore, groundwater monitoring is necessary to formulate measures against sea water intrusion.

It is pointed that groundwater contamination is worsening in urban area. Waste water is infiltrating into aquifer causing groundwater contamination, which is from domestic/industrial drains and damping sites. Groundwater contamination is worsening with progress of urbanization, and it is necessary to monitor groundwater contamination to treat it properly.

Table 8-16 Monitoring for Water Quality Evaluation

Type of contamination	Cause of contamination	Monitoring points	Monitoring method/ period
Increasing of salt concentration of groundwater	Salt concentration of groundwater will rise due to sea water intrusion into aquifer	Coastal cities	Observation method Sampling of groundwater and water quality analysis Motoring period Sampling of once a month
Groundwater contamination	Contaminated water will infiltrate into aquifer from domestic drain, damping sites and factories.	Mainly in urban area	Observation method Sampling of groundwater and water quality analysis Motoring period Sampling of once a month

Source: JICA Project Team

(2-2) Clarification of Responsibility of Related Organization and Strengthening of Institutional and Technical Capacity

NIHSA and NIWRMC are in charge of groundwater monitoring in the Federal level. They should implement technical transfer to State Agencies such as Water Board/Corporation and RUWASSA of Ogun-Oshun Basin. Demarcation of their responsibility is as follows:

NIHSA

NIHSA should make data-base by collecting data on borehole drilling and geophysical survey from State Agencies in charge of borehole construction. They will assess groundwater development potential to identify adequate amount of groundwater to be developed. When a risk in groundwater environment is detected through groundwater monitoring, they will analyze and examine measures against it.

NIWRMC

NIWRMC is expected to issue i) water right for groundwater development and ii) borehole registration based on result of assessment of groundwater development. Moreover, NIWRMC will propose measures against groundwater environmental problems such as pumping control, based on result of monitoring/ analysis/ prediction by NIHSA.

State Agency

State agencies are in charge of groundwater development for water supply for urban and rural area. However, they do not implement groundwater monitoring and cannot assess and manage groundwater resources. This is currently implemented by NIHSA and NIWRMC. However, NIHSA and NIWRMC have limitation in terms of budget and manpower, and they cannot cover the entire Nigeria of 37 States including Ogun-Oshun Basin by their monitoring network with high accuracy. Therefore, it is expected that State Agency should implement groundwater monitoring, receiving technical transfer from NIHSA and NIWRMC, to make effective use of the monitoring result for groundwater development and management in cooperation with NIHSA and NIWRMC.

There are many stakeholders in groundwater development and management in area by area. It is impossible for Federal Government to coordinate stakeholders in each site in direct way, so that State Agency and related organizations (Water Board/Corporation and RUWASSA) should coordinate stakeholders instead of the Federal Government. In this view points, State Agencies should improve their capacity to implement groundwater monitoring and to solve problems.

8.5 Data and Information Management

(1) Overview

Though analysis such as statistical analysis etc., hydrological observation data give us precious data for sustainable development, such as figure of rainfall runoff, design condition of the river structures, river structure's operation rules.

In order to acquire precious data, it is necessary to observe hydrological phenomenon in consistent manner for very long term. Therefore, it is very important to manage observation, collection, and archiving of data to implement sustainable water resource development.

On the other hand, unfortunately there are very few organizations in HA-6 could keep observing and archiving their data in consistent manner. Therefore, it is hard to find reliable data which covers whole area.

In this section, the Project team shall explain implementation policy for observing data and collecting data which considers current HA-6's condition.

(2) Vision of Data and Information Management

Vision for the data and information management on hydrological data are as follows;

- Through sharing knowledge, allow people to make "INFORMED DECISION"
- NIHSA and CMO (Catchment Management Office or NIWRMC main body) should be focal Agencies of the database maintenance and operation

In addition, by developing data collection and archiving scheme shown in below table, NIHSA and CMO shall become body to stock information which can reference and utilize by other entities.

(3) Scope of Data

In this section, the Project team shall present management policy for following two (2) types of data.

- Observation data (Observed data in the observing station such as Precipitation, water level, water flow, groundwater level, quantities of water intake, water quality etc.)
- Inventory data (Location information and its attribute of Object such as observing station, dam, intake, irrigation project etc.)

Following table shows data collection and archiving bodies for each water resource sector.

Table 8-17 Data Collection and Archiving Scheme

Sector	Collection	Consolidation / Analysis	Evaluation / Judgment	Remark
Hydrological Monitoring (Surface Water Monitoring Station)	NISHA	NISHA	NISHA, FMWR, SMWR	
Hydrological Monitoring at Existing Facilities (Dam etc.)	RBDA, SMWR	NISHA	NISHA, FMWR, SMWR	
Hydrological Monitoring for New Project Site	Project Implementing Entity	NISHA	NISHA, FMWR, SMWR	
Groundwater Monitoring (Groundwater Monitoring station)	NISHA	NISHA	NISHA, FMWR, SMWR	
Groundwater Monitoring (Major Pumping Well)	SWB, STWSSA	NISHA	NISHA, FMWR, SMWR	
Water Supply (Major Pumping Well)	SWB	CMO	NIWRMC, FMWR, SMWR	
Rural Water Supply (Major Pumping Well)	STWSSA	CMO	NIWRMC, FMWR, SMWR	
Factories, Independent Water Supply Cooperation, Independent Irrigation scheme	Private Business Entities	CMO	NIWRMC, FMWR, SMWR	Surface water and Groundwater
Irrigation Facilities	RBDA	CMO	NIWRMC, FMWR, SMWR	
Hydro Power Station	Hydro Power Business Entities	NISHA	NISHA, FMWR, SMWR	

Source: JICA Project Team

(4) Policy for Data Acquisition

Currently, observing stations' operation is very weak in Nigeria. Therefore it often faces difficulty to maintain continuity and quality of observed data. Following table show major problem and its cause.

Table 9-18 Major Problems on Data Acquisition

Problem	Cause
Missing Observation	Due to unstable power supply, electricity outage or poor maintenance stops observing stations' equipment.
Entrain of Low Quality Data	There was no validation scheme to carry out checking.
Disruption of Data	Due to lack of funding, renewal and maintenance of equipment has abandoned.

Source: JICA Project Team

In order to avoid above mentioned condition, especially for important observing point, adding redundancy with human-powered observation is recommended (e.g. Automatic hydrological observing station equipped with water level sensor, also requires water-level gauging with human-power). In addition, observing items that are difficult to add redundancy may change observing condition, in order to meet continuity. By utilizing redundant data, quality of observation data (continuance and validity) shall be improved. Reasons are as follows;

- During power outage, human-powered observation data shall alternate data
- For validation, human-powered observation data shall be comparison data
- During operation stage, utilize affordable and off-the-shelf equipment to avoid disruption of the data even in limited budget condition

(5) Management on Data Acquisition and Archiving

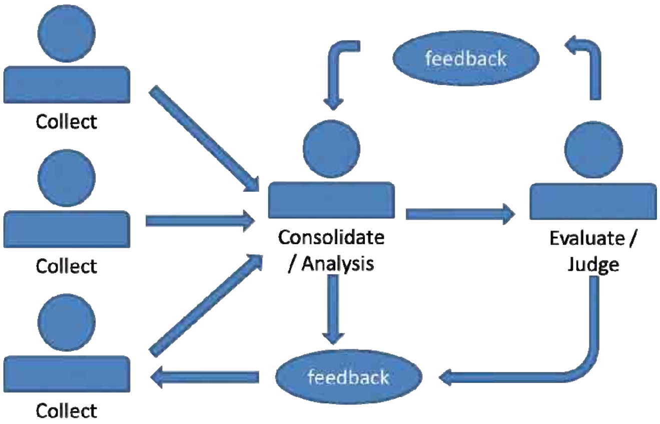
Observation data and inventory data shall become accessible from focal agencies. Therefore, it is necessary to develop data validating mechanism inside of focal agencies such as NIHSA, CMO under NIWRWC and other related agencies.

Following table shows how to monitor progress of data acquisition and archiving, for management level (Evaluation / Judgment). It reports progress of observation and archiving on a regular and systematic manner. The Project team recommends to management level of focal agencies to understand and direct situation through this mechanism. Following figure shows data flow to make evaluation and judgment by management. Monitoring items shall be changed accordance with the progress of data collection and archiving. Therefore, monitoring item can be changed by situation.

Table 9-19 Data Acquisition and Archiving

Monitoring Item	Collection		Consolidation / Analysis		Evaluation / Judgment		Feedback	
	Frequency	Method	Frequency	Method	Frequency	Method	Frequency	Method
Observation Data								
Number of Missing Data	Monthly	Count Missing Data	Monthly	Inputting Form	Monthly	Checking Form	As Needed	Revise Input
Observation Error*	Daily	Comparing Data	Monthly	Inputting Form	Monthly	Checking Form	As Needed	Revise Input
Alternative Observation Data	Every Day	Human-powered observation	Every Day	Data Supplement	As Needed	Checking Form	As Needed	Input Repair parts
Inventory Data								
Location Data	Annually	GPS	Annually	Inputting Form	Annually	Checking Form	As Needed	Revise Budget
Attribute Data	As Needed	Manual Recording	As needed	Inputting Form	As Needed	Checking Form	As Needed	

*Only apply on observation station which added redundancy for observation.
Source: JICA Project Team



Source: JICA Project Team

Figure 8-22 Data Flow Diagram to make Evaluation / Judgment

(6) Conclusion

In this section, the project team recommends following methodology to improve quality of observing data.

- By adding redundancy to the observing method at especially important observing point. By adding redundancy, it will improve continuity and validity of the data.
- By reconsidering condition of observation, where it doesn't meet continuity and validity for its cost

In addition, the project team introduced monitor mechanism to help understanding and directing progress of data collection and archiving. The project team also recommends to management level of focal agencies to show commitment on building database by utilizing this mechanism.

8.6 Consideration of Risk Associated with Climate Change and Trans-boundary Water

8.6.1 Identification of Risk on Water Resources associated with Climate Change

In chapters 3 to 5, the impact of climate change on water demand, water resources potential and water balance has been analyzed. On the basis of those analyses, the risk associated with climate change is summarized as follows.

- The scenarios for change in precipitation and air temperature at 2050 are set, based on the output from the GCMs.
- The following risk is expected under the scenario set.
  - The expected change in air temperature could bring about the reduction of annual runoff with about 20% in Ogun-Oshun Basin.
  - The response of runoff against the expected change in precipitation is not large in Ogun-Oshun Basin.
  - The irrigation water demand could increase with about 15% in average compared to base climate condition. The impact could be severer in rainy season than in dry season. The increase of irrigation water demand could be higher in private irrigation which utilizes groundwater than public irrigation.
  - Further lowering of groundwater level with 5 to 20m is expected due to reduction of recharge associated with the climate change.
  - The safety level of municipal water supply and the irrigable area with 1/5 safety level could decrease.
  - The average generated energy by hydropower plant could become 60-80% of the base case without climate change.

8.6.2 Identification of Risk related to Trans-boundary Water

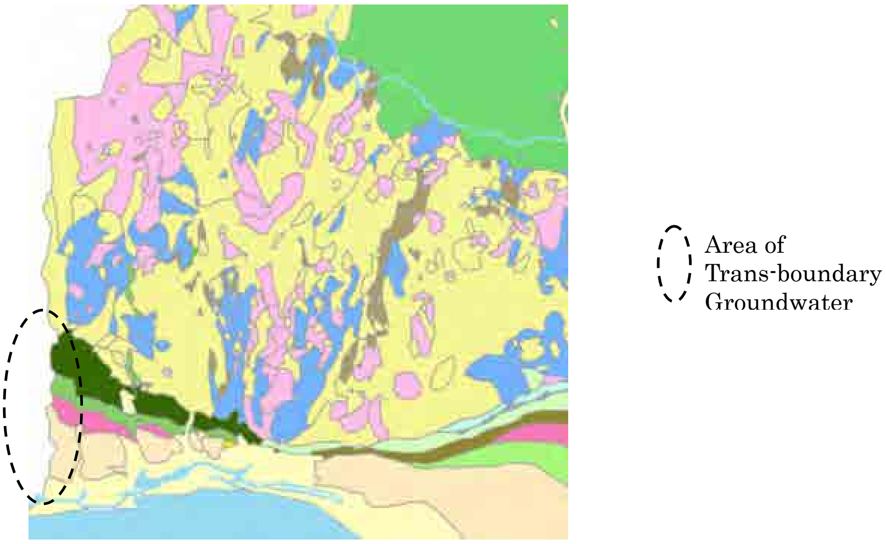
The catchment belongs to upstream countries is quite limited in Ogun-Oshun Basin. It is limited to the upstream part of Yewa River. It is thereby judged that there is almost no risk related to water supply-demand balance associated with trans-boundary water.

<u>Example of groundwater risk (Trans-boundary groundwater)</u>

Ogun-Oshun Basin area has the border with Republic of Benin in the western part of Ogun-Oshun Basin. There is high possibility that groundwater will flow passing through the border. Trans-boundary groundwater is limited in area of sedimentary aquifer of the southern part of Ogun-Oshun Basin. The reason is below:

- Aquifer system in Basement Complex is divided into isolated small aquifers. Therefore, groundwater cannot flow in regional scale. Groundwater is passing through the boundary within only small aquifers in small scale.
- Aquifers extend in large area in sedimentary rock area. Therefore, groundwater can flow passing through the boundary in large scale.

Groundwater is flowing naturally from the north to the south parallel to the border line with Benin according to aquifer structure and distribution as shown in Figure 8-23. Therefore, it is assumed that total amount of groundwater is small which passes through the border as natural condition. The border is near Lagos state where huge amount of groundwater is pumped up. However, considering distance between the border and Lagos city, pumping up of Lagos has small effect on trans-boundary groundwater of the border.



Source: JICA Project Team

Figure 8-23 Possible Area of Trans-boundary Groundwater

8.6.3 Coping Strategy on Risk associate with Climate Change and Trans-boundary Water

The followings are recommended to cope with the risk associated with climate change and trans-boundary water, as proposed in the M/P2013.

- Refinement of identification of the risk by enhancement of water-related data/information
  - Enhancing accuracy of estimation of water resources by promoting refinement of meteorological and hydrological monitoring
  - Enhancing accuracy of estimation of water demand by promoting refinement of data/information on water use
  - Enhancing communication with neighboring countries and promoting information sharing on water resources
  - Preparing flood risk maps along the main course of the Niger and Benue rivers and other important rivers by conducting detail survey on rivers and flood plains
- Promotion of adaptive management
  - The impact by climate change and trans-boundary water always includes uncertainty. When the uncertainty will become more certain, the plan should be revised accordingly. The flexible implementation structure is required to do so. The importance of proper monitoring & evaluation will be more significant for the flexible implementation structure.
- Enhancement of emergency management against flood and drought
  - More frequent flood and drought could happen due to climate change and trans-boundary water. The mechanism for determining the water allocation during flood and drought by discussion among stakeholders should be established by CMCC in each hydrological area. Furthermore, preparedness and response on flood and drought should be enhanced in collaboration with LEMA, SEMA and NEMA.
- Promotion of Water Demand Management
  - In order to cope with possible future decrease in water resources, the water demand management such as decreasing delivery loss in municipal water supply and increasing irrigation efficiency. It can reduce the risk during drought condition.

8.7 Water Environment Management

Two Sectors namely Water Environment Conservation and Water Quality Management are considered as fundamental for proper Water Environment Management. As for Water Environment Conservation, the well management of forest plays an important role to protect the water resources of a basin. As for Water Quality Management, the control of pollution of sources and the monitoring of water quality are subcomponents on which relies the water quality of the water sources.

The JICA Project Team through review of existing information, stakeholder workshops and interview to relevant officers of various relevant agencies has identified the main problems and issues in the sector of water environment management in Ogun-Oshun Basin. In addition to this, the water related recreational areas were studied in order to know their current conditions and to propose recommendations for their improvement. Based on these findings recommendations were proposed. For details on water environment management in Ogun-Oshun Basin, please refer Supplement-8.

The identified important problems/issues and proposed recommendations are presented as follows.

Table 8-20 Important Problems/Issues and Recommendations on Water Environment Management

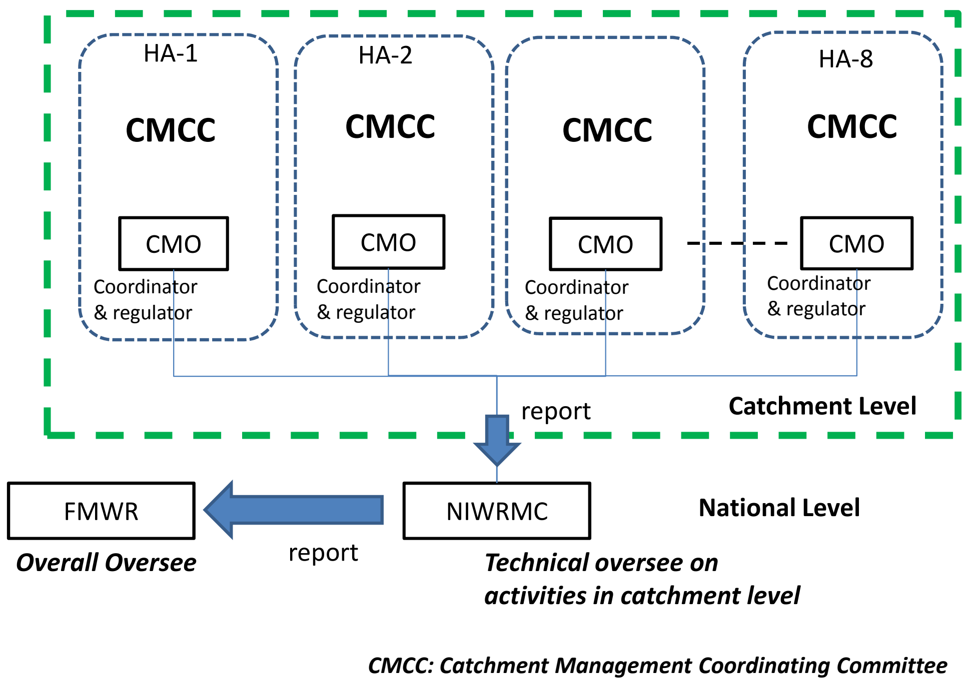
Important Issues	Recommendations
Drinking Water Quality Monitoring	
Drinking Water Quality Monitoring is very poor in HA-1 and this present a risk for the public health of the population. Main constraints of the water quality monitoring system are financial, technical capability, lack of equipment and sufficient human power. Due to this fact, the Laboratories cannot cover the operational areas efficiently and the number of samples analyzed is very poor and not adequate for realistic water quality assessment.	A joint-work agreement among stakeholders is proposed to be implemented for improving the existing Drinking Water Quality Monitoring in Ogun-Oshun Basin as follows: For Lagos State: agreement shall be made between FMWR Water Laboratory at Lagos, Lagos Water Corporation and LASEPA for the joint elaboration and implementation of a monitoring program to cover the whole State of Lagos For Oyo State: agreement shall be made between FMWR Water Laboratory at Lagos, Oyo Water Corporation, Central Laboratory and RUWASA for the joint elaboration and implementation of a monitoring program to cover the whole State of Oyo For Ogun State: agreement shall be made between FMWR Water Laboratory at Lagos and Ogun Water Corporation for the joint elaboration and implementation of a monitoring program to cover the whole State of Ogun. For Osun State: agreement shall be made between FMWR Water Laboratory at Akure, Osun Water Corporation and RUWESA for the joint elaboration and implementation of a monitoring program to cover the whole State of Osun. These agreements must include the provision of funds for operation and maintenance of equipment and the training upgrading of the involved personnel. Through these agreements is expected a synergy among stakeholders for a better use of the available financial, human and technical resources..
Water Pollution Control	
Low level of compliance by industrialists for wastewater discharging into water bodies	Awareness creation of industrialist and the establishment of financial mechanism for the installation of wastewater treatment facilities in the industries
There is a poor enforcement of Laws, regulations and standards to control industrial wastewater pollution	A memorandum of understanding should be promoted among FMWR, FME, State Ministries of Environment, LASEPA and OGEPA to prioritize programs for water pollution control of water sources used as domestic source. These programs must include the provision of funds for operation and maintenance of equipment and the training upgrading of the involved personnel.
Lack of awareness of the people on environmental issues, therefore not collaboration from them to avoid water pollution from solid waste and domestic wastewater	Environmental education and awareness campaign on water resources protection from pollution must be implemented for primary & secondary schools and for the general public.
In many urban cities of Ogun-Oshun Basin can be observed illegal disposal of solid waste generally in open spaces, along the roads or in watercourses polluting the environment.	Solid waste management needs to be improved in the Ogun-Oshun Basin to avoid pollution of watercourses or water sources.
Water Environment Conservation	
Management Plans of forest are not implemented and as result there are uncontrolled clearing of forest in many parts of HA-6 and as results erosion increase affecting water courses	The management plans of forest should be put in place to achieve a sustainable production, protection and conservation of forest resources.
Currently many rivers and dams in Ogun-Oshun Basin are affected negatively by aquatic weeds and plants	In the period 2007-2011, the FME implemented a project for aquatic weeds and plants control in 25 states. A second phase of this project is now under preparation. It is recommended that FMWR takes part actively of the above project to promote a sustainable control of this nuisance in important surface water of Ogun-Oshun Basin.
Nigeria is blessed with many water recreational areas that can be exploited as tourism attractions in the world of tourist industry. Besides, the cultural celebrations by its population composed by diverse cultural groups could represent the best destinations for tourist lovers of the history and culture. However, these potentials of tourism need to be developed adequately to promote the sector in the country	The promotion of tourism in Ogun-Oshun Basin is indispensable for creating jobs and income generation. The best point to start, is implementing the existing Master Plan for the Tourism Sector. The existence of water related recreation places should be considered when water resources development project is proposed. The management of these places should also be considered as a part of watershed conservation activities

Source: JICA Project Team

8.8 Water Allocation and Regulation

8.8.1 Proposed Framework on Water Allocation and Regulation in M/P2013

In the M/P2013, the framework on water resources planning, management and regulation by unit of hydrological area is proposed as shown in Figure 8-24.



Source：JICA Project Team

Figure 8-24 Framework on Water Resources Planning, Management and Regulation by Unit of Hydrological Area

The basic unit of water resources management is each of eight hydrological areas. The Catchment Management Office (CMO), which is local office of NIWRMC for each hydrological area, acts major role on water resources management in hydrological area. The headquarters of NIWRMC in Abuja oversees the activities of CMO. FMWR further oversees all activities by NIWRMC. NIWRMC reports its activities on water resources planning, management and regulation by unit of hydrological area to FMWR and receives advice from FMWR.

The framework of the activities of CMO at catchment level is proposed as shown in Figure 8-25.

The activities of CMO at catchment level can be divided into the following two categories;

- Coordination of stakeholders for macro management; and
- Daily work as regulator of water use for micro management.

The macro and micro management are defined as follows;

- Macro Management
  - On the basis of the water use and water resources development plans included in the Catchment Management Plan, the water allocation in the scale of the entire hydrological area is managed. It is required that the proper water allocation which should reflect the progress of the implementation of the CMP be considered by monitoring the situation of water use facilities and water resources development facilities time to time.
  - The Catchment Management Plan (CMP) would be formulated by consensus among Catchment Management Coordination Committee (CMCC) that consists of stakeholders in hydrological area. The CMO as well as NIWRMC plays important role to support formulation and revision of CMP from technical point of view and to coordinate stakeholders.
  - Coordinating emergent water allocation during draught and/or flood conditions.

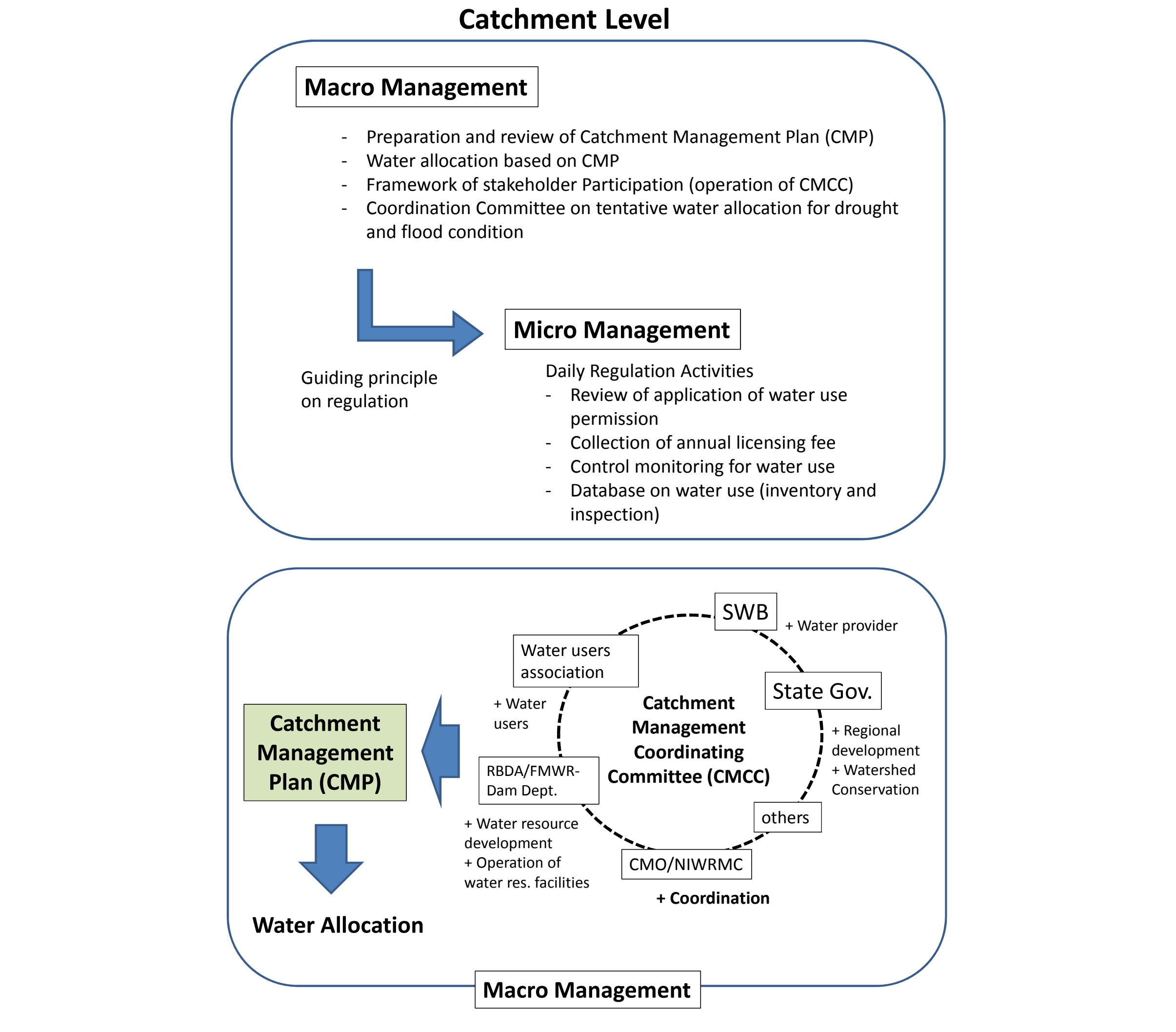
- Micro Management
  - Based on the water allocation managed by the macro management, the daily activities for water regulation such as reviewing and approving the application of water use license, collection of license fee, data and information management related to water use permit and control monitoring should be implemented.

Without the macro management, it is impossible to implement the micro management. The knowledge obtained through the micro management should be reflected to the macro management.

The role of CMO for micro management is presented in Figure 8-26. The daily activities as regulator of water use include 1) Reviewing and approving the application of water use license, 2) Collection of license fee, 3) Data and information management related to water use permit and control monitoring.

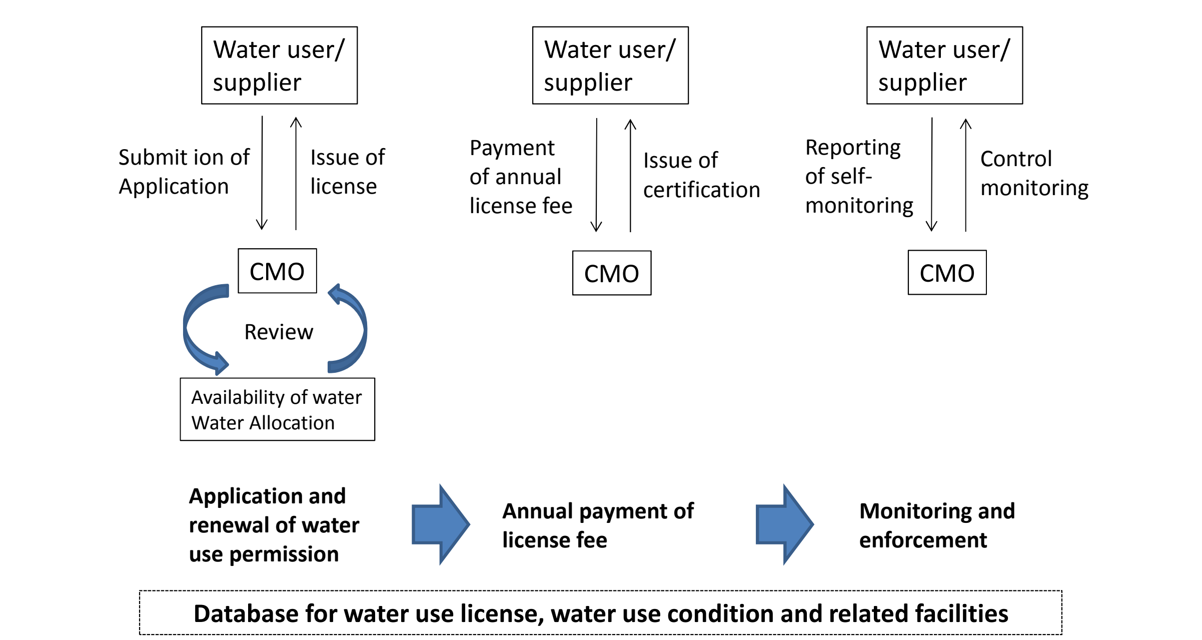
It should be noted that the license fee for water use which is collected by CMO is different from water charge by SWB, service provider for municipal water supply, and irrigation service charge collected by RBDA from famers. These charges are collected to recover the cost for construction, operation and maintenance of water resources facilities by water users, whereas the license fee is collected against the opportunity cost of natural flow without any specific water uses. The license fees may be added to the water charges and be shouldered by the end user of water. The typical patterns of the cost recovery on water use are shown in Figure 8-27.

It is proposed that the guideline for water pricing including setting water charges and water license fee be prepared by FMWR through NIWRMC. The license fee collected by CMO should be utilized for supporting the activities related to water resources management such as organizing CMCC that consists of stakeholders in hydrological area.



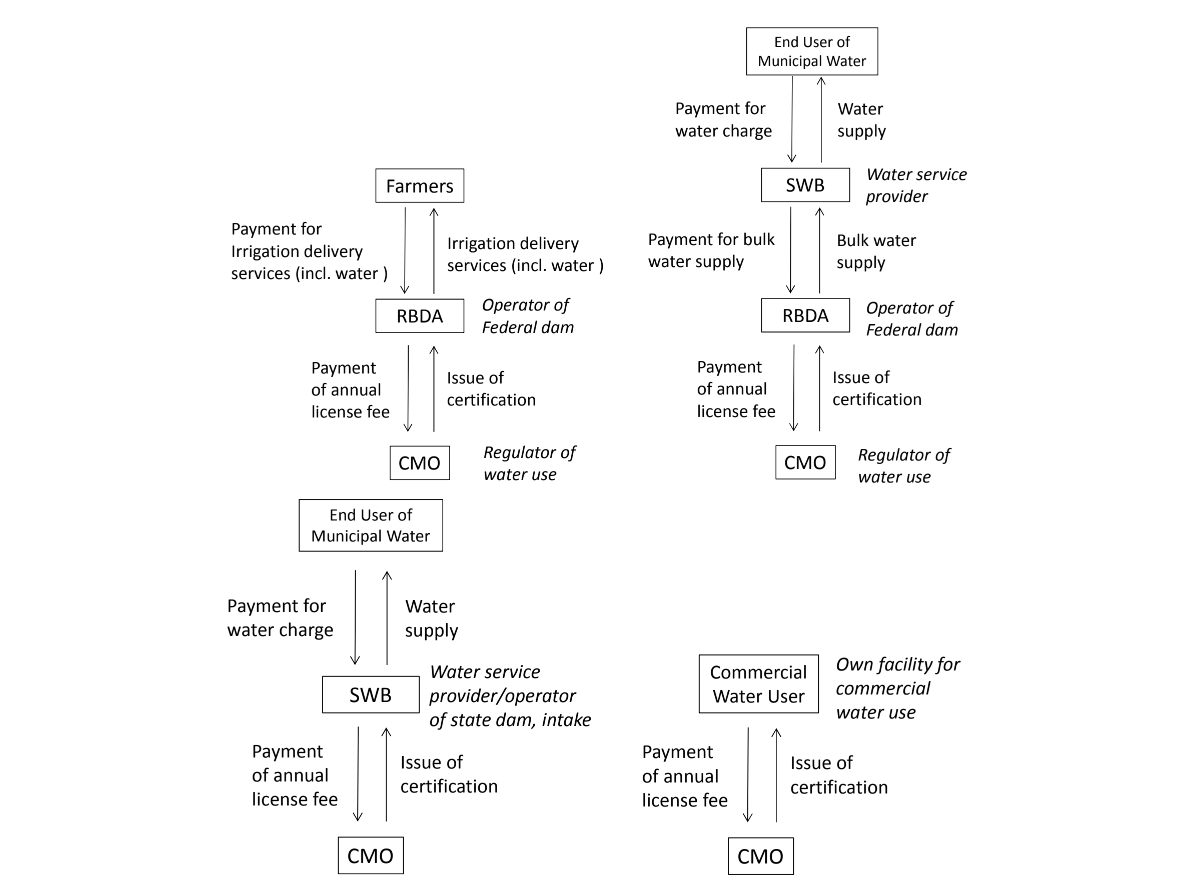
Source：JICA Project Team

Figure 8-25 Framework on Activities of CMO at Catchment Level



Source：JICA Project Team

Figure 8-26 Role of CMO for Micro Management



Source：JICA Project Team

Figure 8-27 Typical Patterns of Cost Recovery on Water Use

8.8.2 Promotion of the Framework on Water Allocation and Regulation in HA-1

In order to promote the framework on water allocation and regulation in Ogun-Oshun Basin, the followings are recommended.

- Formulation of the Catchment Management Plan (CMP) is a first step for improving the water allocation and regulation in Ogun-Oshun Basin and HA-6. The draft CMP should be finalized by continuing the stakeholder meetings.
- Stakeholder forum should be established based on the stakeholder meetings hold on the process of formulating the draft CMP. The stakeholder forum should be the basis for CMCC. In future, CMCC should be officially established when the CMP will be finalized.
- In order to implement the micro management, the capacity of CMO as well as NIWRMC should be enhanced. On the same time, the capacity of stakeholders on water management should also be enhanced.
- The appropriate charge of bulk water supply from the dams operated by RBDA to State Water Corporation should be set, considering cost recovery and possible payment by end user of municipal water supply.

8.8.3 Water Allocation and Regulation of Groundwater

(1) Current condition of groundwater development and usage

Huge amount of groundwater is pumped up in urban and rural area in Ogun-Oshun Basin. Groundwater is not only for public groundwater use such as by Water Bard but also for private use. Individual users and industrial users drilled huge number of boreholes to pump up groundwater. Many shallow wells were dug by people as familiar water sources, and many boreholes were drilled for pumping by many factories as cheaper water sources than public water supply. Moreover, many tube wells were drilled by famers for irrigation purpose.

(2) Groundwater development and use out of order

Currently borehole drilling and groundwater pumping are practically out of order. Groundwater development and use in such disorder will cause over pumping to bring about extreme lowering of groundwater level and deterioration of groundwater environment, which will finally interrupt groundwater use of many users. It is necessary to control groundwater development and use, which is currently in disorder, for equitable, efficient and sustainable use of groundwater.

(3) Control of groundwater development and use

Area of influence, from which a borehole can collect groundwater, is limited. Groundwater management has purpose for adequate demarcation of groundwater among users within the same influence area. It is practically impossible for stakeholders to coordinate with each other for demarcation of groundwater because there are so many stakeholders.

Additionally, borehole and shallow wells are owned by individuals, so that presence of boreholes and shallow wells are not made public. Based on above situation, borehole registration system is necessary at first for control of groundwater development and usage. As well as boreholes itself, yield from boreholes also must be registered. Based on information above, the regulator can manage groundwater resources.

(4) Priority of groundwater usage

Groundwater is used for public water supply. Such groundwater usage seems to have higher priority than other private groundwater use.

(5) Groundwater management organization

Influence area of borehole is decided by scale of borehole field and capacity of aquifer. Influence area might be only around 100m in rural water supply in basement rock area. On the other hand, influence area might be sometimes several to tens of kilometers in urban water supply in sedimentary rock area. Considering above situation, organization in charge and their responsibility should be below:

- Estimation of groundwater potential in groundwater basin: NIWMC, NIHSA

- Regional demarcation of groundwater development : State Ministry of Water Resources, Water Board/Corporation, RUWASSA
- Setting of number of borehole, depth of boreholes and distance between boreholes in a borehole field: Water Board/Corporation, RUWASSA

Target of groundwater control is local resident and companies, so that groundwater regulator should be State Ministry, Water Board/Corporation and RUWASSA, which can directory negotiate with users. On the other hand, Federal Organization should have responsibility of formulation of policy and guideline for groundwater management.

(6) Control method of groundwater use

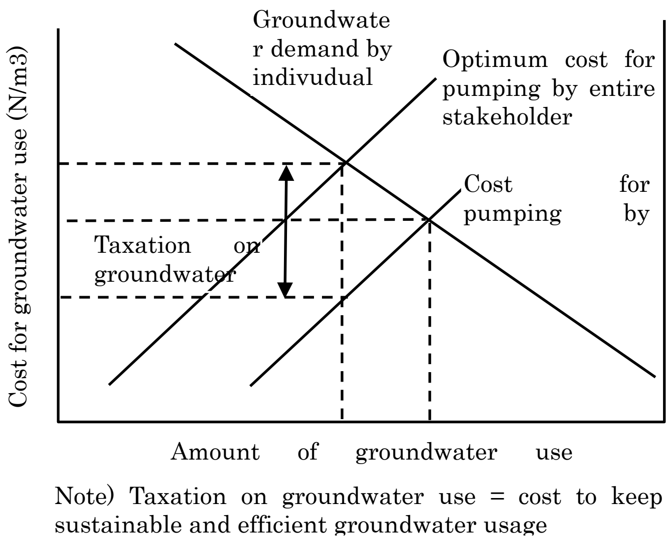
(6-1) Direct control of borehole use

Groundwater pumping was directly controlled to prevent land subsidence in case of Japan. The method of control is mentioned in Section 2.3.2 (8).

(6-2) Control by tax to groundwater usage

Tax to groundwater usage has merit and characteristics below:

- Groundwater level will be lowered due to disorder pumping, which will increase pumping cost and cause drying up of boreholes, losing total benefit of users within the same influence area.
- Over pumping and extreme lowering of groundwater level can be prevented by tax for sustainable groundwater usage as shown in Figure 8-28.
- On the other hand, efficient groundwater usage must not be interrupted by too much tax.



Source: JICA Project Team

Figure 8-28 Concept of Optimum Tax on Groundwater Usage

Parameters, which are related to lowering of groundwater level by pumping, must be set adequately to examine efficiency of taxation when tax rate is decided, considering items below:

- Identification of number of boreholes and users within the same influence area.
- Parameter on groundwater recharge and aquifer in target area

8.9 Communication Strategies for Water Resources Management

Communication in water sector is undertaken mainly by the Press and Public Relations (PR) Unit of FMWR. The following action plans were suggested in the M/P2013 based on the communication strategies of FMWR.

- Strengthening of Public Relations (PR), through updating FMWR's quarterly magazine known as WATER
- Strengthening and diversifying of the tools of PR to include all the media such as newspapers, TV, radio, magazines, etc.
- Strict and efficient management of document files within FMWR (digitalization, etc.)
- Support and assist in participatory process of water resources management considering gender equality, empowerment for women, local behavior practices at households and communities
- Development of manpower and capacity building in the PR Unit and the Gender and Human Rights Unit

In line with the above-stated action plans, we suggest the proposals for improving the communication in terms of catchment management of water resource as follows.

Table 8-21 Explanation of Proposal: PR01

Proposal Title	Dissemination of the National Water Policy, the Water Management Legislation and the CMP in collaboration and consultation with the PR Unit
Objectives, etc.	To promote partnership and harmonization of coordinated activities and action of governments and stakeholders involved in implementation of the CMP.
Lead Institutions	State MDAs/PR Unit/NIWRMC
Legislations	Completion and promulgation of the CMP

Source: JICA Project Team

Table 8-22 Explanation of Proposal: PR02

Proposal Title	Organization of Programs, Workshops and Seminars on Role of Water in the Economy and Society in the basin
Objectives, etc.	To develop tools and guidelines that consider health, gender and vulnerability in the use and management of water resources
Lead Institutions	RUWASSA/LGAs/State MDAs/NIWRMC/PR Unit of FMWR, etc.
Legislations	Regulations as contained in the various state edicts

Source: JICA Project Team

8.10 Public Private Partnership (PPP)

A tendency of the budgets of the Basin States in the past few years was discussed in the previous section of this Report. With regard to the future possible budgets, it is necessary to seek an alternative funding source from private sector to cope with ever increasing demand for water infrastructure planned in each of the Basin States. It is, therefore, recommendable to apply the same action plans which were suggested in the M/P2013 as follows.

- Strengthening of the PPP Unit of FMWR
- Capacity building for PPP projects preparation and implementation
- Budget allocation for PPP projects preparation
- Establishment of Projects Delivery Teams and Steering Committee
- Regular Partners/Stakeholders Consultation on the PPP process
- Regular updating of policies and strategies to promote private sector participation

We suggest the following proposals for each of the Basin State.

Table 8-23 Explanation of Proposal: PPP01

Proposal Title	Cost Effective Delivery of Water Services Using Private Sector's Support and Initiative
Objectives, etc.	To improve sustainability and performance in water supply and sanitation sector, water quality management, etc.
Lead Institutions	State MDAs/ FMWR/PPP Unit of FMWR/ICRC
Legislations	State-level policies and strategies for PPP in collaboration with the PPP Unit of FMWR and ICRC

Source: JICA Project Team

Table 8-24 Explanation of Proposal: PPP02

Proposal Title	Creation of State PPP Unit within the Basin States
Objectives, etc.	State PPP Unit is expected to act as focal points for PPP projects at state level. The roles of State PPP Units include consulting and coordination in identification, preparation and procurement of potential PPP projects with other state MDAs.
Lead Institutions	State MDAs/State PPP Unit (proposed)/ FMWR/PPP Unit of FMWR/ICRC
Legislations	State-level policies and strategies for PPP in consultation with the PPP Unit of FMWR and ICRC

Source: JICA Project Team

8.11 Manpower Development and Institutional Capacity Development

In view of the basic policies for Human Resources Development (HRD) in the M/P2013, we believe that it is extremely significant to emphasize the needs for HRD focusing on IWRM at basin and catchment status. Hence, we present the summary of HRD Plan for the M/P2013 below, and suggest the proposals for manpower development and institutional capacity development for the CMP as shown in Table 8-25.

(1) Main Points of HRD Plan in M/P2013

Basic Policy-1: Development and Increase Access to Training Opportunities

Rationale:
For realization of IWRM with the central principles of management of water at river basin and catchment level, the needs and priority for HRD in various field is increasing. Of the various institutions responsible for HRD, placing the Human Resource Unit of FMWR and NWRI as core institutions in FMWR, access to training opportunities assuring the capacity building of all staff who engage in integrated water resources management shall be developed and increased

Major Activities:
- Formulation of the HRD plan in line with HRD needs and priority in the target water sub-sectors, vocational function and job-classes. It must be noted it is greatly requested to conduct a periodic survey for manpower to grasp current status and capacity so as to adequately make a plan to fill the capacity gap.
- Budget plan (Assistance from external development partners shall be considered)
- Development of multipronged and effective training courses in collaboration with NIHSA and other relevant agencies and bureaus
- Improvement of M & E systems
- Improvement of personnel appointment, promotion systems, including recruiting engineers and officers in mid-career

Basic Policy-2: Strengthening of Training to Respond to the Needs at River Basin Level

Rationale:
It is noted that with regard to the needs to strengthen training to inspire the management at river basin level, HRD for NIWRMC including its subsidiary CMOs and their staff who shall be responsible for the water resources management at river basins is one of the most important and prioritized HRD.

Major Activities:
- Development of HRD programs for water resources management in river basins (preparation of guidelines, etc.)
- Promotion of the HRD plans in quality in cooperation with river basin management institutions such as NIWRMC including CMOs, NIHSA, RBDAs, etc.
- A comprehensive HRD to be achieved through formulation and implementation of River Basin Strategies and Plans, etc.
- Strengthening of assistance for the purpose of increasing participation by all stakeholders in operation and maintenance of infrastructure

Basic Policy-3: Strengthening and Enlargement of Training Functions of NWRI within FMWR

Rationale:
It is necessary to strengthen and enlarge the nationwide training functions of NWRI which is the foremost institution for HRD for sustainable water resources management inside and outside Nigeria.

Major Activities:
- Establishment of NWRCBNet (National Water Resources Capacity Building Network)

(2) Suggestion

Table 8-25 Explanation of Proposal: HRD01

Proposal Title	Project for Human Resources and Institutional Capacity Development Focused on IWRM at Basin and Catchment Level
Objectives, etc.	To develop the capacity in IWRM in order to efficiently and effectively execute the mandates of various stakeholders as contained in the CMP. Scope of CD is as follows: ● Capacity Assessment (Base-line study) ● CD for Water Allocation, Licensing, Charges and Conflict Management ● CD for Trans-boundary Water Management ● CD for Establishing Partnership in the Basin ● CD for Water Resources Monitoring and Data Management ● CD for Improving and Updating of the CMP ● CD for Institutional Management including Financial Management ● CD for PPP Capacity ● CD for Mainstreaming Water-related issues – Gender concerns, Hygiene Practices, Water Security, etc.
Lead Institutions	FMWR/NIWRMC/RBDAs/NIHSA/FMA&RD/FMEnv/State MDAs
Legislations	Completion and promulgation of the National Water Policy (Draft) and the National Water Resources Bill (Draft)

Source: JICA Project Team

8.12 Monitoring and Evaluation

In order to implement steadily planned projects, a development of M&E system particularly for the preparatory stage of project is strongly recommended. The implementation of the projects proposed in the existing M/P1995 is far behind the proposed schedules. One of the causes is that the proper preparation for initial stage of the implementation has been neither planned nor managed appropriately.

For this stage, the processes below must be pursued properly and definitely:

1) To draft a Project Proposal based on the M/P2013
2) To carry out the F/S
3) To prepare the Project Explanatory Note
4) To propose the Budget Request
5) To secure Budge Approval, and
6) To implement the projects.

Taking the PDCA (Plan-Do-Check-Action) system as examples, the above numbers of 1), 2) and 3) can be compared to the definition of "Plan" in the PDCA, and 4), 5),and 6) to "Do". Finally, by monitoring and evaluating carefully the above processes, the project can be promoted and progressed. The processes of above 1), 2) and 3) are described more in details below. For drafting and implementing these processes, the close cooperation is essential among FMWR, NIWRMC, RBDA, CMO and the concerned state governments.

(1) Project Proposal

The DAs responsible for each project proposed in the M/P2013 prepares the project proposal as shown in Table 8-26.

Table 8-26 Drafting Project Proposal (an example)

Name of responsible DA:				Drafting date:	
Projects	Component		Implementation	Cost	Direct effect
1.Irrigation A	1. Dam	MCM	2 years from 20xx	Naira	1)Irrigation Area: ZZ ha
	2. Irrigation channel	km	ditto	Naira	2)Increase of production: ZZ ton/ha
	3. Paddy fields	ha	ditto	Naira	3)Increase of farmers' income: ZZ Naira
2.Irriagtion B					

Source: JICA Project Team

(2) F/S

FMWR makes a detail examination of the above proposal, selects the priority projects among all and finally implement the F/S on the selected projects for the detail design, implementation schedule, project cost estimate, and social, environmental and economic/financial evaluation.

(3) Project Explanatory Note

The responsible DAs prepare the detail plan of the projects on the items such as the construction work, equipment composition, procurement schedule, cost and financing.

M&E for Planning Stage

Thus, the definite processing of the "Plan stage of PDCA" can lead the selected projects to the implementation stage followed by the budget request and the budget approval. Accordingly, the M&E work during this "Plan stage" is essential; so the actions as shown in Table 8-27 are strongly recommended to be taken.

Table 8-27 Progress and Achievement of Irrigation Projects "A" (an example)

	Time	Activities	Plan	Actual	Action to be followed
Proposal	1st half	Drafting and submission	50%	40%	To discuss in the internal meeting of ministry
	2nd half		100%	100%	To prepare budget request for F/S implementation
F/S	1st half	Preparation	30%	30%	Preparation of TOR
	2nd half		60%	60%	Preparation of bidding documents sheet
---	1st half				
	2nd half				

Source: JICA Project Team

CHAPTER 9 IMPLEMENTATION PROGRAM

This chapter is composed of two parts, firstly "Scenario-A" based on development plans of M/P2013, and secondly "Scenario-B" based on state own water demand and development plans.

9.1 Implementation Program (Scenario-A)

9.1.1 Implementation Schedule

(1) Outline of Projects

Outline of the proposed Project in the Catchment Management Plan (CMP) is shown in Table 9-1.

Table 9-1 Outline of Proposed Schemes (Scenario-A)

Project	Outline	Responsible Agency
A. Water Source Development		
A.1 Surface Water Development		
A.1.1 On-going Projects		
● On-going Surface water source development	On-going surface water source development. Number of dams: 4. Total storage capacity:75MCM.	FMWR
A.1.2 Effective Utilization of Existing Dams		
● Capacity development of dam management	This project is to enhance the capacity of dam department of FWMR, as well as dam owners such as RBDAs, SWA on dam management.	FMWR
● Rehabilitation of equipment for proper operation of major dams	This project is to rehabilitate the equipment for proper operation of dams such as meteorological, hydrological mentoring, monitoring for reservoir operation.	FMWR
● Rehabilitation of deteriorated dams	This project is to rehabilitate deteriorated dam which may threaten the downstream area. The rehabilitation would be implemented case by case up to 2030.	FMWR
A.1.3 New Water Source Development		
● Surface water development for municipal water supply	This project is to prepare stable water source for municipal water supply against the water source where the safety level is expected to be lower than 10% yearly dependability in 2030. Number of dams/weir: 4, Total storage capacity: 213MCM	FMWR
A.2 Groundwater Development		
A.2.1 Borehole rehabilitation		
● Urban/small-urban/small town	Rehabilitation of 227 boreholes with motorized pumps with yield of 225,251m^3/day	State Water Agencies
● Rural	Rehabilitation of 59 boreholes with motorized pumps with yield of 58,956 m^3/day, and 1,128 of hand pumps with yield of 11,284 m^3/day.	RUWASAA
A.2.2 New boreholes drillings		
● Urban/small-urban/small town	New drilling of boreholes with motorized pumps: 6 boreholes with 200m depth, 464 boreholes with depth of 50m, total yield of 69,572 m^3/day.	State Water Agencies
● Rural	● New drilling of boreholes with motorized pumps: 193 boreholes with 200m depth, 673 boreholes with depth of 50m, total yield of 130,333 m^3/day. ● New drilling of boreholes with hand-pumps: 5,797 boreholes with depth of 50m, total yield of 46,382 m^3/day.	RUWASSA
B. Sub-sector Development		
B.1 Water Supply and Sanitation		
B.1.1 Water Supply Rehabilitation Scheme		
● Urban and Semi-Urban / Small Town	Target: Urban and semi-urban/small town in 4 states in OORB Scope: Rehabilitation of piped water supply facilities using surface water or groundwater (2015-2030) Beneficiaries: 1,858,000 Development: 457 MLD (Surface water : 421 Groundwater: 36)	FMWR, State Ministries, SWAs, STWSSAs
● Rural	Target: Rural areas in 4 states in HA-8 Scope: Rehabilitation of point-source type water supply facilities equipped with motorized pump or handpump using groundwater (2015-2030) Beneficiaries: 1,573,000 Development: 55 MLD (Groundwater only)	FMWR, State Ministries, RUWASSAs
B.1.2 Water Supply Newly Construction Scheme		
● Urban and Semi-Urban /	Target: Urban and semi-urban/small town in 4 states in OORB	FMWR, State

Project	Outline	Responsible Agency
Small Town	Scope: Newly construction of piped water supply facilities using surface water or groundwater (2015-2030) Beneficiaries: 10,336,000 Development: 2,543 MLD (Surface water: 2,497, Groundwater: 45)	Ministries, SWAs, STWSSAs
● Rural	Target: Rural areas in 4 states in OORB Scope: Newly construction of point-source type water supply facilities equipped with motorized pump or handpump using groundwater (2015-2030) Beneficiaries: 3,232,000 Development: 113 MLD (Groundwater only)	FMWR, State Ministries, RUWASSAs
B.1.3 Sanitation Scheme		
● Public Toilet	Target: Urban and semi-urban/small town in 4 states in OORB Place of installation: Markets, bus terminal and so on (2015-2030) Development: 4,356 places	FMWR, state ministries
● Final Septage Disposal Facility / Site	Target: Urban in 4 states in OORB Scope: Septage disposal system with considering collection and transportation from domestic septic tanks (2015-2030) Beneficiaries: 2,342,000 households	FMWR, FME, FEPA, SEPA
● Sewerage System	Target: Major urban area of Central in Lagos state, Osogbo in Osun state, and Ibadan in Oyo Scope: Sewerage system including sewerage treatment plant and sewer (2015-2030) Beneficiaries: 139,000 households Treatment; 284,424 m3/day	MWR, FME, FEPA, SEPA
● Hygiene Promotion	Target: Urban, semi-urban/small town and rural in 4 states in OORB Scope: Education and promotion through community-led total sanitation (2015-2030) Beneficiaries: 5,532,000 households	FMWR, state ministries, LGAs
● Domestic Sanitation Facilities	Responsibility: Residents in urban, semi-urban/small town and rural in 4 states and FCT Abuja (2015-2030) Description: Installation of domestic toilet or latrine Households: Urban: 2,480,000, Semi-Urban/Small Town: 3,563,000 Rural: 1,969,000	
B.2 Irrigation/Drainage		
B.2.1 Rehabilitation of Existing scheme	Subject: 3schemes, Future Irrigation Area 500ha,	FMWR, State
B.2.2 New Irrigation scheme		
● Ongoing Scheme	Scheme which has been on-going by FMWR and has a sure plan to implement in future. Subject: 4 schemes, Future Irrigation Area 24,617 ha	FMWR
● Extension Scheme	Scheme which is recommended to expand planned irrigation area more in future, even if scheme has already completed or suspended. Subject: 10 schemes, Future Irrigation Area 2,800 ha	FMWR
C. Water Resources Management		
C.1 Hydrological Monitoring		
● Improvement of Surface Water Monitoring Network	The monitoring network on surface water is setup step by step. Depending on the main purpose of monitoring, the monitoring stations are categorized into four types: primary (2), priority secondary (3), secondary (4) and tertiary (6).	NIHSA
● Improvement of Groundwater Monitoring Network	Project to install groundwater level monitoring: ①Assessment for groundwater potential (15 sites), ②Groundwater environmental monitoring such as over-pumping, regional lowering of groundwater level and sea water intrusion (4 sites)	NIHSA
● Enhancement of Data Management Capacity in NIHSA	This project is to enhance the data management of hydrological monitoring. Phase-1 is to enhance the capacity of the following items in a pilot area. In phase-2, the activities conducted in Phase-1 will be expanded continuously by NIHSA with more proactive manner.	NIHSA
● Establishment of Hydrological Modeling Center within NIHSA	In order to make use of hydrological monitoring data and assure high quality of those data, it is proposed that Nigerian Government establish Hydrological Modeling Center within NIHSA. The capacity development project related to hydrological modeling is proposed, in order to consolidate the related activities.	NIHSA
● Enhancement of Awareness on Importance of Hydrological Monitoring	This project is to promote awareness on importance of hydrological monitoring by NIHSA staffs.	NIHSA
C.2 Water Allocation and Regulation		

Project	Outline	Responsible Agency
● Formulation of Catchment Management Plan for Eight (8) Hydrological Areas	This project is to formulate Catchment Management Plan for each of eight hydrological areas.	NIWRMC, CMO
● Enhancement of Capacity on Water Use Permitting and Regulation	This is to enhance the capacity of NIWRMC and CMO on water use permitting and regulation.	NIWRMC, CMO
● Promotion of Catchment Management for Eight (8) Hydrological Areas	This project is proposed to be promoting catchment management for all hydrological areas including operation of the water use permitting and regulation system, on the basis of the experiences by the above two projects.	NIWRMC, CMO
● Preparation of Guideline for Water Pricing	This project is to examine the cost of water use and consequently to prepare the guideline to set proper water license fee and water charge.	NIWRMC, CMO
C.3 Water Environment Management		
● National Drinking Water Quality Monitoring Improvement Plan	In order to generate scientific data of the water source and drinking water quality in Nigeria, the capacity development for water quality monitoring is proposed to be conducted. The continuous water quality monitoring is implemented after the capacity development.	FMWR
● Water Quality Monitoring Plan for Important Rivers of Nigeria	This project is to implement the water quality monitoring for important rivers in Nigeria, in order to assess the water quality situation in the important rivers.	FMWR

Source: JICA Project Team

(2) Implementation Program

Implementation schedule of the proposed projects is shown in Table 9-2 to 9-5. The schedule is decided based on strategies of each sector explained below:

(2-1) Water Source Development

<u>Surface Water Development</u>

On-Going Projects

At least, the on-going projects would be completed by 2020.

Effective Utilization of Existing Dams

It is proposed to implement urgently the capacity development project on dam management for FMWR and relevant agencies. During the capacity development activities, necessary survey such as safety management survey and dam body survey should be implemented as many as possible, so as to materialize the rehabilitation project. Higher priority is given to the rehabilitation of equipment for proper operation of major dams.

New Water Source Development

It is proposed that the stable water source for urban water supply should be achieved by 2025 at which the 100% coverage of the municipal water supply is targeted.

<u>Groundwater Development</u>

Groundwater will be developed by new borehole drilling and rehabilitation of nonoperational boreholes. It is most efficient to develop groundwater following growth of groundwater demand. Therefore, amount of groundwater development, i.e. total yield from new boreholes and rehabilitated boreholes, will be increased in proportional to increase of groundwater demand, which can be assumed as linear growth during 2014 to 2030. It means that number of new boreholes and rehabilitated borehole is the same every year.

(2-2) Water Resources Sub-sector Development

<u>Water Supply and Sanitation</u>

Water supply facilities using surface water; the CMP proposes rehabilitation of existing facilities and newly construction of the facilities in the process of concrete designing as priorities in the 1st state, and then continuing newly construction of facilities according to progress of water sources development in the 2nd and 3rd stages.

Water supply facilities using groundwater; the CMP proposes rehabilitation of existing facilities and newly construction of facilities in the entire period from 1st to 3rd stage.

As for sanitation, the CMP proposes construction of public toilets in the entire period, construction of final septage disposal facilities and/or sites in the short term, and construction of sewerage systems in the 2nd and 3rd stages.

Irrigation and Drainage

It is proposed that the Ongoing Scheme should be achieved by 2025 considering their high priority in accordance with implementation schedule in Master plan. Extension Scheme and Integration Scheme would be prepared on 1st Stage and implemented by 2020 considering their own medium scale development.

(2-3) Water Resources Management

Hydrological Monitoring

The monitoring network would be improved step by step. As for the hydrological services such as data management and hydrological modeling, the capacity development project would be urgently implemented. Then, the related hydrological services would be continuously implemented. The awareness on importance of hydrology would be promoted continuously for the entire period.

Water Allocation and Regulation

The Catchment Management Plans should be urgently prepared. Simultaneously, capacity on water use permitting and regulation by NIWRMC should be enhanced. Furthermore, guideline for water pricing should be prepared. These should be implemented urgently in short term. On the basis of these experiences, catchment management for hydrological areas would be implemented continuously.

Water Environment Management

The capacity development for water quality monitoring would be implemented firstly. Then, the continuous water quality monitoring for drinking water as well as for important rivers would be implemented.

Table 9-2 Implementation Schedule of Water Sources Schemes (Scenario-A)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.Surface Water Development																	
1.1 Ono-going Project	XXX	XXX	XXX	XXX	XXX	XXX	XXX										
1.2 Effective Utilization of Existing Dams																	
● Capacity development of dam management	XXX	XXX	XXX														
● Rehabilitation of equipment for proper operation of major dams				XXX	XXX	XXX	XXX										
● Rehabilitation of deteriorated dams				XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
1.3 New Water Source Development																	
● Surface water development for municipal water supply				***	***	***	***	XXX	XXX	XXX	XXX						
2 Groundwater development																	
2.1Rehabilitation of existing boreholes																	
● Urban/small-urban/small town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2.2New drilling boreholes																	
● Urban/small-urban/small town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-3 Implementation Schedule of Water Supply and Sanitation Schemes (Scenario-A)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1 Water Supply Rehabilitation Scheme																	
● Urban and Semi-Urban/Small Town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2 Water Supply Newly Construction Scheme																	
● Urban and Semi-Urban/Small Town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
3 Sanitation Scheme																	
● Public Toilet	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Final Septage Disposal Facility/Site	***	XXX	XXX	XXX	XXX	XXX	XXX										
● Sewerage System							***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Hygiene Promotion	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Domestic Sanitation Facility	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-4 Implementation Schedule of Irrigation and Drainage Schemes (Scenario-A)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Existing Irrigation scheme																	
1.1 Ongoing Scheme	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XX					
1.2 Extension Scheme		***	***	XXX	XXX	XXX	XXX										

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-5 Implementation Schedule of Water Resources Management Schemes (Scenario-A)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Hydrological Monitoring																	
● Improvement of Surface Water Monitoring Network	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Improvement of Groundwater Monitoring Network	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Enhancement of Data Management Capacity in NIHSA	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Establishment of Hydrological Modeling Center within NIHSA	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Enhancement of Awareness on Importance of Hydrological Monitoring	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2. Water Allocation and Regulation																	
● Formulation of CMP for Eight (8) Hydrological Areas	XXX	XXX	XXX														
● Enhancement of Capacity on Water Use Permitting and Regulation	XXX	XXX	XXX														
● Promotion of Catchment Management for Eight (8) Hydrological Areas				XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Preparation of Guideline for Water Pricing	XXX	XXX	XXX														
3. Water Environment Management																	
● National Drinking Water Quality Monitoring Improvement Plan	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Water Quality Monitoring Plan for Important Rivers of Nigeria	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
4. Floodplain Management																	
● Flood Risk Evaluation in Floodplain		XXX	XXX	XXX													
● Flood control for proposed irrigation project in the Benue river floodplain		XXX	XXX	XXX													
5. Financial Strengthening																	
● Capacity Develop't of RDBA's Accounting		XXX	XXX	XXX													
6. Operation & Maintenance																	
● Optimization Project of Irrigation Water Pricing of RBDA		XXX	XXX	XXX													
● Human Resources Devlop't in Dam Operation		XXX	XXX	XXX													
7. Project Management																	
● Capacity Develop't of Project Management on Water Resources		XXX	XXX	XXX													
● Capacity Develop't of Water Resources Development and Management		XXX	XXX	XXX													

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

9.1.2 Cost Estimate

Among the projects proposed in the CMP, the costs of these projects that FMWR supervise and manage are estimated below: that is, Water Resources Development Projects, Water Supply & Sanitation Projects, and Irrigation & Drainage Projects. The costs of these projects that contain the explicit scope are also presented below; that is, the hydrological monitoring project and the water environment management project.

The project costs are estimated based on the price and exchange rate (US$1=155Naira) as of December 2012. The unit price is set up on the basis of the actual construction orders done by FMWR.

(1) Conditions for Cost Estimate

Table 9-6 presents the conditions for cost estimate applied here.

Table 9-6 Conditions for Estimate (Scenario-A)

Cost Items	Contents and Conditions
(1) Construction	Labor, materials, machinery, etc.
(2) Equipment	Procurement of equipment not included in above construction costs: that is, hydropower generators and irrigation pumps
(3) Engineering	10% of the sum of above (1) and (2)
(4) Administration	5% of the sum of above (1) and (2)
(5) Physical Contingency	10% of the sum of above (1) to (4)

Source: JICA Project Team

(2) Project Cost

Cost of high priority projects is shown in Table 9-7 to 9-9 with its detail. Total amount of the Project cost is 24.6 billion Naira for surface water development, 5.3 billion Naira for groundwater development, and 29.9 billion Naira in total. On the other hand, it is 1,299.5 billion Naira for water supply and sanitation and 106.9 billion Naira for irrigation and drainage. Also it is 3.2 billion Naira for water resources management.

Of the total project cost, 2% for water supply development and water resources management, 90% for water supply and sanitation and 7% for irrigation and drainage. Water supply and sanitation cost occupies large part of the total cost.

Table 9-7 Project Cost for Water sources Development Schemes (Scenario-A)

Project	Content (Million Naira)					Total (Million Naira)
	Construction	Equipment	Engineering	Admini-stration	Physical contingency	
1. Surface Water Development	**19,412**	**0**	**1,941**	**971**	**2,232**	**24,556**
1.1 On-going Project	3,012	0	301	151	346	3,810
1.2 New Water Source Development	50,700	0	1,640	820	1,886	20,746
● Surface water development for municipal water supply	*50,700*	*0*	*1,640*	*820*	*1886*	*20,746*
2 Groundwater development	**4,213**	**0**	**422**	**210**	**484**	**5,329**
2.1Rehabilitation of existing boreholes	153		15	7	18	193
● Urban/small-urban/small town	*9*		*1*	*0*	*1*	*11*
● Rural	*144*		*14*	*7*	*17*	*182*
2.2New drilling boreholes	4,060		407	203	466	5,136
● Urban/small-urban/small town	*225*		*23*	*11*	*26*	*285*
● Rural	*3,835*		*384*	*192*	*440*	*4,851*
Total	**23,625**	**0**	**2,363**	**1,181**	**2,716**	**29,885**

Source: JICA Project Team

Table 9-8 Cost of Sub-sector Development Schemes (Scenario-A)

Project	Content (Million Naira)					Total (Million Naira)
	Construction	Equipment	Engineering	Admini-stration	Physical contingency	
1. Water Supply and Sanitation	**1,027,291**		**102,729**	**51,365**	**118,139**	**1,299,524**
1.1 Water Supply Rehabilitation Scheme	26,633		2,663	1,332	3,063	33,691
● Urban and Semi-Urban/Small Town	*24,774*		*2,477*	*1,239*	*2,849*	*31,339*
● Rural	*1,859*		*186*	*93*	*214*	*2,352*
1.2 Water Supply Newly Construction Scheme	634,118		63,412	31,706	72,924	802,160
● Urban and Semi-Urban/Small Town	*627,831*		*62,783*	*31,392*	*72,201*	*794,206*
● Rural	*6,288*		*629*	*314*	*723*	*7,954*
1.3 Sanitation Scheme	366,540		36,654	18,327	42,152	463,673
● Public Toilet	*5,663*		*566*	*283*	*651*	*7,163*
● Final Septage Disposal Facility / Site	*55,260*		*5,526*	*2,763*	*6,355*	*69,903*
● Sewerage System	*305,617*		*30,562*	*15,281*	*35,146*	*386,606*
2. Irrigation and Drainage	**82,134**	**2,400**	**8,454**	**4,226**	**9,721**	**106,935**
2.1 Rehabilitation of Existing scheme	1,705	0	171	85	196	2,157
2.2 New Irrigation scheme	80,429	2,400	8,283	4,141	9,525	104,778
● Ongoing Scheme	*76,429*	*2,400*	*7,883*	*3,941*	*9,065*	*99,718*
● Extension Scheme	*4,000*	*0*	*400*	*200*	*460*	*5,060*
Total	**1,111,825**		**111,183**	**55,591**	**127,860**	**1,406,459**

Source: JICA Project Team

Table 9-9 Cost of Water Resources Management Schemes (Scenario-A)

Project	Content (Million Naira)		Total
	Equipment	Administration	(Million Naira)
1. Hydrological Monitoring	**1,307**	**1,165**	**2,473**
● Improvement of Surface Water Monitoring Network	*246*	*822*	*1,068*
● Improvement of Groundwater Monitoring Network	*1,050*	*172*	*1,222*
● Establishment of Hydrological Modeling Center within NIHSA	*11*	*171*	*183*
2. Water Environment Management	**463**	**251**	**714**
● National Drinking Water Quality Monitoring Improvement Plan	*463*	*239*	*702*
● Water Quality Monitoring Plan for Important Rivers of Nigeria	*0*	*12*	*12*

Remarks
1) The project cost is shown for the project which may require considerable cost for equipment as well as operation and maintenance.
2) The cost in the table does not include the cost for foreign experts for capacity development.
Source: JICA Project Team

9.1.3 Financial Program for Project Implementation

Financial program is shown in Table 9-10, which was estimated in the previous sections for water sources development, water supply and sanitation and irrigation and drainage.

In water sources development sector (surface water and groundwater), 18% of the total investment is for the 1st Stage, 74% for the 2nd Stage and 8% for the 3rd Stage. Investment for the 2nd Stage is the largest of all the stage.

In water supply and sanitation sector, 52% of the total investment is for the 1st Stage, 31% for the 2nd

Stage and 17% for the 3rd Stage. Investment for the 1st Stage is the largest of all the stage. Then investment will gradually reduce afterward.

In irrigation and drainage sector, 59% of the total investment is for the 1st Stage, 39% for the 2nd Stage and 2% for the 3rd Stage. Investment for the 1st Stage is the largest of all the stage. Then investment will gradually reduce afterward.

Table 9-10 Financial Program of Investment for Water Sources Development Schemes (Scenario-A)

Project	Investment for each Stage（Billion Naira）			Total (Billion Naira)
	1st Stage 2014-2020	2nd Stage 2021-2025	3rd Stage 2026-2030	
A. Water Source Development	**5.4**	**22.1**	**2.5**	**30.0**
A.1 Surface Water Development	3.8	20.8	0	24.6
A.1.1 On-going Project	3.8	0	0	3.8
A.1.2 New Water Source Development	0	20.8	0	20.8
● Surface water development for municipal water supply	*0*	*20.8*	*0*	*20.8*
A.2 Groundwater development	1.6	1.3	2.5	5.4
A.2.1Rehabilitation of existing boreholes	0.1	0.1	0	0.2
● Urban/small-urban/small town	*0*	*0*	*0*	*0*
● Rural	*0.1*	*0.1*	*0*	*0.2*
A.2.2New drilling boreholes	1.5	1.2	2.5	5.2
● Urban/small-urban/small town	*0*	*0*	*0.3*	*0.3*
● Rural	*1.5*	*1.2*	*2.2*	*4.9*
B. Water Supply and Sanitation	**676.6**	**397.9**	**255.1**	**1,299.6**
B.1 Water Supply Rehabilitation Scheme	30.0	1.3	2.4	33.7
● Urban and Semi-Urban/Small Town	*29.0*	*0.5*	*1.8*	*31.3*
● Rural	*1.0*	*0.8*	*0.5*	*2.4*
B.2 Water Supply Newly Construction Scheme	573.8	179.4	49.0	802.2
● Urban and Semi-Urban/Small Town	*570.4*	*176.5*	*47.3*	*794.2*
● Rural	*3.4*	*2.8*	*1.7*	*8.0*
B.3 Sanitation Scheme	72.8	217.2	173.7	463.7
● Public Toilet	*2.9*	*2.4*	*1.9*	*7.2*
● Final Septage Disposal Facility / Site	*69.9*	*0.0*	*0.0*	*69.9*
● Sewerage System	*0.0*	*214.8*	*171.8*	*386.6*
C. Irrigation and Drainage	**62.7**	**41.9**	**2.3**	**106.9**
C.1 Rehabilitation of Existing scheme	2.2	0	0	2.2
C.2 New Irrigation scheme	60.5	41.9	0	104.6
● Ongoing Scheme	*57.5*	*39.9*	*2.3*	*99.7*
● Extension Scheme	*3.0*	*2.0*	*0*	*5.0*
Total	**744.7**	**461.9**	**229.9**	**1,436.5**

Source: JICA Project Team

9.2 Implementation Program (Scenario-B)

9.2.1 Implementation Schedule

(1) Outline of Projects

Outline of the proposed Project in the Catchment Management Plan (CMP) is shown in Table 9-11.

Table 9-11 Outline of Proposed Schemes (Scenario-B)

Project	Outline	Responsible Agency
A. Water Source Development		
A.1 Surface Water Development		
A.1.1 On-going Projects		
● On-going Surface water source development	On-going surface water source development. Number of dams: 4. Total storage capacity:75MCM.	FMWR
A.1.2 Effective Utilization of Existing Dams		
● Capacity development of dam management	This project is to enhance the capacity of dam department of FWMR, as well as dam owners such as RBDAs, SWA on dam management.	FMWR
● Rehabilitation of equipment for proper operation of major dams	This project is to rehabilitate the equipment for proper operation of dams such as meteorological, hydrological mentoring, monitoring for reservoir operation.	FMWR
● Rehabilitation of deteriorated dams	This project is to rehabilitate deteriorated dam which may threaten the downstream area. The rehabilitation would be implemented case by case up to 2030.	FMWR
A.1.3 New Water Source Development		
● Surface water development for municipal water supply	This project is to prepare stable water source for municipal water supply against the water source where the safety level is expected to be lower than 10% yearly dependability in 2030. Number of dams/weir: 6, Total storage capacity: 953MCM	FMWR
A.2 Groundwater Development		
A.2.1 Borehole rehabilitation		
● Urban/small-urban/small town	Rehabilitation of 227 boreholes with motorized pumps with yield of 225,251m^3/day	State Water Agencies
● Rural	Rehabilitation of 58 boreholes with motorized pumps with yield of 57,351 m^3/day, and 794 of hand pumps with yield of 7,940 m^3/day.	RUWASAA
A.2.2 New boreholes drillings		
● Urban/small-urban/small town	New drilling of boreholes with motorized pumps: 6 boreholes with 200m depth, 659 boreholes with depth of 50m, total yield of 225,251 m^3/day.	State Water Agencies
● Rural	● New drilling of boreholes with motorized pumps: 160 boreholes with 200m depth, 464 boreholes with depth of 50m, total yield of 66,136 m^3/day. ● New drilling of boreholes with hand-pumps: 5,797 boreholes with depth of 50m, total yield of 44,091 m^3/day.	RUWASSA
B. Sub-sector Development		
B.1 Water Supply and Sanitation		
B.1.1 Water Supply Rehabilitation Scheme		
● Urban and Semi-Urban / Small Town	Target: Urban and semi-urban/small town in 4 states in OORB Scope: Rehabilitation of piped water supply facilities using surface water or groundwater (2015-2030) Beneficiaries: 1,952,000 Development: 457 MLD (Surface water : 421 Groundwater: 36)	FMWR, State Ministries, SWAs, STWSSAs
● Rural	Target: Rural areas in 4 states in OORB Scope: Rehabilitation of point-source type water supply facilities equipped with motorized pump or handpump using groundwater (2015-2030) Beneficiaries: 1,469,000 Development: 51 MLD (Groundwater only)	FMWR, State Ministries, RUWASSAs
B.1.2 Water Supply Newly Construction Scheme		
● Urban and Semi-Urban / Small Town	Target: Urban and semi-urban/small town in 4 states in OORB Scope: Newly construction of piped water supply facilities using surface water or groundwater (2015-2030) Beneficiaries: 23,518,000 Development: 5,507 MLD (Surface water: 5,462, Groundwater: 45)	FMWR, State Ministries, SWAs, STWSSAs
● Rural	Target: Rural areas in 4 states in OORB Scope: Newly construction of point-source type water supply facilities equipped with motorized pump or handpump using groundwater (2015-2030)	FMWR, State Ministries, RUWASSAs

Project	Outline	Responsible Agency
	Beneficiaries: 3,083,000 Development: 107 MLD (Groundwater only)	
B.1.3 Sanitation Scheme		
● Public Toilet	Target: Urban and semi-urban/small town in 4 states in OORB Place of installation: Markets, bus terminal and so on (2015-2030) Development: 7,839 places	FMWR, state ministries
● Final Septage Disposal Facility / Site	Target: Urban in 4 states in OORB Scope: Septage disposal system with considering collection and transportation from domestic septic tanks (2015-2030) Beneficiaries: 2,989 households	FMWR, FME, FEPA, SEPA
● Sewerage System	Target: Major urban area of Central in Lagos state, Osogbo in Osun state, and Ibadan in Oyo Scope: Sewerage system including sewerage treatment plant and sewer (2015-2030) Beneficiaries: 1,933 households Treatment; 610,059 m3/day	MWR, FME, FEPA, SEPA
● Hygiene Promotion	Target: Urban, semi-urban/small town and rural in 4 states in OORB Scope: Education and promotion through community-led total sanitation (2015-2030) Beneficiaries: 7,944,000 households	FMWR, state ministries, LGAs
● Domestic Sanitation Facilities	Responsibility: Residents in urban, semi-urban/small town and rural in 36 states and FCT Abuja (2015-2030) Description: Installation of domestic toilet or latrine Households: Urban: 4,923,000, Semi-Urban/Small Town: 6,078,0000 Rural: 1,866,000	
B.2 Irrigation/Drainage		
B.2.1 Rehabilitation of Existing scheme	Subject: 37schemes, Future Irrigation Area 36,163ha,	FMWR, State
B.2.2 New Irrigation scheme		
● Ongoing Scheme	Scheme which has been on-going by FMWR and has a sure plan to implement in future. Subject: 4 schemes, Future Irrigation Area 24,617 ha	FMWR
● Extension Scheme	Scheme which is recommended to expand planned irrigation area more in future, even if scheme has already completed or suspended. Subject: 10 schemes, Future Irrigation Area 2,800 ha	FMWR
C. Water Resources Management		
C.1 Hydrological Monitoring		
● Improvement of Surface Water Monitoring Network	The monitoring network on surface water is setup step by step. Depending on the main purpose of monitoring, the monitoring stations are categorized into four types: primary (2), priority secondary (3), secondary (4) and tertiary (6).	NIHSA
● Improvement of Groundwater Monitoring Network	Project to install groundwater level monitoring: ①Assessment for groundwater potential (15 sites), ②Groundwater environmental monitoring such as over-pumping, regional lowering of groundwater level and sea water intrusion (4 sites)	NIHSA
● Enhancement of Data Management Capacity in NIHSA	This project is to enhance the data management of hydrological monitoring. Phase-1 is to enhance the capacity of the following items in a pilot area. In phase-2, the activities conducted in Phase-1 will be expanded continuously by NIHSA with more proactive manner.	NIHSA
● Establishment of Hydrological Modeling Center within NIHSA	In order to make use of hydrological monitoring data and assure high quality of those data, it is proposed that Nigerian Government establish Hydrological Modeling Center within NIHSA. The capacity development project related to hydrological modeling is proposed, in order to consolidate the related activities.	NIHSA
● Enhancement of Awareness on Importance of Hydrological Monitoring	This project is to promote awareness on importance of hydrological monitoring by NIHSA staffs.	NIHSA
C.2 Water Allocation and Regulation		
● Formulation of Catchment Management Plan for Eight (8) Hydrological Areas	This project is to formulate Catchment Management Plan for each of eight hydrological areas.	NIWRMC, CMO
● Enhancement of Capacity on Water Use Permitting and Regulation	This is to enhance the capacity of NIWRMC and CMO on water use permitting and regulation.	NIWRMC, CMO
● Promotion of Catchment	This project is proposed to be promoting catchment management for all	NIWRMC,

Project	Outline	Responsible Agency
Management for Eight (8) Hydrological Areas	hydrological areas including operation of the water use permitting and regulation system, on the basis of the experiences by the above two projects.	CMO
● Preparation of Guideline for Water Pricing	This project is to examine the cost of water use and consequently to prepare the guideline to set proper water license fee and water charge.	NIWRMC, CMO
C.3 Water Environment Management		
● National Drinking Water Quality Monitoring Improvement Plan	In order to generate scientific data of the water source and drinking water quality in Nigeria, the capacity development for water quality monitoring is proposed to be conducted. The continuous water quality monitoring is implemented after the capacity development.	FMWR
● Water Quality Monitoring Plan for Important Rivers of Nigeria	This project is to implement the water quality monitoring for important rivers in Nigeria, in order to assess the water quality situation in the important rivers.	FMWR

Source: JICA Project Team

(2) Implementation Program

Implementation schedule of the proposed projects is shown in Table 9-12 to 9-15. The schedule is decided based on strategies of each sector explained below:

(2-1) Water Source Development

<u>**Surface Water Development**</u>

On-Going Projects

At least, the on-going projects would be completed by 2020.

Effective Utilization of Existing Dams

It is proposed to implement urgently the capacity development project on dam management for FMWR and relevant agencies. During the capacity development activities, necessary survey such as safety management survey and dam body survey should be implemented as many as possible, so as to materialize the rehabilitation project. Higher priority is given to the rehabilitation of equipment for proper operation of major dams.

New Water Source Development

It is proposed that the stable water source for urban water supply should be achieved by 2025 at which the 100% coverage of the municipal water supply is targeted, and also additional water source for urban water supply should be achieved by 2030 against huge water demand in Lagos State.

<u>**Groundwater Development**</u>

Groundwater will be developed by new borehole drilling and rehabilitation of nonoperational boreholes. It is most efficient to develop groundwater following growth of groundwater demand. Therefore, amount of groundwater development, i.e. total yield from new boreholes and rehabilitated boreholes, will be increased in proportional to increase of groundwater demand, which can be assumed as linear growth during 2014 to 2030. It means that number of new boreholes and rehabilitated borehole is the same every year.

In Lagos State, there is no more groundwater development in the future because the State will shift water source from groundwater to surface water, but the existing groundwater facilities of Lagos Water Corporation will be utilized in 2030.

(2-2) Water Resources Sub-sector Development

<u>**Water Supply and Sanitation**</u>

Water supply facilities using surface water; the CMP proposes rehabilitation of existing facilities and newly construction of the facilities in the process of concrete designing as priorities in the 1st state, and then continuing newly construction of facilities according to progress of water sources development in the 2nd and 3rd stages.

Water supply facilities using groundwater; the CMP proposes rehabilitation of existing facilities and newly construction of facilities in the entire period from 1st to 3rd stage.

As for sanitation, the CMP proposes construction of public toilets in the entire period, construction of final septage disposal facilities and/or sites in the short term, and construction of sewerage systems in the 2nd and 3rd stages.

Irrigation and Drainage

Implementation schedule of Lower Ogun Irrigation Scheme (A=12,000ha) and Middle Ogun Irrigation Scheme (A=12,000ha) are reviewed, considering the water demand of Lagos state own. The first stage (A=3000ha respectively) of above-cited irrigation area are completed by middle term, and remaining stage (A=9000ha) are completed in long term. Extension Scheme and Integration Scheme would be prepared on 1st Stage and implemented by 2020 considering their own medium scale development.

(2-3) Water Resources Management

Hydrological Monitoring

The monitoring network would be improved step by step. As for the hydrological services such as data management and hydrological modeling, the capacity development project would be urgently implemented. Then, the related hydrological services would be continuously implemented. The awareness on importance of hydrology would be promoted continuously for the entire period.

Water Allocation and Regulation

The Catchment Management Plans should be urgently prepared. Simultaneously, capacity on water use permitting and regulation by NIWRMC should be enhanced. Furthermore, guideline for water pricing should be prepared. These should be implemented urgently in short term. On the basis of these experiences, catchment management for hydrological areas would be implemented continuously.

Water Environment Management

The capacity development for water quality monitoring would be implemented firstly. Then, the continuous water quality monitoring for drinking water as well as for important rivers would be implemented.

Table 9-12 Implementation Schedule of Water Sources Schemes (Scenario-B)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1.Surface Water Development																	
1.1 Ono-going Project	XXX	XXX	XXX	XXX	XXX	XXX	XXX										
1.2 Effective Utilization of Existing Dams																	
● Capacity development of dam management	XXX	XXX	XXX														
● Rehabilitation of equipment for proper operation of major dams				XXX	XXX	XXX	XXX										
● Rehabilitation of deteriorated dams				XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
1.3 New Water Source Development																	
● Surface water development for municipal water supply				***	***	***	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	
2 Groundwater development																	
2.1Rehabilitation of existing boreholes																	
● Urban/small-urban/small town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2.2New drilling boreholes																	
● Urban/small-urban/small town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-13 Implementation Schedule of Water Supply and Sanitation Schemes (Scenario-B)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1 Water Supply Rehabilitation Scheme																	
● Urban and Semi-Urban/Small Town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2 Water Supply Newly Construction Scheme																	
● Urban and Semi-Urban/Small Town	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Rural	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
3 Sanitation Scheme																	
● Public Toilet	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Final Septage Disposal Facility/Site	***	XXX	XXX	XXX	XXX	XXX	XXX										
● Sewerage System							***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Hygiene Promotion	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Domestic Sanitation Facility	***	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-14 Implementation Schedule of Irrigation and Drainage Schemes (Scenario-B)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Existing Irrigation scheme																	
1.1 Ongoing Scheme	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XX	XXX	XXX	XXX	XX	
1.2 Extension Scheme		***	***	XXX	XXX	XXX	XXX										

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

Table 9-15 Implementation Schedule of Water Resources Management Schemes (Scenario-B)

Project	1st Stage							2nd Stage					3rd Stage				
	2014-2020							2021-2025					2026-2030				
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1. Hydrological Monitoring																	
● Improvement of Surface Water Monitoring Network	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Improvement of Groundwater Monitoring Network	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Enhancement of Data Management Capacity in NIHSA	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Establishment of Hydrological Modeling Center within NIHSA	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Enhancement of Awareness on Importance of Hydrological Monitoring	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
2. Water Allocation and Regulation																	
● Formulation of CMP for Eight (8) Hydrological Areas	XXX	XXX	XXX														
● Enhancement of Capacity on Water Use Permitting and Regulation	XXX	XXX	XXX														
● Promotion of Catchment Management for Eight (8) Hydrological Areas				XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Preparation of Guideline for Water Pricing	XXX	XXX	XXX														
3. Water Environment Management																	
● National Drinking Water Quality Monitoring Improvement Plan	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
● Water Quality Monitoring Plan for Important Rivers of Nigeria	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
4. Floodplain Management																	
● Flood Risk Evaluation in Floodplain		XXX	XXX	XXX													
● Flood control for proposed irrigation project in the Benue river floodplain		XXX	XXX	XXX													
5. Financial Strengthening																	
● Capacity Develop't of RDBA's Accounting		XXX	XXX	XXX													
6. Operation & Maintenance																	
● Optimization Project of Irrigation Water Pricing of RBDA		XXX	XXX	XXX													
● Human Resources Devlop't in Dam Operation		XXX	XXX	XXX													
7. Project Management																	
● Capacity Develop't of Project Management on Water Resources		XXX	XXX	XXX													
● Capacity Develop't of Water Resources Development and Management		XXX	XXX	XXX													

[Note] ***: Preparation, XXX: Implementation
Source: JICA Project Team

9.2.2 Cost Estimate

Among the projects proposed in the CMP, the costs of these projects that FMWR supervise and manage are estimated below: that is, Water Resources Development Projects, Water Supply & Sanitation Projects, and Irrigation & Drainage Projects. The costs of these projects that contain the explicit scope are also presented below; that is, the hydrological monitoring project and the water environment management project.

The project costs are estimated based on the price and exchange rate (US$1=155Naira) as of December 2012. The unit price is set up on the basis of the actual construction orders done by FMWR.

(1) Conditions for Cost Estimate

Table 9-16 presents the conditions for cost estimate applied here.

Table 9-16 Conditions for Estimate (Scenario-B)

Cost Items	Contents and Conditions
(1) Construction	Labor, materials, machinery, etc.
(2) Equipment	Procurement of equipment not included in above construction costs: that is, hydropower generators and irrigation pumps
(3) Engineering	10% of the sum of above (1) and (2)
(4) Administration	5% of the sum of above (1) and (2)
(5) Physical Contingency	10% of the sum of above (1) to (4)

Source: JICA Project Team

(2) Project Cost

Cost of high priority projects is shown in Table 9-17 to 9-19 with its detail. Total amount of the Project cost is 67.9 billion Naira for surface water development, 5 billion Naira for groundwater development, and 72.9 billion Naira in total. On the other hand, it is 2,669.3 billion Naira for water supply and sanitation and 106.9 billion Naira for irrigation and drainage. Also it is 3.2 billion Naira for water resources management.

Of the total project cost, 3 % for water supply development and water resources management, 94 % for water supply and sanitation and 4 % for irrigation and drainage. Water supply and sanitation cost occupies large part of the total cost.

Table 9-17 Project Cost for Water sources Development Schemes (Scenario-B)

Project	Content (Million Naira)					Total (Million Naira)
	Construction	Equipment	Engineering	Administration	Physical contingency	
1. Surface Water Development	**53,712**	**0**	**5,371**	**2,686**	**6,177**	**67,946**
1.1 On-going Project	3,012	0	301	151	346	3,810
1.2 New Water Source Development	16,400	0	5,070	2,535	5,831	64,136
● Surface water development for municipal water supply	*16,400*	*0*	*5,070*	*2,535*	*5,831*	*64,136*
2 Groundwater development	**3,944**	**0**	**396**	**196**	**454**	**4,990**
2.1Rehabilitation of existing boreholes	113		12	5	13	193
● Urban/small-urban/small town	*9*		*1*	*0*	*1*	*11*
● Rural	*104*		*11*	*5*	*12*	*182*
2.2New drilling boreholes	3,831		384	191	441	4,847
● Urban/small-urban/small town	*225*		*23*	*11*	*26*	*285*
● Rural	*3,606*		*361*	*180*	*415*	*4,562*
Total	**57,656**	**0**	**5,767**	**2,882**	**6,631**	**72,936**

Source: JICA Project Team

Table 9-18 Cost of Sub-sector Development Schemes (Scenario-B)

Project	Content (Million Naira)					Total (Million Naira)
	Construction	Equipment	Engineering	Admini-stration	Physical contingency	
1. Water Supply and Sanitation	**2,110,097**		**211,010**	**105,505**	**242,662**	**2,669,274**
1.1 Water Supply Rehabilitation Scheme	26,519		2,652	1,326	3,050	33,547
● Urban and Semi-Urban/Small Town	*24,774*		*2,477*	*1,239*	*2,849*	*31,339*
● Rural	*1,745*		*174*	*87*	*201*	*2,207*
1.2 Water Supply Newly Construction Scheme	1,348,117		134,812	67,406	155,034	1,705,369
● Urban and Semi-Urban/Small Town	*1,342,129*		*134,213*	*67,106*	*154,345*	*1,697,793*
● Rural	*5,988*		*599*	*299*	*689*	*7,575*
1.3 Sanitation Scheme	735,461		73,546	36,773	84,578	930,358
● Public Toilet	*10,191*		*1,019*	*510*	*1,172*	*12,891*
● Final Septage Disposal Facility / Site	*70,551*		*7,055*	*3,528*	*8,113*	*89,247*
● Sewerage System	*654,719*		*65,472*	*32,736*	*75,293*	*828,220*
2. Irrigation and Drainage	**82,134**	**2,400**	**8,454**	**4,226**	**9,721**	**106,935**
2.1 Rehabilitation of Existing scheme	1,705	0	171	85	196	2,157
2.2 New Irrigation scheme	80,429	2,400	8,283	4,141	9,525	104,778
● Ongoing Scheme	*76,429*	*2,400*	*7,883*	*3,941*	*9,065*	*99,718*
● Extension Scheme	*4,000*	*0*	*400*	*200*	*460*	*5,060*
Total	**2,194,631**		**219,464**	**109,731**	**252,383**	**2,776,209**

Source: JICA Project Team

Table 9-19 Cost of Water Resources Management Schemes (Scenario-B)

Project	Content (Million Naira)		Total (Million Naira)
	Equipment	Administration	
1. Hydrological Monitoring	**1,307**	**1,165**	**2,473**
● Improvement of Surface Water Monitoring Network	*246*	*822*	*1,068*
● Improvement of Groundwater Monitoring Network	*1,050*	*172*	*1,222*
● Establishment of Hydrological Modeling Center within NIHSA	*11*	*171*	*183*
2. Water Environment Management	**463**	**251**	**714**
● National Drinking Water Quality Monitoring Improvement Plan	*463*	*239*	*702*
● Water Quality Monitoring Plan for Important Rivers of Nigeria	*0*	*12*	*12*

Remarks
3) The project cost is shown for the project which may require considerable cost for equipment as well as operation and maintenance.
4) The cost in the table does not include the cost for foreign experts for capacity development.
Source: JICA Project Team

9.2.3 Financial Program for Project Implementation

Financial program is shown in Table 9-20, which was estimated in the previous sections for water sources development, water supply and sanitation and irrigation and drainage.

In water sources development sector (surface water and groundwater), 7% of the total investment is for the 1st Stage, 55% for the 2nd Stage and 38% for the 3rd Stage. Investment for the 2nd Stage is the largest of all the stage.

In water supply and sanitation sector, 27% of the total investment is for the 1st Stage, 44% for the 2nd

Stage and 28% for the 3rd Stage. Investment for the 2nd Stage is the largest of all the stage.

In irrigation and drainage sector, 18% of the total investment is for the 1st Stage, 10% for the 2nd Stage and 72% for the 3rd Stage. Investment for the 3rd Stage is the largest of all the stage.

Table 9-20 Financial Program of Investment for Water Sources Development Schemes (Scenario-B)

Project	Investment for each Stage (Billion Naira)			Total (Billion Naira)
	1st Stage 2014-2020	2nd Stage 2021-2025	3rd Stage 2026-2030	
A. Water Source Development	**5.2**	**40.3**	**27.3**	**72.8**
A.1 Surface Water Development	3.8	39.2	24.9	67.9
A.1.1 On-going Project	3.8	0	0	3.8
A.1.2 New Water Source Development	0	39.2	24.9	64.1
● Surface water development for municipal water supply	*0*	*39.2*	*24.9*	*64.1*
A.2 Groundwater development	1.4	1.1	2.4	4.9
A.2.1Rehabilitation of existing boreholes	0.1	0	0	0.1
● Urban/small-urban/small town	*0*	*0*	*0*	*0*
● Rural	*0.1*	*0*	*0*	*0.1*
A.2.2New drilling boreholes	1.3	1.1	2.4	4.8
● Urban/small-urban/small town	*0*	*0*	*0.3*	*0.3*
● Rural	*1.3*	*1.1*	*2.1*	*4.5*
B. Water Supply and Sanitation	**727.2**	**1,183.8**	**758.3**	**2,669.3**
B.1 Water Supply Rehabilitation Scheme	30.0	1.2	2.4	33.5
● Urban and Semi-Urban/Small Town	*29.0*	*0.5*	*1.8*	*31.3*
● Rural	*0.9*	*0.8*	*0.5*	*2.2*
B.2 Water Supply Newly Construction Scheme	602.8	718.2	384.4	1,705.4
● Urban and Semi-Urban/Small Town	*599.6*	*715.6*	*382.7*	*1,697.8*
● Rural	*3.2*	*2.7*	*1.7*	*7.6*
B.3 Sanitation Scheme	94.4	464.4	371.5	930.4
● Public Toilet	*5.2*	*4.3*	*3.4*	*12.9*
● Final Septage Disposal Facility / Site	*89.2*	*0.0*	*0.0*	*89.2*
● Sewerage System	*0.0*	*460.1*	*368.1*	*828.2*
C. Irrigation and Drainage	**18.9**	**10.6**	**77.4**	**106.9**
C.1 Rehabilitation of Existing scheme	2.2	0	0	2.2
C.2 New Irrigation scheme	61.7	10.6	77.4	104.7
● Ongoing Scheme	*13.7*	*8.6*	*77.4*	*99.7*
● Extension Scheme	*3.0*	*2.0*	*0*	*5.0*
Total	**751.3**	**1,234.7**	**863.0**	**2,849.0**

Source: JICA Project Team

CHAPTER 10 EVALUATION OF CATCHMENT MANAGEMENT PLAN

10.1 Evaluation from Economic and Financial Aspects

10.1.1 Economic Evaluation

An economic evaluation on projects such as "Water Supply" and "Irrigation and Drainage" proposed as the sub-sector development project in Chapter-7 is carried out in this chapter based on the manner shown in Table 10-1.

Table 10-1 Evaluation Manner

Projects		Project Cost			Benefit
		Water Resources Develop. Cost	Own Cost	O&M	
1.Water Supply					
1) Rehabilitation Schemes					
・Urban Supply	State-wise	-	Repair & Replacement	O&M	Increase of Water Supply
・Rural Supply		-			
2) New Development Schemes					
・Urban Supply	State-wise	Dam・GW	WTP & Distribution	O&M	Increase of Water Supply
・Rural Supply		GW			
2.Irrigationand Drainage					
1) Existing Schemes					
・Rehabilitation	HA-wise	-	Repair & Replacement	O&M	Increase of Producers' Net Income
・Irrigation Extension of ongoing scheme		Dam (1 project.)	Irrigation & Farm Field		
・Irrigation Extension of coming scheme		Dam (3 projects.)			
2) New Irrigation Schemes					
・Supplementary Irrigation	HA-wise	-	Irrigation & Farm Field	O&M	Increase of Producers' Net Income
・Dam Irrigation		Dam			
・Integrated Development (3)	Indivi dually	Dam	Irrigation, Field & Power Plant		The above benefit + Net Income from Power Sale

Concepts and Assumptions	
1. Evaluation Measures	Economic Internal Rate of Return (EIRR), Benefit-to-Cost Ratio (B/C) and Net Present Value (NPV)
2. Opportunity Cost of Capital	10% (adopted by referring the other projects in Nigeria)
3. Evaluation Period	30 years from the next year of construction termination
4. Economic Life (year)	WTP: 40, Irrigation & Farm Field: 50, Dam: 80, Well: 40, Equipment: 15
5. Project Cost	Cost presented in Chapter 10
6. O&M Cost	Structures: 0.1% on its projects cost, Equipment: 2.5% on its project cost, Desalination: 10% on its project cost
7. Economic Conversion Factors	Mechanical: 0.8, Civil 0.72 (Referred the projects in other developing country)

Source: JICA Project Team

(1) Water Supply Projects

The economic evaluation of the projects is carried out based on the projects costs and the implementation schedule presented in Chapter-9 and the benefits below.

$$\text{Benefit} = \text{Increase of Water Supply with Projects } (m^3) \text{ X Ability-to-Pay of Customers (Naira/}m^3\text{)}$$

The ability-to-pay of customers is estimated in the manner as shown in Table 10-2.

Table 10-2 Manners to estimate Ability-to Pay of Customers

Customers	Items	Estimates and Assumptions
1. Domestic	Water consumption per person	(liter/person) Urban & Semi-urban: 67～91, Rural: 30
	Persons living in household (NBS data)	5.2 persons
	Household income （based on NBS data）	State-wise (Rural: 50% on Urban)
	Ability-to-Pay on household income	Urban & Semi-urban: 3%, Rural 1%
	Figures obtained from the above manner	(Naira/m^3) Urban & Semi-urban: 65～170, Rural: 20～40
2. Commercial & Industry・	Adopted by referring the data of water agencies in Indonesia and Brazil	1.6 X domestic water

Source: JICA Project Team

Table 10-3 shows the results of economic analysis conducted in line with the above manners.

Table 10-3 Results of Economic Analysis of Water Supply Projects (NPV: Naira in billion）

Region		Rehabilitation Schemes						New Construction Schemes					
		Urban & Semi-urban			Rural			Urban & Semi-urban			Rural		
		EIRR	B/C	NPV	EIRR	B/C	NPV	EIRR	B/C	NPV	EIRR	B/C	NPV
Nigeria		50%	3.6	314.7	28%	2.2	11.1	10.1%	1.01	13.5	9.2%	0.94	-4.9
Scenario-A		59%	6.1	96.3	37%	2.8	2.1	13.3%	1.3	145.4	13.9%	1.3	1.5
1	Lagos	74%	8.2	49.6	27%	2.2	0.1	14.7%	1.4	140.1	11.7%	1.1	0.0
2	Ogun	40%	4.0	7.8	41%	2.9	0.3	8.6%	1.0	-5.2	17.4%	1.4	0.6
3	Osun	51%	5.0	16.7	41%	3.0	0.7	10.5%	1.0	1.0	12.9%	1.2	0.2
4	Oyo	47%	4.8	13.4	37%	2.7	0.8	9.3%	0.9	-3.6	13.0%	1.2	0.5
Scenario-B													
1	Lagos	74%	8.2	49.1	-	-	-	15.3%	1.5	324.4	-	-	-

Source: JICA Project Team

Actually, the above results vary from state to state.

However, the EIRR of both Scenario A and Scenario B in the CMP exceeds the 10 % of opportunity cost of capital (OCC). Accordingly, the Water Supply Projects of the CMP are judged to be economically feasible.

(1-1) Rehabilitation Schemes

Urban and Semi-urban/Small-town

The EIRR of both Scenario-A and Scenario-B shows quite high rate of EIRR. This is mostly due to the low project cost of rehabilitation compared to new construction. Particularly the states, where the rehabilitation work concentrates in groundwater supply improvement show the higher EIRR.

Rural

The EIRR shows also quite high; 37%; because all rehabilitation work in rural area converges on groundwater supply improvement.

(1-2) New Construction Schemes

Urban and Semi-urban/Small-town

Projects cost is estimated higher than rehabilitation projects due to new wells and water treatment facilities and new dams of some states. Accordingly, the EIRR vary from state to state. However, the EIRR of both Scenario-A of whole Ogun-Oshun river basin and Scenario-B exceeds 10% of OCC.

Rural

The EIRR presents 13.9% that exceeds 10% of OCC.

(2) Irrigation and Drainage Projects

The economic evaluation of the projects is carried out based on the projects costs and the implementation schedule presented in Chapter-9 and the benefits bellow.

Benefit

1. Integration Schemes

＝ Producers' Net Income (With-project Net Income - Without-project Net Income) + Net Income from Electric Power Sale

2. Other Schemes

＝ Producers' Net Income (With-project Net Income - Without-project Net Income)

The net incomes of producer and electric power sale are estimated in the manner as shown in Table 10-4.

Table 10-4 Items and Assumptions to estimate Net Income of Producer and Power Sale

Net Income of Producers					
With-project		Without-project		In common	
Products	Yield ton/ha	Products	Yield ton/ha	Producer's Price Naira/kg	Producer's Cost
Irrigated Rice	4.9	Rain-fed Rice	2.6	170	50% of Price
Maize	3.0	Maize	1.7	80	
-	-	Millet: HA1 and HA8	1.1	40	
Net Income from Electric Power Sale					
Power Generation	/day	Nassarawa: 6MWx24h, Taraba: 9MWx24h, Donga-Suntai: 15MWx24h			
Selling Price	Naira/MWh	9,563 :Whole Sale Contract Price of 2012 (Source：MYTO)			

Note: 1) Producers' price was unavailable. So JICA Project Team estimated it in the manner by deducting processing, distribution and retail cost from market price. 2) Producer's cost includes the variable cost only. Since fixed cost such as labor cost was considered as family internal cost and excluded from it.
Source: Producers' price of maize and millet - NBS data.

Table 10-5 and 10-6 shows the results of economic analysis worked out in line with the above manners.

Table 10-5 Results of Economic Analysis of Existing Schemes (NPV: Naira in billion)

Region	Rehabilitation Schemes			Irrigation Extension of ongoing Schemes			Irrigation Extension of coming Schemes		
	EIRR	B/C	NPV	EIRR	B/C	NPV	EIRR	B/C	NPV
Nigeria	41.8%	4.1	47.9	13.2%	1.3	33.4	10.8%	1.1	5.2
< Scenario A >	45.5%	4.3	2.9	14.6%	1.4	16.9	14.3%	1.3	0.7
< Scenario B >	-	-	-	10.5%	1.0	1.3	-	-	-

Source: JICA Project Team

Table 10-6 Results of Economic Analysis of New Schemes (NPV: Naira in billion)

Region	Supplementary Irrigation Schemes			Dam Irrigation Schemes			Integration Schemes		
	EIRR	B/C	NPV	EIRR	B/C	NPV	EIRR	B/C	NPV
Nigeria	20.3%	2.0	66.5	9.6%	0.96	-3.9	10.4%	1.0	4.3
< Scenario A >	-	-	-	8.0%	0.8	-0.4	-	-	-
< Scenario B >	-	-	-	-	-	-	-	--	--

Source: JICA Project Team

<u>Rehabilitation Schemes</u>

The EIRR presents quite high rate of 45.5%, due to lower cost of rehabilitation projects compared to of new projects.

<u>Irrigation Extension Projects of ongoing Scheme</u>

The EIRR of both Scenario A and Scenario B shows exceed 10% of OCC.

<u>Irrigation Extension Projects of coming Scheme, and Dam Irrigation Schemes</u>

The EIRR of the irrigation extension projects presents economically feasible, 14.3%. On the other hand, the EIRR of the dam irrigation schemes shows lower than 10% of OCC. In order to exceed 10% of OCC, 20% of reduction on investment cost is required.

<u>Benefits of Flood Control by Dam</u>

Construction of dam would produce the possibility of preventing a serious impact on human lives, property and socio-economic activities damaged by flood and erosion; as a result, the long-time prevention enables to develop furthermore the new farm land and residence area. Such economical effectiveness obviously increases the EIRR and other economic figures if considered as benefit. In the CMP, the monetary calculation of this kind of effectiveness is not carried out; however, such implicit benefit should be kept in mind when evaluate the dam project, as well as "Dam Irrigation Projects" mentioned above.

10.1.2 Financing Consideration

(1) Financial Schedule

(1-1) Water Supply Projects

Table 10-7 shows the project costs by state and by stage up to the target year of 2030. The project costs of Scenario-A amount to 862.1billion Naira: that is broken up into 70% of the 1st stage, 24% of the 2nd stage and 6% of the 3rd stage. Meanwhile, Scenario-B costs total to 1,809.2billion Naira: 35% of the 1st stage, 42% of the 2nd stage and 23% of the 3rd stage.

Table 10-7 Water Supply Project Costs by Stage (Naira in billion)

Target Area	1st Stage 2014 - 2020	2nd Stage 2021 - 2025	3rd Stage 2026 - 2030	Total 2014 - 2030
< Scenario A >	605.5	202.8	53.8	862.1
1. Lagos	490.3	32.1	0.0	522.4
2. Ogun	6.7	116.8	2.3	125.8
3. Osun	39.9	3.0	12.6	55.5
4. Oyo	68.6	50.9	38.9	158.4
< Scenario B >	634.7	760.3	414.2	1,809.2
1. Lagos	519.5	589.6	360.4	1,469.4
2. Other 3 States	115.2	170.7	53.8	339.8

Source: JICA Project Team

(1-2) Irrigation and Drainage Projects

Table 10-8 presents the project costs by scheme and by stage up to the target year of 2030. Total of the project costs amount to 118billion Naira for both Scenario A and Scenario B. Scenario A is broken up into 55% of the 1st stage, 36% of the 2nd stage and 9% of the 3rd stage; meanwhile, Scenario B into 16% of the 1st stage, 9% of the 2nd stage and 75% of the 3rd stage.

Table 10-8 Irrigation & Drainage Project Costs by Stage (Naira in billion)

Schemes	1st Stage 2014 - 2020	2nd Stage 2021 - 2025	3rd Stage 2026 - 2030	Total 2014 - 2030
< Scenario A >	65.4	41.6	11.0	118.0
1. Rehabilitation	2.2		-	2.2
2. On-going	60.2	39.6	-	99.7
3. Extension	3.0	2.0	0.0	5.1
4. Supplementary Irrigation	-	-	-	-
5. Dam Irrigation	-	-	11.0	11.0
6. Integration	-	-	-	-
< Scenario B >	18.9	10.7	88.4	118.0
1. On-going	13.7	8.6	77.4	99.7
2. Other Schemes	5.2	2.1	11.0	18.3

Source: JICA Project Team

(2) Promotion of Financing Arrangement

(2-1) Water Supply Projects

In Nigeria, the water supply development is generally assumed by FGN and the state governments. Particularly, the state governments play the crucial role for it, currently bearing more than 80% of the entire development costs of Nigeria. However, the financial conditions of the states are not enough sufficient to implement the development projects. So, the state governments have to collaborate closely with FGN for the financial support for the implementation. Also, it is strongly required to the state governments to make continuous efforts to diversify the financial mobilization for the sector development by elaborating and proposing the business models accompanied with the state's guarantee that may attract the both national and international private firms and NGOs as well as by appealing to the international donor agencies.

The possible financing arrangement of each state for the project implementation is analysed below from the view point of the current capital-budget allocation of each state as figured in Section 1.2.2 (2).

Lagos State

Table 10-9 shows the summarized financing scheme toward the project costs of Lagos State.

Scenario A: The project costs of the state amounts to 522.4billion Naira in total or 30.7billion annually. However, only an amount of 10.9billion Naira is currently allocated to the water supply development annually in the state budget. Assuming the same allocation continues, a large part of the project cost of the 1st stage has to be mobilized with the additional state budget and/or FGN grants; meanwhile the project costs of the 2nd stage could be financed solely with the state budget. It is obvious that this additional state budget includes the diversified fund-raising in the capital market through the issue of the state bond as mentioned in Section 1.2.2 (2). Moreover, it should be stressed that the joint investment/operation through the public-private partnership (PPP) on some treatment plants are planned in the Mater Plan of Lagos Water Corporation envisaging the cost reduction.

Scenario B: The project costs of the state are extremely large, which amount to 1,469.4.4billion Naira in total or 91.8billion annually. As a result, substantial amount of the additional state budget and/or FGN grants will be inevitable for implementation of these entire projects.

Table 10-9 Financing toward Project Costs of Lagos State (Naira in billion)

Items		1st Stage 2014 - 2020		2nd Stage 2021 - 2025		3rd Stage 2026 - 2030		Total 2014 - 2030	
		7 years	Year Average	5 years	Year Average	5 years	Year Average	17 years	Year Average
< Scenario A >									
1. Project Costs	Rehabilitation	12.2	1.7	0.1	-	0.0	-	12.3	0.7
	New Development	478.1	68.3	32.0	6.4	0.0	-	510.1	30.0
	Total	490.3	70.0	32.1	6.4	0.0	-	522.4	30.7
2. Expected Financing	Primarily: Continue of actual allocation of State Budget	76.3	10.9	32.1	6.4	0.0	-	108.4	6.4
	Secondarily: Additional State Budget and Grant of FGN	414.0	59.1	-	-	-	-	414.0	24.3
	Total	490.3	70.0	32.1	6.4	0.0	-	522.4	30.7
< Scenario B >									
1. Project Costs	Rehabilitation	12.1	1.7	0.1	-	0	-	12.2	0.7
	New Development	507.3	72.5	589.6	117.9	360.3	72.1	1,457.2	91.1
	Total	519.4	74.2	589.7	117.9	360.3	72.1	1,469.4	86.4
2. Expected Financing	Primarily: Continue of actual allocation of State Budget	76.3	10.9	54.5	10.9	43.6	10.9	174.4	10.9
	Secondarily: Additional State Budget and Grant of FGN	443.1	63.3	535.2	106.4	316.7	61.2	1,295.0	80.9
	Total	519.4	74.2	589.7	117.9	360.3	72.1	1,469.4	91.8

Note: Annual average budget allocation (from 2011 to 2012) to the water sector of the state amounted to 10.9billion Naira.
Source: JICA Project Team

Ogun State

Table 10-10 shows the summarized financing scheme toward the project costs of Ogun State. The project costs are 125.8billion Naira in total and 7.4billion annually. However, the budgetary allocated amount is currently only 1.1billion Naira annually. If the same level of budget is allocated continuously, a large part of the project costs of the 2nd stage should be mobilized with the additional state budget and/or the FGN grants. Meanwhile the costs of the 1st and 3rd stage could be financed solely with the state budget.

Table 10-10 Financing toward Project Costs of Ogun State (Naira in billion)

Items		1st Stage 2014 - 2020		2nd Stage 2021 - 2025		3rd Stage 2026 - 2030		Total 2014 - 2030	
		7 years	Year Average	5 years	Year Average	5 years	Year Average	17 years	Year Average
1. Project Costs	Rehabilitation	4.6	0.7	0.3	-	0.1	-	5.0	0.3
	New Development	2.1	0.3	116.5	23.4	2.2	0.3	120.8	7.1
	Total	6.7	1.0	116.8	23.4	2.3	0.3	125.8	7.4
2. Expected Financing	Primarily: Continue of actual allocation of State Budget	6.7	1.0	5.5	1.1	2.3	0.3	14.5	0.9
	Secondarily: Additional State Budget and Grant of FGN	-	-	111.3	22.3	-	-	111.3	6.5
	Total	6.7	1.0	116.8	23.4	2.3	0.3	125.8	7.4

Note: Annual average budget allocation (from 2009 to 2011) to the water sector of the state amounted to 1.1billion Naira.
Source: JICA Project Team

Osun State

Table 10-11 shows the summarized financing scheme toward the project costs of Osun State. The project costs are 55.5billion Naira in total and 3.3billion annually. If the same level as previous 3 years' budgetary allocation of 2.7billion Naira a year is retained continuously, a large part of the project costs of the 1st stage should be mobilized with the additional state budget and/or the FGN grants. Meanwhile the costs of the 2nd and 3rd stage could be financed solely with the state budget.

Table 10-11 Financing toward Project Costs of Osun State (Naira in billion)

Items		1st Stage 2014 - 2020		2nd Stage 2021 - 2025		3rd Stage 2026 - 2030		Total 2014 - 2030	
		7 years	Year Average	5 years	Year Average	5 years	Year Average	17 years	Year Average
1. Project Costs	Rehabilitation	6.8	1.0	0.6	0.1	2.1	0.4	9.5	0.6
	New Development	33.1	4.7	2.4	0.5	10.5	2.1	46.0	2.7
	Total	39.9	5.7	3.0	0.6	12.6	2.5	55.5	3.3
2. Expected Financing	Primarily: Continue of actual allocation of State Budget	18.9	2.7	3.0	0.6	12.6	2.5	34.5	2.1
	Secondarily: Additional State Budget and Grant of FGN	21.0	3.0	-	-	-	-	21.0	1.2
	Total	39.9	5.7	3.0	0.6	12.6	2.5	55.5	3.3

Note: Annual average budget allocation (from 2009 to 2011) to the water sector of the state amounted to 2.7billion Naira.
Source: JICA Project Team

Oyo State

Table 10-12 shows the summarized financing scheme toward the project costs of Oyo State. The project costs are 158.4billion Naira in total and 9.3billion annually. However, the budgetary allocated amount is currently only 2.4billion Naira annually. If the same level of budget is allocated continuously, a large part of the project costs should be mobilized with the additional state budget and/or the FGN grants.

Table 10-12 Financing toward Project Costs of Oyo State (Naira in billion)

Items		1st Stage 2014 - 2020		2nd Stage 2021 - 2025		3rd Stage 2026 - 2030		Total 2014 - 2030	
		7 years	Year Average	5 years	Year Average	5 years	Year Average	17 years	Year Average
1. Project Costs	Rehabilitation	6.6	0.9	0.4	0.1	0.3	=	7.3	0.4
	New Development	62.0	8.9	50.5	10.1	38.6	7.7	151.1	8.9
	Total	68.6	9.8	50.9	10.2	38.9	7.7	158.4	9.3
2. Expected Financing	Primarily: Continue of actual allocation of State Budget	16.8	2.4	12.0	2.4	12.0	2.4	40.8	2.4
	Secondarily: Additional State Budget and Grant of FGN	51.8	7.4	38.9	7.8	26.9	5.4	117.6	6.9
	Total	68.6	9.8	50.9	10.2	38.9	7.8	158.4	9.3

Note: Annual average budget allocation (from 2009 to 2011) to the water sector of the state amounted to 2.4billion Naira.
Source: JICA Project Team

(2-2) Irrigation and Drainage Projects

The stage-wise project costs of Ogun-Oshun river basin are presented in Table 10-13. Meanwhile the year averaged costs are as shown in table below, which will be 6.9billion Naira over the period until 2030 for both Scenario A and Scenario B.

Table 10-13 Annual Averaged Project Costs by Stage (Naira in billion)

Items	1st Stage 2014 - 2020		2nd Stage 2021 - 2025		3rd Stage 2026 - 2030		Total 2014 - 2030	
	7 years	Year Average	5 years	Year Average	5 years	Year Average	17 years	Year Average
< Scenario A > Project Costs	65.4	9.3	41.6	8.2	11.0	2.2	118.0	6.9
< Scenario B > Project Costs	18.9	2.7	10.7	2.1	88.4	17.7	118.0	6.9

Source: JICA Project Team

This amount of 6.9billion Naira equivalents to 20% of 350billion which a 3-years'averaged figure from 2009 to 2011 budgeted by the FGN for the development of the irrigation and drainage sector. Obviously the FGN budget is to be allocated to all 8 HAs in nation-wide consideration of such factors as location, soil, social needs, economic efficiency and environmental conservation. With regard to Ogun-Oshun river basin, as recommended in the M/P2013, the budget should be allocated firstly to the projects that could achieve the highest economical effectiveness, namely the rehabilitation projects. Secondary, the budget should be spent to the new projects.

Current level of the FGN budget allocation to irrigation and drainage sector is not sufficient to fulfill the whole costs of the projects required in the whole areas of Nigeria. However, FGN has been challenging the 100% self-supply of rice. Accordingly, it is strongly proposed that the government would finance with an additional budget to accomplish this national goal.

FMWR has started to select the candidates for PPP out of the irrigation projects run by RBDA. The success of PPP requires an attractive business plan that makes risk-sharing clear. Accordingly, it is recommended for the whole departments of FMWR to take the initiatives in formulating these plans and doing PR activities for marketing outside and inside Nigeria.

10.2 Evaluation from Social and Environmental Aspects

10.2.1 Objectives of Evaluation from Social and Environmental Aspects

The principal objective of this evaluation is to examine how the proposed projects in the CMP may potentially influence on the current condition of the natural and social environment. If negative impacts are forecasted by the project's implementation, then, necessary mitigation measures will be examined.

10.2.2 Methodology on Evaluation of Environmental and Social Aspects

The projects proposed in the CMP shall be evaluated through the execution of the Initial Environmental Examination (IEE). The Terms of Reference is presented in Supplement-10.

10.2.3 Evaluation through IEE

(1) Natural and Social-Environmental Condition of the Study Area

The current condition of the natural and social environment is described in Chapter 1 and 4. The summary of them is presented in Supplement-10.

(2) List of Projects and Brief Description

Two sceneries were developed as follows: Scenario-A in which projects were analyzed and proposed using the National Master Plan 2013 elaborated by the JICA Project Team and; Scenario-B in which projects were analyzed and proposed using water demand projections provided by the States belonging to the Study Area.

(2-1) Scenario-A

The list of projects is composed of four (4) sectors including eight (8) ongoing and 165 proposed projects as listed below. The complete list of the projects with a brief description of the main activities is given in Supplement-10.

Table 10-14 Number of Projects under Scenario-A

Sector	Ongoing Projects	Proposed Projects*	Total
1. Dam	4	4	8
2. Municipal Water Supply	0	120	120
3. Irrigation and Drainage	4	10	14
4. Sanitation	0	31	31
Total	8	165	173

Note (*): Proposed by JICA Project Team based on existing proposed projects by Nigerian government as well as necessary measures for achieving the CMP in Ogun-Oshun river basin for Scenario-A, (**): The projects for groundwater development are included in the projects for Municipal Water Supply for the purpose of conducting IEE, (**): This table does not include the project for water resources management.

Source: JICA Project Team

It is opportune to mention here that for IEE purposes the Municipal Water Supply sector includes projects for construction and rehabilitation of boreholes since the categorization depend on the volume to be abstracted from the water source.

(2-2) Scenario-B

The list of projects is composed of four (4) sectors including eight (8) ongoing and 167 proposed projects as listed below. The complete list of the projects with a brief description of the main activities is given in Supplement-10.

Table 10-15 Number of Projects under Scenario-B

Sector	Ongoing Projects	Proposed Projects*	Total
1. Dam	4	6	10
2. Municipal Water Supply	0	120	120
3. Irrigation and Drainage	4	10	14
4. Sanitation	0	31	31
Total	8	167	175

Note (*): Proposed by JICA Project Team based on existing proposed projects by Nigerian government as well as necessary measures for achieving the CMP in Ogun-Oshun river basin for Scenario-B, (**): The projects for groundwater development are included in the projects for Municipal Water Supply for the purpose of conducting IEE, (**): This table does not include the project for water resources management.
Source: JICA Project Team

It is opportune to mention here that for IEE purposes the Municipal Water Supply sector includes projects for construction and rehabilitation of boreholes since the categorization depend on the volume to be abstracted from the water source.

f projects was made based on the Categories List stipulated in the Procedural Guidelines on Environmental Impact Assessment, Decree 86, 1992. The result of the screening is summarized in the bellow tables for both Scenarios.

(3-1) Scenario-A

Table 10-16 Categorization of Projects in CMP subjected to IEE/EIA Study (Scenario-A)

EIA Category	Description	Documents Required For Application to EIA Division	Projects affected	
			Sector	Number
1	Full EIA is required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	33
			Irrigation/Drainage	3
			Sanitation	7
			Total Category 1	47
2	Partial EIA may be required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	83
			Irrigation/Drainage	10
			Sanitation	8
			Total Category 2	105
3	Not require EIA	Application letter for EIS	Dam	0
			Municipal Water Supply	4
			Irrigation/Drainage	0
			Sanitation	16
			Total Category 3	20
	Disregarded projects*		Irrigation/Drainage	1
Total Projects in Ogun-Osun Basin (Scenery-A)				173

*: One (1) project was disregarded in the Sector of Irrigation/Drainage and not proposed in this CMP due to unavailability of water for its implementation. Project's Code is IP109.
Source: JICA Study Team

Projects in Category 3 such as capacity development, awareness creation, etc. do not require EIA therefore these projects are not scoped for IEE.

From the above table, 47 projects in Category I and 105 projects in Category II are subject to scoping at IEE study level (total=152) in four (4) Sectors (Dams, Municipal Water Supply, Irrigation/Drainage and Sanitation). This is in compliance with the Guidelines for EIA and JICA guidelines for environmental and social considerations (ver.2004).

(3-2) Scenario-B

Table 10-17 Categorization of Projects in CMP subjected to IEE/EIA Study (Scenario-B)

EIA Category	Description	Documents Required For Application to EIA Division	Projects affected	
			Sector	Number
1	Full EIA is required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	6
			Municipal Water Supply	37
			Irrigation/Drainage	3
			Sanitation	7
			Total Category 1	53
2	Partial EIA may be required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	80
			Irrigation/Drainage	10
			Sanitation	8
			Total Category 2	102
3	Not require EIA	Application letter for EIS	Dam	0
			Municipal Water Supply	3
			Irrigation/Drainage	0
			Sanitation	16
			Total Category 3	19
	Disregarded projects*		Irrigation/Drainage	1
Total Projects in Ogun-Osun Basin (Scenery-A)				175

*: One (1) project was disregarded in the Sector of Irrigation/Drainage and not proposed in this CMP due to unavailability of water for its implementation. Project's Code is IP109.
Source: JICA Study Team

Projects in Category 3 such as capacity development, awareness creation, etc. do not require EIA therefore these projects are not scoped for IEE.

From the above table, 53 projects in Category I and 102 projects in Category II are subject to scoping at IEE study level (total=155) in four (4) Sectors (Dams, Municipal Water Supply, Irrigation/Drainage and Sanitation). This is in compliance with the Guidelines for EIA and JICA guidelines for environmental and social considerations (ver.2004).

(4) Identification of Potential Impacts and Its Significance

For projects that have been scoped for IEE study for the two Sceneries, the identification of potential impacts and its significance were made based on scoping matrix. The summary is shown in Table 10-18 and 10-19. The detailed scoping matrix is presented in Supplement-10.

Table 10-18 Summary of Matrix for Scoping (Dams and Municipal Water Supply Sectors)

Environmental Component	Nº	Likely Impact Items	Overall Rating										
			Sector Dams				Sector Municipal Water Supply						
			Dams with surface area > 200 has- Group 1	Dams with surface area < 200 has - Group 2	Dam with surface area > 200 has located in Protected Areas- Group 3	Dam with surface area < 200 has located in Protected Areas - Group 4	WS with Treatment Plant Capacity more than 4,500 m3/d- Group 1	WS with Treatment Plant Capacity less than 4,500 m3/d- Group 2	WS with Field Motorized Boreholes Capacity > 4,500 m3/d- Group 3	WS with Single Motorized Borehole- Group 4	WS with Single Borehole with Hand Pump- Group 5	Rehabilitation of Facilities with big scale of activities- Group R1	Rehabilitation of Facilities with smale scale of activities- Group R2
Social Environment	1	Involuntary resettlement	A-	B-	-	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	B+	A+	B+	A+	B+	B+	-	-	A+	B+
	3	Land use and utilization of local resources	A-	B-	A-	B-	B-	B-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	C-	C-	-	C-	C-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	B-	A-	B-	A-	B-	-	-	-	A-	B-
	6	The poor, indigenous and ethnic people	C-	C-	C-	C-	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	C-	C-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	A-	A-	-	C-	-	-	-	-	-
	10	Water use right and common land use right	C-	C-	C-	C-	-	-	-	-	-	-	-
	11	Water supply and/or Irrigation with Potential Power generation	A+	A+	A+	A+	A+	A+	A+	A+	A+	-	-
	12	Vector of diseases	A-	A-	A-	A-	-	-		-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	A-	B-	A-	B-	B-	B-	B-	B-	B-	B-	B-
Natural Environment	14	Topography and geographical features	C-	B-	B-	B-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	B-	B-	B-	B-	-	-	-	-	-	-	-
	16	Protected Area	-	-	A-	A-	C-/C+	C-/C+	C-/C+	-	-	-	-
	17	Ground water	C-/C+	C-/C+	C-/C+	C-/C+	-	-	-	-	-	-	-
	18	Soil erosion	B-	B-	B-	B-	B-	B-	-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	B-	B-	B-	B-	B-	C-	-	-	-	-
	20	Coastal zone	-	-	-	-	C-	C-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	B-	A-	A-	B-	B-	-	-	-	-	-
	22	Meteorology	-	-	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-
	26	Water pollution	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-
	27	Soil pollution	-				-	-	-		-	-	
	28	Waste	B-	B-	B-	B-	B-	B-	B-	B-	-	B-	B-
	29	Noise and vibration	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	C-	C-	C-	C-	B-	B-	-	-	-	-	-
	33	Accident	C-	C-	C-	C-	C-	C-	C-	C-	C-	C-	C-

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

- -: No impact is expected.

Source: JICA Project Team

Table 10-19 Summary of Matrix for Scoping (Irrigation/Drainage and Sanitation Sectors)

Environmental Component	Nº	Likely Impact Items	Overall Rating						
			Sector Irrigation and Drainage				Sector Sanitation		
			Irrigation Schemes with Area > 5,000 ha - Group 1	Irrigation Schemes with Area < 5,000 ha - Group 2	Irrigation Schemes with Area > 5,000 ha located in protected area - Group 3	Irrigation Schemes with Area < 5,000 ha located in protected area - Group 4	Construction of Sewerage- Group 1	Construction of Septage Treatment System- Group 2	Construction of Public Toilets- Group 3
Social Environment	1	Involuntary resettlement	A-	B-	C-	C-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	A+	A+	B+	B+	B+	-
	3	Land use and utilization of local resources	A-	B-	A-	B-	B-	B-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	C-	C-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	B-	A-	B-	B-	B-	-
	6	The poor, indigenous and ethnic people	C-	C-	C-	C-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples		-	-	-	-	-	-
	8	Cultural heritage		-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	C-	A-	A-	-
	10	Water use right and common land use right	B-	B-	C-	C-	-	-	-
	11	Sanitation	-	-	-	-	A+	A+	A+
	12	Vector of diseases	A-	B-	A-	B-	B-	B-	B-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	B-	A-	B-	B-	B-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-
	16	Protected Area	-	-	A-	A-	C-/C+	C-/C+	-
	17	Ground water	-	-		-	-	-	-
	18	Soil erosion	B-	B-	B-	B-	B-	B-	-
	19	Hydrological situation (flow regime)	B-	B-	B-	B-	-	-	-
	20	Coastal zone	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	B-	A-	A-	B-	B-	-
	22	Meteorology	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	B-	B-	B-	B-	B-	-
	26	Water pollution	A-	B-	A-	A-	B-	B-	B-
	27	Soil pollution	B-	B-	B-	B-	-	-	-
	28	Waste	B-	B-	B-	B-	B-	B-	B-
	29	Noise and vibration	B-	B-	B-	B-	B-	B-	-
	30	Ground subsidence	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	A-	A-	A-
	32	Bottom sediment	B-	B-	B-	B-	B-	B-	-
	33	Accident	C-	C-	C-	C-	C-	C-	C-

Rating Criteria
A+/-: Significant positive/negative impact is expected.
B+/-: Some positive/negative impact is expected.
C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)
・-: No impact is expected.
Source: JICA Project Team

(5) Description of Mitigation Measures against Adverse Impacts

Based on the scoping activities as shown above, the following main mitigation measures are recommended for major adverse impacts in each Sector of both Scenarios.

Table 10-20 Recommended Main Mitigation Measures

Sector	Major Impact	Main Mitigation Measures
Dam	Resettlement	Conduct public consultation with Project affected person (PAPs) and local residents to explain the benefits of the project. For PAPs prepare detail analysis for compensation
	Utilization of Local Resources	Prepare utilization and post utilization plan for those areas from where materials will be extracted for construction of the dam
	Traffic	Control on the number of vehicles/equipment to avoid traffic congestion during construction
	Vector of diseases and HIV/AIDS	Implement medical check-up program
	Flora & Fauna	Plantation of forest to be home of the biodiversity and to compensate deforestation due to the construction of the dams.
Municipal Water Supply	Traffic	Control on the number of vehicles/equipment to avoid traffic congestion during construction.
Irrigation and Drainage	Resettlement	Conduct public consultation with Project affected person (PAPs) and local residents to explain the benefits of the project. For PAPs prepare detail analysis for compensation
	Utilization of Local Resources	Prepare utilization and post utilization plan for those areas from where materials will be extracted for construction of the dam
	Traffic	Control on the number of vehicles/equipment to avoid traffic congestion during construction.
	Vector of diseases and HIV/AIDS	Implement medical check-up program
	Flora & Fauna	Plantation of forest to be home of the biodiversity and to compensate deforestation due to the construction of the dams.
	Water Pollution	• Proper management of chemicals and waste oil from equipment maintenance • Implement training and education of farmers on the kind of chemicals they can use rationally • Check that only authorized chemicals are used at the site • Implement water quality monitoring for existing drinking wells. If affected, construct boreholes for affected people
Sanitation	Social Conflict	Conflicts to get approval from citizens for the location of the facility may arise. It is recommended to conduct public consultation with project affected person to arrive to a beneficial agreement. The Agency should make a compromise to manage properly the facility to obtain the consensus of the population on the Project implementation.
	Offensive Odor	Proper management of the facility

Source: JICA Project Team

(6) Conclusions and Recommendations

In general, the projects proposed in the CMP will benefit three main sectors namely municipal water supply, irrigation/drainage and sanitation. As for municipal water supply high positive impacts are expected through the project implementation on the current health level of the beneficiary population by consuming potable water which in turn will allow the exercise of better hygiene practices in the households. As for irrigation/drainage, the socio-economic status of the population will be highly upgraded through the increase of agricultural production and employment opportunities. In addition food security for the population will be improved. As for sanitation, a high positive impact is expected on the public health of the population through the safe disposal of sewage and excreta.

Some adverse impacts on the environment are also expected from the project implementation which shall be diminished through the proposed mitigation measures. In this sense, especial attention must be given to the dam sectors since it involve huge physical intervention and may need the resettlement of people living around the candidate site.

CHAPTER 11 RECOMMENDATIONS

11.1 Development of Catchment Management System and Establishment of CMP

With the technical cooperation of JICA, Federal Ministry of Water Resources (FMWR) has formulated National Water Resources Master Plan 2013 (M/P2013) through the work of 30 months starting from August 2011.

On the basis of the M/P2013, the first version of Catchment Management Plan (CMP) for the western part of Hydrological Area - 6 (namely, Ogun-Oshun Basin) was prepared by the collaboration of JICA Project Team and NIWRMC - an agency of FMWR. Although the CMP is based on the M/P2013, this first version of CMP should be elaborated with further efforts due to the following reasons. 1) A consensus of the stakeholders is not concluded yet sufficiently as the preparation of the CMP was done in short period of a half year. 2) The CMP is not finalized as the organization and institution to authorize it are not established year. It is important to solve these issues and to achieve the water resources development and management in HA-1 to suffice people's water demands such as water use, flood disaster mitigation and water quality conservation.

(1) Development of Catchment Management System

The CMP proposes three (3) new organizations as an important catchment management system. Namely 1) Catchment Management Coordination Committee (CMCC), 2) Technical Advisory Committee (TAC) and 3) State Integrated Water Resources Management Committee (State IWRM Committee). Such system is not developed yet in HA-1. Representatives of stakeholder related to water resources should be selected as members of the committees.

As for the member state of the CMP, the main states were four (4) states: Lagos, Ogun, Osun and Oyo at the preparation time of the first version. Participation of other states (Ekiti、Kwara and Ondo: small occupation in the territory) in Ogun-Oshun River Basin to CMCC and TAC will be a matter of discussion in future.

FMWR and NIWRMC should take action immediately to start the development of catchment management system.

(2) Establishment of Catchment Management Plan

The stakeholders' consensus in the first version of the CMP is insufficient as the preparation period is short. In particular, among water subsectors (hydropower generation, livestock, inland fishery, flood management, water quality conservation etc.) other than water supply & sanitation and irrigation & drainage, the consensus of stakeholders will be necessary. In addition, as well as government agencies, consensus building including water user stakeholders, NGO, academic institutions will be also needed.

Further, CMP shows a option of water source development to meet the water demand in Lagos State forecasted by Lagos State. Permission of this option will be committed by CMCC to be established in future.

FMWR and NIWRMC should take action immediately to establish the CMP through enough and repeated stakeholder meetings.

11.2 Practical Use and Periodic Review of CMP

(1) Practical Use of CMP

The CMP has been prepared in the collaboration with the consultant team dispatched by JICA Technical Cooperation Program (JICA Project Team) and "Steering Committee", "Technical Advisory Committee" and "Counterpart Team" formulated by the members from FMWR. In other words, this plan is a work produced by enthusiasm for the water vision of Nigeria and technology of Japan on water resources development and management.

In the future, FMWR and State Governments are recommended to elaborate and maintain the CMP for better utilization of it.

(2) Periodic Review of CMP

The CMP has been formulated on the basis of the evidence of 1) water resource potential based on a scientific approach and 2) water demand forecast based on economic growth and population projections up to 2030. In future, it will be necessary to check the demand forecast by looking at the track record of economic growth and population growth.

In addition, it is necessary also to check water resource potential on a regular basis. The reason is a matter of global climate change. Increase in drought frequency and occurrence of large floods have been foreseen. Due to this situation, water resource potential also may change.

In view of the above, FMWR, NIWRMC and State Governments are recommended to carry out periodic reviews (for example, every five years) of the CMP.

11.3 Implementation of Water Resources Development

As water resources development plan, the CMP shows two (2) development plans for water sub-sectors, namely "Water Supply Development Plan" and "Irrigation and Drainage Development Plan", including the water source development (groundwater development and surface water development).

(1) Water Supply Development Plan

Water Supply Development Plan is a development plan that corresponds to the improvement of water supply rate and new water demand of future population growth in Ogun-Oshun River Basin (Scenario-A: around 16 million people, Scenario-B: around 31 million people) to increase to up to 2030. The current water supply rates are: 71% (Urban), 51% (Semi-urban), 40% (Rural) and 56% in the national average. In accordance with the road map of FMWR (2011), the water supply rate in 2025 is planned to achieve 100% of each.

As to the water demand projection of Lagos State, there are two (2) scenarios. Namely, Scenario-A: water supply demand projection based on the national population census (adopted at the M/P2013) and Scenario-B: water supply demand projection based on the state own population census. The CMP proposes four new dams for Scenario A and six new dams for Scenario B with the addition of two added to Scenario-A.

Water supply system is a critical infrastructure underlying the country. As the investment to water source development facilities (dams and wells), water purification facilities and water distribution networks will be large-scale, investment in government level become essential. Both governments of Federal and State are recommended to implement steadily the projects proposed in the plan.

(2) Irrigation and Drainage Development Plan

Irrigation and Drainage Plan is a development plan with the aim of 100% self-sufficiency rate of rice in conjunction with the promotion of rain-fed rice cultivation by 2030. The projects with high investment efficiency have been selected in the development plan. Areas with a gravity irrigation system and areas with good development efficiency for water source development have been selected. The large scale irrigation projects are on-going currently in the areas of Lower Ogun and Middle Ogun. These irrigation projects will enable double cropping of rice and contribute to the increase of self-sufficiency rate of rice.

In the case of pump irrigation system, the promotion of sound and self-reliant irrigation with hydroelectric power generation using the dam for water resources development is recommendable. For the potential of hydroelectric power plant installation at existing dams in Ogun-Oshun River Basin, future research is needed.

For food security of the country, the promotion of irrigated agriculture with high yield and toughness to drought is of particular importance. Urbanization progresses, there is a tendency that the demand for rice will increase. In Nigeria urbanizing, future demand for rice will increase. In addition, large-scale projects such as irrigated agriculture, will contribute significantly to the creation of employment opportunities in rural areas. From these points of view, planned investment of the federal government to irrigation scheme will be necessary.

FMWR is recommended to steadily implement the irrigation scheme proposed in the M/P2013.

(3) Involvement in Other Sub-sectors

Also in water resource-related schemes under the jurisdiction different, involvement of FMWR becomes more and more important in future. For example, flood management and hydroelectric power generation are important areas.

Regarding hydropower generation using dam, future cooperation with the Federal Ministry of Power and related state ministry having jurisdiction over the power becomes necessary. Also, regarding flood management, future cooperation with the Federal Ministry of Environment and related state ministry having jurisdiction over the flood management becomes necessary. As inland aquaculture and livestock farming may conflict with the irrigation sector, coordination among stakeholders is necessary for promotion of efficient use of water resources.

Against this background, for the water related projects under the jurisdiction of other ministries, FMWR and the related state governments are recommended to strengthen cooperation with other ministries in order to participate actively.

11.4 Implementation of Water Resource Management

Water Resources Management Plan shows the methodology how to provide the water services based on the Sufficiency, Efficiency, Fairness, Safety and Sustainability, to the water users who expect [Effective Use of Water], [Mitigation of Flood Damage] and [Conservation of Water Quality], by using the facilities and operational systems installed on the basis of Water Resources Development Plan.

FMWR is recommended to implement steadily the projects and action plans which are indicated by Water Resources Management Plan proposed in M/P2013. Water Resources Management Plan is aiming at the state shown below.

The best state of water resources management:

- There is a good plan. There is an appropriate action.
- There are organizations and systems for desirable Water Services.
- Water Services to suffice safety and security are provided for water users.
- Water Services are never delayed. If there is trouble in delivery system for Water Service, someone restores it immediately.
- Water users pay the price gladly for the right price of Water Services.
- Information relating to Water Services is collected and analyzed. This information is managed and utilized to improve Water Services
- People engaging Water Service study every day with the spirit of self-advancement.
- Water Services are always monitored by water users, and the results of services are evaluated.

11.5 Steady and Sound Investment

(1) Direct Capital Investment of Federal Government of Nigeria (FGN)

In the M/P2013 which is the basis of the CMP shows the investment plan to realize 100% water supply rate and 100% of rice self-sufficiency at the target year 2030 in Nigeria. For water supply projects, investment of about 200 billion Naira per year (almost 2 times of current 3 years average) is necessary. In particular, the estimated investment in the first phase (2014-2020) is about 280 billion Naira per year.

On the other hand, for irrigation projects, investment of about 105 billion Naira (almost 4 times of current 3 years average) is required. In particular, the estimated investment in the first phase (2014-2020) is about 49 billion Naira per year.

Government financial support is indispensable. Nigerian Government is recommended to allocate the budget on priority basis for these two sectors to realize the national goals although the national financial situation is severe.

(2) Other Sources of Financing

The CMP envisages that the governments will make an intensive capital investment more exceeding the current capital expenditures of annual average to the water supply projects and to the irrigation &

drainage projects. For the smooth financing and implementation of the projects, the efforts to find other source of funds like below are indispensable, apart from relying heavily on the increase of the government direct capital investment.

- **Utilization of Private-sector Funds**

  FMWR shall promote the introduction of the Public-Private Partnership (PPP) and the privatization of the water supply projects and the irrigation projects currently undertaken by the governments in order to decrease the government direct capital investment.

- **Utilization of International Development Partners' (IDPs) Funds**

  The intensive efforts to get the awards such as the "Grant Technical Aid and Grant Financial Aid" or "Soft Loan" from IDPs are to be made for decreasing the government direct capital investment. Besides, for realizing actually the investment programs efficiently and concretely, it is also requested to share the related information among all IDPs through the actions such as the stakeholders' meetings and the use of the donor's coordination platforms.

- **Promotion of Users' Pay Principle**

  Every user of treated water and irrigation water must pay the charge according to the volume they use. However, most of the users actually don't pay the charge. This causes the quite low level of revenues of these projects. So, it is a crucial matter to improve the revenues through the efforts in making users aware of the importance of payment through such as public awareness campaign. As a result, the incomes from the projects are expected to grow, which could generate the incremental cash flow for the coming new projects and simultaneously decrease the government direct capital investment.

Aiming to realize steadily the CMP, Federal Government and State Governments are recommend to actualize the above three (3) actions which contribute toward decreasing the government direct capital investment.

Supplement

Supplement 3.1 Water Demand of Existing Irrigation Schemes

1. Water Demand of Existing Irrigation Schemes

A: Surface water (existing)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	1,660	2,317	0.0	0.0	0.0
		60002	60002	8,252.4	0	1,660	2,317	0.0	0.0	0.0
		601	601	391.8	0	1,660	2,317	0.0	0.0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	1,660	2,317	0.4	0.6	1.0
		603	603	1,965.7	340	1,660	2,317	0.6	0.8	1.4
		60401	60401	2,034.9	545	1,660	2,317	0.9	1.3	2.2
		604021	604021	168.9	0	1,660	2,317	0.0	0.0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	44	1,660	2,317	0.1	0.1	0.2
		60403	60403	6,011.7	750	1,660	2,317	1.2	1.7	2.9
		60405	60405	4,704.2	80	1,660	2,317	0.1	0.2	0.3
		605	605	2,167.8	0	1,660	2,317	0.0	0.0	0.0
		606	606	3,425.1	451	1,660	2,317	0.7	1.0	1.7
		607	607	325.1	0	1,660	2,317	0.0	0.0	0.0
		608	608	9,764.4	1680	1,660	2,317	2.8	3.9	6.7
		609	609	113.5	0	1,660	2,317	0.0	0.0	0.0
		610	610	6,462.0	100	1,660	2,317	0.2	0.2	0.4
		699	699	4,809.4	0	1,660	2,317	0.0	0.0	0.0
	Total				**4,240**			**7.0**	**9.8**	**16.8**

B. Underflow Water (existing)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	3,862	0.0	0.0
	60002	60002	0	0	0	3,862	0.0	0.0
	601	601	0	0	0	3,862	0.0	0.0
	602	602_e						
		602_i	0	0	0	3,862	0.0	1.0
	603	603	0	0	0	3,862	0.0	1.4
	60401	60401	0	0	0	3,862	0.0	2.2
	604021	604021	0	0	0	3,862	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	3,862	0.0	0.2
	60403	60403	0	0	0	3,862	0.0	2.9
	60405	60405	0	0	0	3,862	0.0	0.3
	605	605	0	0	0	3,862	0.0	0.0
	606	606	0	0	0	3,862	0.0	1.7
	607	607	0	0	0	3,862	0.0	0.0
	608	608	0	0	0	3,862	0.0	6.7
	609	609	0	0	0	3,862	0.0	0.0
	610	610	0	0	0	3,862	0.0	0.4
	699	699	0	0	0	3,862	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**16.8**

C: Groundwater (existing)

C: Groundwater (existing)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Ground Water Total (MCM)
6	60001	60001	175	1,058	3,862	0.2	0.7	0.9
	60002	60002	269	1,058	3,862	0.3	1.0	1.3
	601	601	80	1,058	3,862	0.1	0.3	0.4
	602	602_e						
		602_i	703	1,058	3,862	0.7	2.7	3.4
	603	603	281	1,058	3,862	0.3	1.1	1.4
	60401	60401	380	1,058	3,862	0.4	1.5	1.9
	604021	604021	23	1,058	3,862	0.0	0.1	0.1
	604023	604023_e						
		604023_i	1,270	1,058	3,862	1.3	4.9	6.2
	60403	60403	1,172	1,058	3,862	1.2	4.5	5.7
	60405	60405	447	1,058	3,862	0.5	1.7	2.2
	605	605	492	1,058	3,862	0.5	1.9	2.4
	606	606	611	1,058	3,862	0.6	2.4	3.0
	607	607	61	1,058	3,862	0.1	0.2	0.3

	608	608	1,778	1,058	3,862	1.9	6.9	8.8
	609	609	16	1,058	3,862	0.0	0.1	0.1
	610	610	999	1,058	3,862	1.1	3.9	5.0
	699	699	354	1,058	3,862	0.4	1.4	1.8
	Total		**9,111**			**9.6**	**35.3**	**44.9**

2. Surface Water Demand of Existing Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
6	60001	60001	I		1,660	2,317			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250					0.0
			Oke-Odan	250	1,660	2,317	0.4	0.6	1.0
	603	603	I	340					0.0
			Otta	340	1,660	2,317	0.6	0.8	1.4
	60401	60401	I	545					0.0
			Owiwi	45	1,660	2,317	0.1	0.1	0.2
			Mokoloki	500	1,660	2,317	0.8	1.2	2.0
	604021	604021	I	0			0.0	0.0	0.0
					1,660	2,317	0.0	0.0	0.0
	604023	604023_e	O						
		604023_i	I	44					0.0
			Upper Ogun	10	1,660	2,317	0.0	0.0	0.0
			Ofiki(A)	24	1,660	2,317	0.0	0.1	0.1
			Ofiki(B)	10	1,660	2,317	0.0	0.0	0.0
			Ilero	0	1,660	2,317	0.0	0.0	0.0
	60403	60403	I	750					0.0
			Middle Ogun (I.G)	750	1,660	2,317	1.2	1.7	2.9
	60405	60405	I	80					0.0
			Sepeteri(A)	80	1,660	2,317	0.1	0.2	0.3
			Sepeteri(B)	0	1,660	2,317	0.0	0.0	0.0
	605	605	I	0					0.0
	606	606	I	451					0.0
			Eyinwa	300	1,660	2,317	0.5	0.7	1.2
			Itokin	141	1,660	2,317	0.2	0.3	0.5
			Eniosa	10	1,660	2,317	0.0	0.0	0.0
	607	607	I	0			0.0	0.0	0.0
	608	608	I	1680					0.0
			Esa Odo Dam	800	1,660	2,317	1.3	1.9	3.2
			Igbonla	130	1,660	2,317	0.2	0.3	0.5
			New Erinle	500	1,660	2,317	0.8	1.2	2.0
			Asa	0	1,660	2,317	0.0	0.0	0.0
			Okuku	0	1,660	2,317	0.0	0.0	0.0
			Iwo	0	1,660	2,317	0.0	0.0	0.0
			Osun Ekiti	100	1,660	2,317	0.2	0.2	0.4
			Old Erinle Dam	150	1,660	2,317	0.2	0.3	0.5
	609	609	I	0			0.0	0.0	0.0
	610	610	I	100					0.0
			Oogi	0	1,660	2,317	0.0	0.0	0.0
			Ipetu-Ijesha	0	1,660	2,317	0.0	0.0	0.0
			Orile Owu	100	1,660	2,317	0.2	0.2	0.4
	699	699	I	0			0.0	0.0	0.0
	Total			**4,240**			**7.0**	**9.8**	**16.8**

3. Existing Diversion Water Requirement of Irrigation Project

Water Resirces: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	205	45	4,100	900	35	25	1,660
	Dry	642	331	12,840	6,620	0	35	2,317

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	205	45	3,417	750	20	50	1,058
	Dry	642	331	10,700	5,517	0	70	3,862

4. NET IRRGATION REQUIREMENT (for Existing Irrigation scheme)

Hydrological Area: **HA-6** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					21	77	110	101	61	16			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					126	182	170	161	91	46			776
⑤	Effective rainfall	mm	3	0	37	71	112	140	116	66	154	105	15	3	
⑥	Net Irrigation Requirement	mm					14	42	54	95	0	0			205
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					16	51	84	88	54	15			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					46	81	84	88	54	15			368
④	Effective rainfall	mm					78	98	81	46	108	74			
⑤	Net Irrigation Requirement	mm					0	0	3	42	0	0			45

Hydrological Area: **HA-6** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	117	71	20							18	72	117	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	177	101	50							123	177	177	805
⑤	Effective rainfall	mm	3	0	37							105	15	3	
⑥	Net Irrigation Requirement	mm	174	101	13							18	162	174	642
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	106	107	125	121	122	111	106	102	100	105	105	105	
	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	86	93	68	17							15	50	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	86	93	68	17							45	80	389
④	Effective rainfall	mm	2	0	26	50							11	2	
⑤	Net Irrigation Requirement	mm	84	93	42	0							34	78	331

Supplement 3.2 Water Demand of Proposed Irrigation Schemes

1. Water Demand of Proposed Irrigation Schemes

A: Surface water (proposed)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	2,730	7,784	0	0	0.0
		60002	60002	8,252.4	0	2,730	7,784	0	0	0.0
		601	601	391.8	0	2,730	7,784	0	0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	2,730	7,784	0.7	1.9	2.6
		603	603	1,965.7	0	2,730	7,784	0	0	0.0
		60401	60401	2,034.9	12302	2,730	7,784	33.6	95.8	129.4
		604021	604021	168.9	0	2,730	7,784	0	0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	114	2,730	7,784	0.3	0.9	1.2
		60403	60403	6,011.7	12000	2,730	7,784	32.8	93.4	126.2
		60405	60405	4,704.2	30	2,730	7,784	0.1	0.2	0.3
		605	605	2,167.8	0	2,730	7,784	0	0	0.0
		606	606	3,425.1	335	2,730	7,784	0.9	2.7	3.6
		607	607	325.1	0	2,730	7,784	0	0	0.0
		608	608	9,764.4	2210	2,730	7,784	6.2	17.2	23.4
		609	609	113.5	0	2,730	7,784	0	0	0.0
		610	610	6,462.0	750	2,730	7,784	2.1	5.8	7.9
		699	699	4,809.4	0	2,730	7,784	0	0	0.0
	Total				**27,991**			**76.7**	**217.9**	**294.6**

B. Underflow Water (proposed)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	4,414	0.0	0.0
	60002	60002	0	0	0	4,414	0.0	0.0
	601	601	0	0	0	4,414	0.0	0.0
	602	602_e						
		602_i	0	0	0	4,414	0.0	2.6
	603	603	0	0	0	4,414	0.0	0.0
	60401	60401	0	0	0	4,414	0.0	129.4
	604021	604021	0	0	0	4,414	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	4,414	0.0	1.2
	60403	60403	0	0	0	4,414	0.0	126.2
	60405	60405	0	0	0	4,414	0.0	0.3
	605	605	0	0	0	4,414	0.0	0.0
	606	606	0	0	0	4,414	0.0	3.6
	607	607	0	0	0	4,414	0.0	0.0
	608	608	0	0	0	4,414	0.0	23.4
	609	609	0	0	0	4,414	0.0	0.0
	610	610	0	0	0	4,414	0.0	7.9
	699	699	0	0	0	4,414	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**294.62**

C: Groundwater (proposed)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
6	60001	60001	381	1,208	4,414	0.5	1.7	2.2
	60002	60002	585	1,208	4,414	0.7	2.6	3.3
	601	601	175	1,208	4,414	0.2	0.8	1.0
	602	602_e						
		602_i	1,531	1,208	4,414	1.8	6.8	8.6
	603	603	611	1,208	4,414	0.7	2.7	3.4
	60401	60401	826	1,208	4,414	1.0	3.6	4.6
	604021	604021	51	1,208	4,414	0.1	0.2	0.3
	604023	604023_e						
		604023_i	2,766	1,208	4,414	3.3	12.2	15.5
	60403	60403	2,552	1,208	4,414	3.1	11.3	14.4
	60405	60405	973	1,208	4,414	1.2	4.3	5.5
	605	605	1,071	1,208	4,414	1.3	4.7	6.0
	606	606	1,330	1,208	4,414	1.6	5.9	7.5
	607	607	133	1,208	4,414	0.2	0.6	0.8
	608	608	3,872	1,208	4,414	4.7	17.1	21.8

	609	609	36	1,208	4,414	0.0	0.2	0.2
	610	610	2,176	1,208	4,414	2.6	9.6	12.2
	699	699	771	1,208	4,414	0.9	3.4	4.3
	Total		**19,840**			**23.9**	**87.7**	**111.6**

2. Surface Water Demand of Proposed Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	60001	60001	I		2,730	7,784			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250			0.7	1.9	2.6
			Oke-Odan	250	2,730	7,784	0.7	1.9	2.6
	603	603	I	0			0	0	0
			Otta	0	2,730	7,784	0.0	0.0	0.0
	60401	60401	I	12,302			34	96	129
			Owiwi	302	2,730	7,784	0.8	2.4	3.2
			Mokoloki	12000	2,730	7,784	32.8	93.4	126.2
	604021	604021	I	0			0	0	0
			Lower Ogun		2,730	7,784	0.0	0.0	0.0
	604023	604023_e	O						
		604023_i	I	114			0.3	0.9	0.5
			Upper Ogun	10	2,730	7,784	0.0	0.1	0.1
			Ofiki(A)	24	2,730	7,784	0.1	0.2	0.3
			Ofiki(B)	10	2,730	7,784	0.0	0.1	0.1
			Ilero	70	2,730	7,784	0.2	0.5	0.7
	60403	60403	I	12000			32.8	93.4	126.2
			Middle Ogun (I.G)	12000	2,730	7,784	32.8	93.4	126.2
	60405	60405	I	30			0.1	0.2	0.3
6			Sepeteri(A)	30	2,730	7,784	0.1	0.2	0.3
			Sepeteri(B)	0	2,730	7,784	0.0	0.0	0.0
	605	605	I	0					0.0
	606	606	I	335			0.9	2.7	3.6
			Eyinwa	10	2,730	7,784	0.0	0.1	0.1
			Itokin	315	2,730	7,784	0.9	2.5	3.4
			Eniosa	10	2,730	7,784	0.0	0.1	0.1
	607	607	I	0			0.0	0.0	0.0
	608	608	I	2210			6.2	17.2	23.4
			Esa Oke Dam	800	2,730	7,784	2.2	6.2	8.4
			Igbonla	130	2,730	7,784	0.4	1.0	1.4
			New Erinle	500	2,730	7,784	1.4	3.9	5.3
			Asa	500	2,730	7,784	1.4	3.9	5.3
			Okuku	30	2,730	7,784	0.1	0.2	0.3
			Iwa	0	2,730	7,784	0.0	0.0	0.0
			Osun Ekiti	100	2,730	7,784	0.3	0.8	1.1
			Old Erinle Dam	150	2,730	7,784	0.4	1.2	1.6
	609	609	I	0			0.0	0.0	0.0
	610	610	I	750			2.1	5.8	7.9
			Oogi	400	2,730	7,784	1.1	3.1	4.2
			Ipetu-Ijesha	250	2,730	7,784	0.7	1.9	2.6
			Orile Owu	100	2,730	7,784	0.3	0.8	1.1
	699	699	I	0			0.0	0.0	0.0
	Total			**27,991**			**76.7**	**217.9**	**294.6**

3. Proposed Diversion Water Requirement of Irrigation Project

Water Resouces: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	205	45	4,100	900	60	30	2,730
	Dry	642	331	12,840	6,620	40	40	7,784

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	205	45	3,417	750	20	70	1,208
	Dry	642	331	10,700	5,517	0	80	4,414

4. NET IRRGATION REQUIREMENT (for Proposed Irrigation scheme)

Net water requirement for proposed irrigation scheme is the same as existing one.

Supplement 3.3 Water Demand of Climate Change

1. Water Demand of Proposed Irrigation Schemes

A: Surface water (climate change)

A: Surface water (climate change)

HA	Area (km2) (only inside Nigeria)	SHA	SHA divided by National Boundary	Area (km2)	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A)(MCM)
6	99,333.2	60001	60001	2,701.1	0	3,420	8,608	0	0	0.0
		60002	60002	8,252.4	0	3,420	8,608	0	0	0.0
		601	601	391.8	0	3,420	8,608	0	0	0.0
		602	602_e	844.5						
			602_i	3,311.6	250	3,420	8,608	0.9	2.2	3.1
		603	603	1,965.7	0	3,420	8,608	0	0	0.0
		60401	60401	2,034.9	12302	3,420	8,608	42	105.9	147.9
		604021	604021	168.9	0	3,420	8,608	0	0	0.0
		604023	604023_e	72.9						
			604023_i	9,040.6	114	3,420	8,608	0.3	1	1.3
		60403	60403	6,011.7	12000	3,420	8,608	41	103.3	144.3
		60405	60405	4,704.2	30	3,420	8,608	0.1	0.3	0.4
		605	605	2,167.8	0	3,420	8,608	0	0	0.0
		606	606	3,425.1	335	3,420	8,608	1.1	2.9	4.0
		607	607	325.1	0	3,420	8,608	0	0	0.0
		608	608	9,764.4	2210	3,420	8,608	7.4	19.1	26.5
		609	609	113.5	0	3,420	8,608	0	0	0.0
		610	610	6,462.0	750	3,420	8,608	2.6	6.5	9.1
		699	699	4,809.4	0	3,420	8,608	0	0	0.0
	Total				**27,991**			**95.4**	**241.2**	**336.6**

B. Underflow Water (climate change)

HA	SHA	SHA divided by National Boundary	Fadama Irrigation Area (ha)	Private Small Irrigation Area(2) (ha)	Area Sub-total (ha)	Dry Seazon Diversion Water Req. (m3/ha)	Underflow Total (B)(MCM)	Total (A)+(B)(MCM)
6	60001	60001	0	0	0	5,014	0.0	0.0
	60002	60002	0	0	0	5,014	0.0	0.0
	601	601	0	0	0	5,014	0.0	0.0
	602	602_e						
		602_i	0	0	0	5,014	0.0	3.1
	603	603	0	0	0	5,014	0.0	0.0
	60401	60401	0	0	0	5,014	0.0	147.9
	604021	604021	0	0	0	5,014	0.0	0.0
	604023	604023_e						
		604023_i	0	0	0	5,014	0.0	1.3
	60403	60403	0	0	0	5,014	0.0	144.3
	60405	60405	0	0	0	5,014	0.0	0.4
	605	605	0	0	0	5,014	0.0	0.0
	606	606	0	0	0	5,014	0.0	4.0
	607	607	0	0	0	5,014	0.0	0.0
	608	608	0	0	0	5,014	0.0	26.5
	609	609	0	0	0	5,014	0.0	0.0
	610	610	0	0	0	5,014	0.0	9.1
	699	699	0	0	0	5,014	0.0	0.0
	Total		**0**	**0**	**0**		**0.0**	**336.6**

C: Groundwater (climate change)

HA	SHA	SHA divided by National Boundary	Private Small Irrigation Area(1) (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Groundwater Total (MCM)
6	60001	60001	381	1,650	5,014	0.6	1.9	2.5
	60002	60002	585	1,650	5,014	1.0	2.9	3.9
	601	601	175	1,650	5,014	0.3	0.9	1.2
	602	602_e						
		602_i	1,531	1,650	5,014	2.5	7.7	10.2
	603	603	611	1,650	5,014	1.0	3.1	4.1
	60401	60401	826	1,650	5,014	1.4	4.1	5.5
	604021	604021	51	1,650	5,014	0.1	0.3	0.4
	604023	604023_e						
		604023_i	2,766	1,650	5,014	4.6	13.9	18.5
	60403	60403	2,552	1,650	5,014	4.2	12.8	17.0
	60405	60405	973	1,650	5,014	1.6	4.9	6.5
	605	605	1,071	1,650	5,014	1.8	5.4	7.2
	606	606	1,330	1,650	5,014	2.2	6.7	8.9
	607	607	133	1,650	5,014	0.2	0.7	0.9

	608	608	3,872	1,650	5,014	6.4	19.4	25.8
	609	609	36	1,650	5,014	0.1	0.2	0.3
	610	610	2,176	1,650	5,014	3.6	10.9	14.5
	699	699	771	1,650	5,014	1.3	3.9	5.2
	Total		**19,840**			**32.9**	**99.7**	**132.6**

2. Surface Water Demand of Proposed Irrigation Scheme

HA	SHA	SHA divided by National Boundary	Inside (I) or Outside (O) Nigeria	Public Irrigation Irrigated Area (ha)	Wet Seazon Diversion Water Req. (m3/ha)	Dry Seazon Diversion Water Req. (m3/ha)	Wet Seazon Water Demand (MCM)	Dry Seazon Water Demand (MCM)	Surface Water Total (A) (MCM)
	60001	60001	I		3,420	8,608			0.0
	60002	60002	I	0					0.0
	601	601	I	0					0.0
	602	602_e	O						
		602_i	I	250			0.9	2.2	3.1
			Oke-Odan	250	3,420	8,608	0.9	2.2	3.1
	603	603	I	0			0	0	0
			Otta	0	3,420	8,608	0.0	0.0	0.0
	60401	60401	I	12,302			42	106	148
			Owiwi	302	3,420	8,608	1.0	2.6	3.6
			Mokoloki	12000	3,420	8,608	41.0	103.3	144.3
	604021	604021	I	0			0	0	0
			Lower Ogun		3,420	8,608	0.0	0.0	0.0
	604023	604023_e	O						
		604023_i	I	114			0.3	1.0	0.5
			Upper Ogun	10	3,420	8,608	0.0	0.1	0.1
			Ofiki(A)	24	3,420	8,608	0.1	0.2	0.3
			Ofiki(B)	10	3,420	8,608	0.0	0.1	0.1
			Ilero	70	3,420	8,608	0.2	0.6	0.8
	60403	60403	I	12000			41	103.3	144.3
			Middle Ogun (I.G)	12000	3,420	8,608	41.0	103.3	144.3
6	60405	60405	I	30			0.1	0.3	0.4
			Sepeteri(A)	30	3,420	8,608	0.1	0.3	0.4
			Sepeteri(B)	0	3,420	8,608	0.0	0.0	0.0
	605	605	I	0					0.0
	606	606	I	335			1.1	2.9	4
			Eyinwa	10	3,420	8,608	0.0	0.1	0.1
			Itokin	315	3,420	8,608	1.1	2.7	3.8
			Eniosa	10	3,420	8,608	0.0	0.1	0.1
	607	607	I	0			0.0	0.0	0.0
	608	608	I	2210			7.4	19.1	26.5
			Esa Oke Dam	800	3,420	8,608	2.7	6.9	9.6
			Igbonla	130	3,420	8,608	0.4	1.1	1.5
			New Erinle	500	3,420	8,608	1.7	4.3	6.0
			Asa	500	3,420	8,608	1.7	4.3	6.0
			Okuku	30	3,420	8,608	0.1	0.3	0.4
			Iwo	0	3,420	8,608	0.0	0.0	0.0
			Osun Ekiti	100	3,420	8,608	0.3	0.9	1.2
			Old Erinle Dam	150	3,420	8,608	0.5	1.3	1.8
	609	609	I	0			0.0	0.0	0.0
	610	610	I	750			2.6	6.5	9.1
			Oogi	400	3,420	8,608	1.4	3.4	4.8
			Ipetu-Ijesha	250	3,420	8,608	0.9	2.2	3.1
			Orile Owu	100	3,420	8,608	0.3	0.9	1.2
	699	699	I	0			0.0	0.0	0.0
	Total			**27,991**			**95.4**	**241.2**	**336.6**

3. Diversion Water Requirement of Irrigation Project (Climate Change)

Water Resources: **Surface Water**

Total Loss = 50% included water deriver loss and irrigation efficiency

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	250	70	5,000	1,400	60	30	3,420
	Dry	700	376	14,000	7,520	40	40	8,608

Water Resources: **Ground Water**

Total Loss = 60% included irrigation efficiency only

HA	Season	Net water Requiment (mm)		Diversion Water Requirement (m3/ha)		Crop Intensity (%)		Seasonal Diversion Water Req. (m3/ha)
		Rice	other Cereal	Rice	other Cereal	Rice	other Cereal	
6	Wet	250	70	4,167	1,167	20	70	1,650
	Dry	700	376	11,667	6,267	0	80	5,014

4. NET IRRGATION REQUIREMENT (for Climate Change)

Hydrological Area: **HA-6** **Wet Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice			106	107	125	121	122	111	106	102	100	105	105	105	
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc						0.17	0.69	1.04	0.99	0.61	0.15			
①	Etcrop (ETo×Kc)	mm					24	88	126	116	70	18			
②	Percoration	mm					30	30	60	60	30	30			
③	Land Preparation	mm					75	75							
④	=①+②+③	mm					129	193	186	176	100	48			832
⑤	Effective rainfall	mm	3	0	37	71	112	140	116	66	154	105	15	3	
⑥	Net Irrigation Requirement	mm					17	53	70	110	0	0			250
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc						0.13	0.46	0.79	0.86	0.54	0.14			
①	ETcrop (ETo×Kc)	mm					18	58	96	101	62	17			
②	Pre-Irrigation	mm					30	30							
③	=①+②	mm					48	88	96	101	62	17			412
④	Effective rainfall	mm					78	98	81	46	108	74			
⑤	Net Irrigation Requirement	mm					0	0	15	55	0	0			70

Hydrological Area: **HA-6** **Dry Season**

		Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1) Rice															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc		1.1	0.66	0.16							0.17	0.69	1.11	
①	ETcrop (ETo×Kc)	mm	133	81	23							20	83	133	
②	Percoration	mm	60	30	30							30	30	60	
③	Land Preparation	mm										75	75		
④	=①+②+③	mm	193	111	53							125	188	193	863
⑤	Effective rainfall	mm	3	0	37							105	15	3	
⑥	Net Irrigation Requirement	mm	190	111	16							20	173	190	700
2) Other Cereal															
	ETo (Potential Evapotranspiration)	mm	121	123	143	139	140	127	121	117	115	120	120	120	
	Kc		0.81	0.87	0.54	0.14							0.14	0.48	
①	Etcrop (ETo×Kc)	mm	98	107	77	19							17	58	
②	Pre-Irrigation	mm											30	30	
③	=①+②	mm	98	107	77	19							47	88	436
④	Effective rainfall	mm	2	0	26	50							11	2	
⑤	Net Irrigation Requirement	mm	96	107	51	0							36	86	376

Supplement 8.1 Water Environment Management

Two Sectors namely Water Environment Conservation and Water Quality Management are considered as fundamental for proper Water Environment Management.

As for Water Environment Conservation, the well management of forest plays an important role to protect the water resources of a basin.

As for Water Quality Management, the control of pollution of sources and the monitoring of water quality are subcomponents on which relies the water quality of the water sources.

The JICA Project Team through field investigation, review of existing information and interview to relevant officers of various relevant agencies has identified the main problems and issues in the sector of water environment management in Hydrological Area Nº 6 of Nigeria (Ogun-Oshun Basin). In addition to this, the water related recreational areas were studied in order to know their current conditions and to propose recommendations for their improvement.

S8.1.1 Water Environment Conservation

(1) Policies for Water Environment Conservation

National Water Policy

The National Water Policy (draft) states that all water infrastructures shall respect the environmental requirements as laid down in the general principles. Besides, this policy states that the regulations to be established must guarantee the achievement of the following objectives: (1) To conserve and protect the environment from degradation, pollution and overexploitation; (2) To prevent uncontrolled exploitation of water as a natural resource and; (3) To ensure sustainable access to water through good environmental management practices. The Policy also presents the following main strategies in order to comply with the environmental regulations: (1) Regulations must impose the preparation of Environmental Impact Assessment and Environmental Audit for all water resources programmes and projects and to impose sanctions to control environmental degradation; (2) Resettlement and compensation programmes must be implemented when executing main projects[1]. This draft Policy produced in 2004 by FMWR has gone through extensive national consultation but its approval is pending.

National Water Supply and Sanitation Policy

The objective of this Policy, which was produced by 2000 year by FMWR, is the provision of sufficient potable water and adequate sanitation to all Nigerians in an affordable and sustainable way through participatory investment by the three tiers of government, the private sector and the beneficiary. The policy target was to cover 100 % of the population in the year 2011 with the service and beyond 2011 to sustain 100% full coverage of water supply and wastewater services for the growing population[2].

In order to achieve the policy objective, the following strategies are mentioned in the document in relation to sanitation which is considered of our interest for water environment conservation.

- Undertake water supply and sanitation feasibility survey for all the States and the FCT to acquire baseline data for proper investment planning
- Promote improvement of sanitation (domestic and human waste disposal) facilities especially in the urban and semi-urban areas
- Promote construction of sewage system in urban areas

National Environmental Sanitation Policy

This Policy was produced in 2004 by the Federal Ministry of Environment[3] to serve as an instrument for securing quality environment for good health and social well-being of present and future generations.

[1] Draft National Water Resource Policy, July 2004, pages 19-20
[2] National Water Supply and Sanitation Policy, 2000
[3] National Environmental Sanitation Policy, 2004.

For the purpose of this Policy document, Environmental Sanitation is defined as the principles and practice of effecting healthful and hygienic conditions in the environment to promote public health and welfare, improve quality of life and ensure a sustainable environment.

The goal of the National Environmental Sanitation Policy is to ensure a clean and healthy environment by adopting efficient, sustainable and cost-effective strategies, so as to safeguard public health and wellbeing in line with the national development objectives.

Some of the specific objectives of the Policy are: to coordinate the activities of all Stakeholders involved in environmental sanitation and streamline their roles; to strengthen the capacity of all institutions and Agencies involved in environmental sanitation programmes.

The Policy includes the following as environmental sanitation components: (a) Solid waste management; (b) Medical waste management; (c) Excreta and sewage management; (d) Food sanitation; (e) Sanitary inspection of premises; (f) Market and abattoir sanitation; (g) Adequate potable water supply; (h) School sanitation; (i) Pest and vector control; (j) Management of urban drainage; (k) Control of reared and stray animals;(l) Disposal of the dead (man and animals); (m) Weed and Vegetation Control; (n) Hygiene education and promotion.

As for the component of solid waste management, the Policy strategies focus among others on waste minimization and recycling; establishment of regulations, sanctions and enforcement mechanisms for solid waste management from its source of generation to the point of disposal; development a Solid Waste Master Plan as a national blue print for effective Solid Waste Management.

As for the component of excreta and sewage management component, the Policy strategies focus among others on the development of Policy Guidelines for sustainable Excreta and Sewage Management, facilitate the construction and maintenance of adequate sanitary facilities in public places including the high ways; foster and promote private sector participation in the maintenance and operation of Excreta and Sewage Management facilities.

As for the component of adequate potable water supply component, the Policy strategies focus among others on undertake potable water supply feasibility survey for all the States and the FCT to acquire baseline data for proper investment planning; to rehabilitate/expand or to construct existing water systems to meet the demand; monitor the output of potable water supply undertakings for conformity with drinking water quality standards.

Some of the targets of the Policy are: increase access to toilet facilities by 25% in public places and 50% in households by 2006; and 75% and 100% respectively by 2010; increase sanitary management of sewage and excreta by 25% in 2006 and 75% in 2010; extend present water supply and wastewater services coverage to 80% of the population by 2007, 100 % by 2011 and to sustain full coverage beyond 2011; increase private sector participation in environmental sanitation services delivery by 20% in 2006 and 75% by 2010; empower 25% of women and youths on income generating environmental sanitation activities by 2006 and 75% by 2010.

The Policy states the creation of National Technical Committee on Environmental Sanitation (NTCES) at the National level with representatives of FME (shall act as chairman), FMH, FMWR, etc. to coordinate, monitor and evaluate the implementation strategies of the National Policy; to undertake periodic review of the National Environmental Sanitation Policy and Guidelines; and to submit annual report on Environmental Sanitation to the National Council on Environment.

Likewise, the Policy states the creation of State and Local Government Technical Committee on Environmental Sanitation.

The Policy also determines roles and responsibilities for various institutions such as FME, FMWR, FMH, etc., State Governments and Local Governments.

Among the main roles and responsibilities determined by the Policies for the FME are: (a) Formulate, review and produce the National Environmental Sanitation Policy and Guidelines; (b) Enact, review and harmonise existing Legislation on Environmental Sanitation; (c) Develop and ensure the implementation of the National Environmental Sanitation Action Plan; (d) Develop a master plan for urban solid waste management in Nigeria, and ensure its implementation; (e) Develop master plan for biomedical waste and ensure its implementation; (f) Establish a National Data Bank on Environmental Sanitation for the purpose of planning and development.

Among the roles and responsibilities determined by the Policies for the FMWR are: (a) collaborate with Federal Ministry of Environment on water sanitation activities including sewerage, storm water control and quality control of water supply sources; and (b) ensure access to adequate potable water supply for all Nigerian.

Among the main roles and responsibilities determined by the Policies for the State Governments are: (a) Provide technical assistance and logistic support to LGA on the implementation of the National Environmental Sanitation Policy and Guidelines; (b) Adopt the master plan on waste management for implementation at the State level; (c) Ensure implementation of the master plan on biomedical wastes; (d) Ensure and coordinate the storage, regular collection, transportation and disposal of solid waste in the urban areas; (e) Ensure proper sitting of final disposal sites for waste management.

Among the main roles and responsibilities determined by the Policies for the Local Governments are: (a) Implement the National Environmental Sanitation Action Plan; (b) Implement the master plan on solid waste management; (c) Implement the master plan on biomedical waste management; (d) Ensure provision of adequate functional public toilets and solid waste management facilities in strategic areas, public assemblies, parks and gardens, refugee camps and other notable places for transient populations within the LGA; (e) Sensitise and mobilise community members to participate in the National Environmental Sanitation Day exercises.

National Water Sanitation Policy

This Policy was produced by 2004 by FMWR[4] to improve the component of sanitation of the National Water Supply and Sanitation Policy approved by 2000 year. The Policy defines water sanitation as effective hygiene practice, handling and disposal of excreta, liquid (sewerage, sullage and storm water) and leachates from dump sites (solid wastes) in so far as it affects water sources.

The Policy objective is for all Nigerians to have access to adequate, affordable and sustainable sanitation through the active participation of Federal, State and Local Governments, NGOs, Development Partners, Private sector, communities, households and individuals. New targets were set as follows: sanitation coverage to 80% by 2015, sanitation coverage to 100 % by 2025 and to sustain 100 % sanitation coverage beyond 2025.

The Policy states the creation of a National Steering Committee on Water Sanitation with representatives of FMWR (shall act as lead coordinating Agency), FMH, FME, etc. including Civil Society Organizations to coordinate and monitor the implementation of the Policy. Likewise, the Policy states the creation of State and Local Government Steering Committee on Water Sanitation.

The Policy also states the establishment of Water Sanitation Division within the Department of Water Supply and Quality Control in the Federal Ministry of Water Resources to coordinate and facilitate the implementation of the National Water Sanitation Policy by collaborating with other key line Ministries at the Federal and State levels and the Local Government. Likewise, the Policy states the creation of State Sanitation Division and Local Government Sanitation Units to coordinate and facilitate the implementation of the National Water Sanitation Policy.

The Policy also determines roles and responsibilities for Federal, State and Local Government Institutions, for Communities, for Households, for NGOs, for Private Sector Participation, for Development Partners.

Among the main roles and responsibilities determined by the Policies for the Federal Government are: (a) Shall take the lead in developing policies on sanitation for Nigeria upon adequate consultation with all stakeholders; (b) Shall establish and appropriately fund the Water Sanitation Division of the Federal Ministry of Water Resources, charged with the responsibility of actualizing the policy objective of 100% sanitation by 2025 in the Federation in collaboration with the National Steering Committee on water sanitation; (c) Shall facilitate the development of sanitation programmes for the Federal Capital Territory and urban areas in consultation with all stakeholders; (d) Shall facilitate the development of sanitation programmes for the Federal Capital Territory and urban areas in consultation with all stakeholders.

Among the main roles and responsibilities determined by the Policies for the State Government are: (a) Shall establish by appropriate legislation, a State Government Agency responsible for sanitation

[4] National Water Sanitation Policy, 2004.

(where such agencies do not exist) charged with the responsibility of actualizing the policy objective of 100% Sanitation by 2025 at the State level; (b) Shall develop sanitation programmes for State Capitals and major cities in the states in consultation with all stakeholders.
Among the main roles and responsibilities determined by the Policies for the Local Government are: (a) Shall develop hygiene and sanitation programmes for the Local Government headquarters and communities in their area in consultation with all stakeholders; (b) Shall provide ;support to communities and households for sanitation development; (c) Shall set sanitation tariff where applicable considering affordability and willingness to pay for services by the household.

National Environmental Policy

The major objective of the national environmental policy[5] is to encourage measures which sustain a balance between population and environment. Its major goal is the sustainable development based on proper management of the environment and in particular to: (a) Secure a quality of environment adequate for good health and well-being; (b) Conserve and use the environment and natural resources for the benefit of present and future generations; (c) Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems; (d) Raise public awareness and promote understanding of the essential linkages between the environment, resources and development, and encourage individual and community participation in environmental improvement efforts; and (e) Co-operate in good faith with other countries, international organisations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental degradation.

The strategies used by the Policy are given in the following sectors: human population, culture, housing and human settlements, biological diversity management, natural resources conservation, land use and soil conservation, agriculture, water resources management, forestry, wildlife and protected natural areas, marine and coastal area resources, mining and mineral resources, industry, energy, gas and oil, construction, health, education, transport and communication systems, trade, tourism, science and technology.

As for the water resources management sector, the Policy states that water is a vital resource that should be managed including environmental issues to minimize among others supply shortages and pollution.

The Policy document further states that a comprehensive medium and long term national plans for water resources management and conservation should be put in place taking into consideration demand and availability. Among the strategies for this sector are: (a) Provision of water in adequate quantity and quality to meet domestic, industrial, agricultural and recreational needs; (b) Environmental impact studies of water resources development; (c) Specification of water quality criteria for different water uses; (d) Continuous monitoring of the public health implications of water resource development projects such as dams and irrigation schemes; (e) Control of point and non-point sources of pollution.

Besides strategies are given for specific issues such as disasters, drought and desertification, flood and erosion.

The Policy also deals with cross-sectoral issues such as: sanitation and waste management (domestic and industrial waste, liquid and solid), toxic, hazardous and radioactive waste management, air pollution, noise pollution, working environment and public participation.

In the sector of sanitation and waste management, the policy states that priority shall be given to the environmental studies of industrial effluents as well as the variety of solid and liquid wastes generated in the various ecological zones. Among the strategies for this sector are: (a) the study of the most reliable treatment systems that are appropriate for domestic and industrial wastes; (b) Introduction of effective protective measures against the indiscriminate discharge of particulate matter and untreated industrial effluents into lakes, rivers, estuaries, lagoons and coastal waters taking into account the following additional points: (i) the establishment of baseline studies to ascertain water quality at various points along the river or other water bodies; (ii) the physical, chemical and biological

[5] National Policy on Environment, 1999.

characteristics of treated effluents; (iii) the location and type of existing and projected uses of river water which will determine the acceptable/optimal location of waste water treatment works and the level of treatment necessary, given the assimilative capacity of the rivers; (iv) the establishment of relevant standards based on river/water quality objectives and the public health criteria and; (v) the need for a comprehensive monitoring programme incorporating an early warning system for the down-stream users.

National Forest Policy

This Policy[6] selects thirty (31) priority areas for its formulation. Among these priority areas, the following five (5) areas are considered pertinent for the protection of water resources: a) Forest Management, b) Community Participation in and outside forest reserves and game reserves, c) Environmental Services of Forests, d) Watershed Forests and Wetland Management and, e) Education and Awareness Creation. The policy statement for each pertinent area is described here under:

(i) Forest Management

Forest management will focus on achieving sustainable delivery of forest goods and services in perpetuity. Forest plantations will be established through-out the country to supplement the supply of wood from the natural forests for domestic consumption as well as promotion for export, industrial uses and environmental conservation.

(ii) Community Participation in and Outside Forest Reserves and Game Reserves

Encourage collaborative partnership with rural communities for the sustainable management of forest resources to ensure the supply of goods and services from the forest for the present and future generations.

(iii) Environmental Services of Forests

Government will recognize and emphasize the protective role of forests in watersheds, buffer zones around rivers and hill so as to prevent water and wind erosion as well as siltation of watercourses and as carbon sequesters.

(iv) Watershed Forests and Wetland Management

Watershed protection forests will be established, rehabilitated and conserved, while all wetlands will be monitored and managed in accordance with international standards. Government will promote the rehabilitation and conservation of forests that protect the soil and water in the nation’s key watersheds and river systems. Achievements on watershed protection through forestry will result from the adoption of appropriate farm forestry methods on degraded private lands, from the improved management of natural forests on private lands, and from the restoration of degraded hills on public lands.

(v) Education and Awareness Creation

To create awareness among the populace on the importance of the forest and the need to conserve forest for the benefit of the present and future generations.

Lagos State Policy Goal on Environment

The State goals on Environment are:

- To execute the State’s mission statement which is committed to the provision of a health environment to its citizens, maintain biodiversity and ensure sustainable social, economic and physical development
- To alternate the level of poverty, hunger and disease in the State and adverse impacts of these problems on the environment
- To promote rational use and conservation of natural resources for the present and future generations as a means of promoting sustainable social and economic development in the State
- To develop, use, restore, preserve and enhance the land, water, air and other natural resources of the State in a manner consistent with the purpose of this policy
- To mitigate and prevent pollution of the natural environment in the State

[6] National Forest Policy, 2006.

- To promote the awareness of the citizen of the State on the need to balance environmental management with development
- To promote community participation in environmental matters
- To provide and encourage other sources of funding environmental programmes and projects in the State
- To cooperate and collaborate with Federal, State and Local Governments, non-governmental organizations, private sectors and individuals on environmental matters.

(2) Forest Management

The sustainable management of forest and wetlands are very important for the conservation of the water quality of the water sources. In the period of 1980-2007 the loss of forest and grassland area in Nigeria were of 7.6 % and 1.1 % respectively, being the large portion of the deforested area used for crop production[7].

Forestland is widely used by local communities for cultivating crops, grazing and for fuelwood gathering, as well as building materials sourcing. Uncontrolled clearing of forest will continue until management plans are put in place to achieve a sustainable production, protection and conservation of forest resources.

The annual consumption of wood in Nigeria is estimated in 80-88 million m^3 of which 80% is consumed as fluelwood mainly by the rural population (80% of the total population). However the fuelwood available on sustainable basis from Forest Reserves and natural woodland is estimated in 11-17 million m^3/y[8]. The gap between the demand and supply is high and necessaries action needs to be taken to counteract this situation.

In terms of deforestation, between 1980-1990, the forest area in Nigeria declined from 14.9 million ha to 10.1 million ha leading to soil degradation, water contamination, siltation, drying up of water bodies, micro-climate change and the depletion of fauna and flora. The clearing of land for farming accounts for over 80% of total forest area deforested every year[9].

As for forest plantation, the total planted area is estimated on 269,000 ha (2006) and composed by Gmelina for the pulp and paper industries and other species (Tectona grandis, Terminalia ivorensis, Nauclea diderrichii, Triplochiton scleroxylon, Eucalyptus, Pinus, Entandrophragma, Khaya) mostly used for industrial wood production. All these plantations have been planted in forest reserves[10]. Wood processing plant can be found in Edo, Delta, Ondo, Ogun, Lagos and to some extend in Kwara and Benue States. Furthemore, wood base industries are located in the Northern States of the country, drawing raw materials from the humid States[11].

The implementation of sustainable management of forest is essential to conserve the water sources since the forest itself helps to prevent erosion that can be affect negatively the water bodies.

Forest Reserves

The States have the responsibility of forest reserve management in their territories. The JICA team approached the Federal Department of Forestry to discuss about the current condition on forest reserves and arrived to the following conclusions: (a) the list of forest reserves in the country is already old and deforestation had occurred mainly in the reserve areas. They need to update the forest reserves since some of them might be without any forest at present; (b) the States are the custody of the land but lack the capacity for management of the forest, consequently, conservation of forest or development plans of forests are not in place.

The following table shows the number of Forest Reserves in Ogun-Oshun Basin which currently need to be updated.

7 Nigeria Review of Public Expenditure in Sustainable Land and Water Management, 2010, page 3.
8 National Forest Policy, 2006, page 7-8
9 National Forest Policy, 2006, pages 13-14
10 National Forest Policy, 2006, page 5
11 National Forest Policy, 2006, page 9

Table S8.1-1 Forest Reserve in Four States of Ogun-Oshun Basin[12]

Nº	States	Nº of Forest Reserve
1	Lagos	2
2	Ogun	9
3	Osun	13
4	Oyo	23
	Total in 4 states	47

Annex S8.1-1 present the name and locations of forest reserves in the four (4) States of Ogun-Oshun Basin. The current Forest Reserves in Ogun State was provided by Ogun State Ministry of Forestry, while for other States was used the list provided by Federal Forestry Department, however, this list is already old and need to be updated to know their existence presently.

National Parks and Game Reserve

National Parks and Game Reserve that hold an extent area of forest needs to be protected from predation. Parks and Game Reserve are designated area of conservation where large population of animals breed under natural conditions and represent a large reserve of genetic resources. Oyo State is the only State that has a national park in Ogun-Oshun Basin and its main characteristics are as follows[13].

Table S8.1-2 National Park in Ogun-Oshun Basin

Nº	Name/(State)	Description
1	Old Oyo (Oyo State)	Its area is of 2,529km^2. It has great potentials for wilderness experience, cultural/historical, water recreation (Ikere Gorge Dam/River Ogun), bird watching, educational, research, mountaineering etc. Large mammal species include Western Kob, Roan Antelope, Western Hartebeest, Grimm's Duiker, Oribi, Crested Porcupine, Anubis Baboon, Patas Monkey, Tantalus Monkey, Buffalo, Red River Hog, Spotted Hyena, Lion, etc. The Park is rich in both National and International migratory birds. Also abundant in the Park are Fishes, Reptiles, Butterflies, Ants, Mushroom, and Millipede etc. This Park was gazzeted by 1991 and its location is 08^0 44' N and 03^0 44' E.

Wetlands

Wetlands are important habitat for many species of animals and birds. The Ramsar list of Wetlands in Nigeria of international importance does not include any wetland which might be located in Ogun-Oshun Basin.

Responsible Agency for Forest Management

National Parks are assets of the Federal Government and the agency responsible for their management is the National Parks Service, an agency of the FME.

Forest Reserves are areas set aside and managed by State Governments for the protection of the wildlife and forest.

In the Ogun-Oshun Basin, the Ministries of Environment are in charge of Forest Reserves Management in the States of Lagos, Osun and Oyo, while, in Ogun State the institution responsible is the Ministry of Forestry.

According to information provided by Ogun State Ministry of Forestry, all Forest Reserves are provided with divisional offices to control the activities in the area including some reforestation programs. Main problems indicated by Ogun State Ministry of Forestry are: (a) Inadequate funding of forestry operations; (b) Untimely release of fund (forestry operations are time bound); (c) Inadequate logistics for proper and improved patrol, monitoring and protection; (d) Economic sabotage of forest resources by illegal farmers; (e) Encroachment from border State & Communities; (f) Illegal activities by timber merchants.

[12] Source: Federal Ministry of Environment, Forestry Department
[13] NIWRMC: Final Report on Water Management for Fisheries and Wildlife, NIWRMC, 2009, pages 15-17,25; The Status of Nigerian Biodiversity 2006, FME

On the other hand, the Osun State Ministry of Environment had informed that they have staff to control activities inside the Forest Reserves and plantations respectively and their major problems they are facing on forest management are: Illegal farming, illegal felling, inadequate staffing and inadequate vehicle for patrol on the forest reserves.

It can be concluded that Forest Reserves are often poorly managed due to insufficient number of personnel, poor funding and lack of equipment.

(3) Aquatic Weeds Control

Aquatic weeds & plants generally are considered as a nuisance in the river water systems since they restrain the free flow of water, clog the water supply and irrigation systems and besides they are home for disease vectors such as mosquitoes and snails

(4) Plans and Projects for Water Environment Conservation

(i) Aquatic Weeds on Nigeria`s River System

Nationwide Study on Aquatic Weeds and Plants on Nigeria`s River System

Recent nationwide study[14] made on this field, has revealed the current situation in Nigeria. According to this Study, in the Ogun-Oshun Basin, the presence of aquatic weeds was identified in the States of Lagos, Ogun and Oyo. The found aquatic weeds are summarized in the bellow table.

Table S8.1-3 Summary of Aquatic Weeds and Plants in Ogun-Oshun Basin

Nº	HAs	Dominant species found in the area	Rivers & Dams affected	States
1	Western Littoral	Eichornia crassipes	Ogun River, Yewa River, Ojumo Dam, Ogumpa, Ofiki	Ogun, Oyo, Lagos
		Typha australis (cattails)	Rivers in Ilage area, coastal water bodies	Lagos
		Nymphaea spp (Water lily)	Ojumo Dam, Yewa River, Ogun River	Ogun, Oyo
		Diplazium samatii (Water fern)	Ogun and Yewa Rivers, Ojumo Dam, Ogunpa, Ofiki	Ogun, Oyo, Lagos

From the above table is concluded that currently many rivers and dams in Ogun-Oshun Basin are affected negatively by aquatic weeds and plants.

Integrated Management of Invasive Aquatic Weeds Project

It is an African Development Bank assisted project which period of implementation was from 2007 to 2011. Twenty five States of Nigeria having weeds problems in their river systems were selected for this project and Lagos, Ogun, Osun and Oyo States took part of it as indicated in the bellow table.

Table S8.1-4 Water Bodies where IMIAWP Operated in

Nº	State	Community/LGA	Name of Water Body
1	Lagos	i. Pivota Community, Badagry LGA ii. Idera Community, Badagry LGA.	Badagry Lagoon Ogun River
2	Ogun	i. Iwopin Community, Ogun-Water Side LGA. ii. Oni Community, Ogun-Water side LGA.	Iwopin Lagoon Oni Lagoon
3	Osun	i. Oba Ekonde Community, Odootin LGA.	Oba River
4	Oyo	Eleyele Community, Ibadan LGA	Eleyele Dam

The implementing agency of this project was the FMA which worked closely with the Ministry of Environment of affected States. The project organized the farmers on Water Weeds Communities for compost production from weeds to apply them in the vegetable cultivation. This Project had finalized in 2011, and now, the second phase is under preparation.

(ii) National Parks Proposals

Commonly forest reserves are not well managed by the States according to some interviewed officers of Nigeria. For the well management of some forest reserves which includes wetlands, currently the National Parks Services is negotiating with the States so that twelve (12) forest reserves under the dominions of States can be lifted to the dominions of National Parks services for its management. Negotiation started on 2011 and expected to be concluded by 2015. The forest reserves which could be become National Park in the Ogun-Oshun Basin is presented in the following table.

[14] Nationwide Study on Aquatic Weeds and Plants on Nigeria`s River System, 2010, pages 11-12, 21-23,28,32,39,40,49-51,69,70,81,82,85,86,97-99,102,112-115,117,121,124.

Table S8.1-5 New National Parks Proposal in Ogun-Oshun Basin

Nº	Forest/wetland to become National Park	Location (States)
1	Upgrading of any existing Forest Reserve	Ogun
2	Upgrading of any existing Forest Reserve	Osun
3	Upgrading of any identified Wetland Reserve	Lagos

Source: Information given by officers of National Parks Services.

So far, the current National Parks are considered as natural tourist attractions where the flora and fauna are managed properly.

(iii) Biodiversity Study

Nigeria has 4,600 plant species (707 of which are endemic) which is being threatened by deforestation of the remaining natural forest and the forest wetlands. By 2004, was put in place the National Biodiversity Strategy and Action Plan to achieve the conservation of the biodiversity[15]. Currently, a GEF funded Study on Biodiversity is being implemented to determine the Biodiversity and Action Plans nationwide. This study will be for 36 months and had started in September 2011.

(iv) Afforestation Program

As a future plan, it can be mentioned the presidential initiative to implement afforestation programs in each State involving the communities, schools, etc. Lands to be afforested are mainly degraded forest areas.

(v) NESREA Corporate Strategic Plan

This Strategic Plan was prepared for the period 2009-2012 focused on the building environmental capacity and enforcing compliance. The Plan describes strategic priorities and outcomes that NESREA will focus on and the key actions to be taken in the period to respond to environmental degradation in Nigeria. Two broad outcomes were identified: (a) Improved quality of air, land, and water as well as reduced biodiversity loss and; (b) Effective compliance and environmental stewardship in sanitation and waste control. The bellow table indicates the main Strategic Actions[16] and the expected results of the Plan by 2012 year.

Table S8.1-6 NESREA Corporate Strategic Plan

Strategic Block	Main Strategic Actions	Expected results by 2012 year
Environmental Advocacy, Communication and Advice	• To work with other Governmental Agencies (national and local) • To work with industries in terms of regulation, environmental impact and future investment	• Partnership agreement with over 20 State Governments • Sector plans published for all key industrial sectors and; environmental best practice published for key sectors
Regulations and Standards	• To prepare a programme of appropriate regulation and guidance to manage environmental risks	• Regulatory programme agreed with FME • Regulation approved with supporting guidance for key industry sector
	• In support of the approved regulation, NESREA will introduce site related permits to interpret the regulation	• All major polluting industries will have agreed improvement plans linked to the permit conditions.
	• To work with other National and State Government Agencies to ensure that NESREA inspection and enforcement are aligned to theirs.	• NESREA will have developed and piloted "Regulatory plan" with other National Agencies and State Governments linking and aligning the regulatory efforts. • Industries will be introducing their own management environmental management systems.
Environmental Monitoring and Reporting	• To finalize the baseline data and information of the current status of Nigerian Environment in relation to enforcement activities	• Produced a regular annual status of the Nigerian Environment in relation to enforcement activities • Produced a report of the best and worst environmental industries and organizations in Nigeria
	• To develop a system to collect, access and analyse environmental data and information	• NESREA will have an Information Technology based system
	• To develop continual monitoring programmes of air quality, waste	• A sampling and reporting process will be established to assess impact from industry, waste

15 National Forest Policy, 2006, page 7.
16 Corporate Strategic Plan of NESREA-"Building Capacity, Enforcing Compliance" 2009-2012.

Strategic Block	Main Strategic Actions	Expected results by 2012 year
	management, water quality, biodiversity and pollution in general. The monitoring program will focus on environmental pressures not monitored by other Agencies	disposal, land use, and climate change.
	• To develop agreements with international, national and relevant stakeholders to collect, access and share environmental data/information	• Memorandum of understanding will be prepared in relation to environmental information sharing.
Partnering and Working through Others	• To support and promote the development of key environmental infrastructure in relation to waste management, water management and air quality, linked to sustainable energy generation	• Reduced the scale of waste dumping • Development of waste strategies and infrastructures to treat and dispose of waste in at least 10 States
	• To work initially with 18 States where NESREA has offices to agree partnerships focusing on joint environmental awareness and compliance monitoring	• Establishment of Joint State Action Partnership for real environmental protection and improvement
NESREA capacity development and learning from other	• To develop a framework for staff development and support	• Agreed staff attachments/secondments with major industries.
	• To continue to share and seek support from development partners and programmes in other countries	• Overseas placement programmes running in 3 countries including the UK where it started.

(e) Water Recreational Areas and the Tourism

Nigeria is blessed with many natural resources that can be exploited as tourism attractions in the world of tourist industry. Besides, the cultural celebrations by its population composed by diverse cultural groups could represent the best destinations for tourist lovers of the history and culture. However, these potentials of tourism need to be developed adequately to promote the sector in the country.

<u>**Master Plan for the Tourism Sector**</u>

The Master Plan for the Tourism Sector[17] was formulated by 2005. An overview of the main key findings of the MP is presented as follows: (a) the existing legislation is weak; (b) the Federal Ministry for Culture and Tourism needs strengthening and professional personnel; (c) the Nigerian Tourism Development Corporation is overstaffed, under resourced, lacks targets and action plans and consequently is in-effective; (d) the commercial sector lacks a strong unified voice; (e) the Public/Private relationships are non-existent; (f) there is a lack of an enabling environment for the private sector involvement and investment in the tourism sector; (g) current marketing of Nigeria is inadequate; (h) the sector lacks reliable statistics and market information; (i) databases to implement the Tourism Satellite Account (TSA) are not available; (j) the project identified 190,000 international air arrivals with visitor spending at US$ 280 million for 2004. No information exists on land frontier arrivals; (k) the existing incentives and investment procedures are not attracting investment in the tourism sector; (l) Nigeria's tourist attractions are unknown to the international travel trade; (m) image of Nigeria abroad is very negative and is not being addressed; (n) the visa regime is a very real barrier to tourism growth. It is punitive and does not serve the tourism interests of Nigeria. Applicants for visas must produce a letter of invitation from Nigeria and apply at the embassy where they reside. Many of Nigeria's competitors have much more friendly visa regimes with some requiring no visa for nationals of the tourism generating countries. This issue needs to be addressed as a matter of priority; (o) Human Resources Development is totally inadequate in training quality, skills range and numbers.

The MP then gives directions and actions plans necessary to overcome the many issues presented above. Unfortunately, this MP is not implemented yet due to the lack of funds to support it.

<u>**Current Status of the Tourism Sector**</u>

Currently in Nigeria, the tourism sector has slow pace of development. Among the main problems that affect the tourism development are[18]: (a) bad road infrastructure. Tourism attractions are dispersed over large areas and need good road linkages; (b) Tourist facilities are obsolete, not well maintained or

[17] Master Plan for the Tourism Sector, 2005
[18] Information given by officers of Nigerian Tourism Development Corporation

not in place; (c) Lack of promotion of touristic activities such as Cultural Festivals in order to attract the coming of tourist in the country; (d) Lack of materials on tourism for the promotion of the sector. The existing ones are obsolete.

Other source consulted indicated that among the problems that affects the poor development of the tourism industry is the lack of loans facilities to prospective tourism practitioners[19]. Other constraints that limits the growth of tourism in Nigeria is the widespread poverty, a perception of the country as unsafe because of high crime rates, and frequent political, religious, and ethnic disturbances. In addition, both private and government investors still lack skills in packaging tourism products for local and international consumers[20]. There have been losses of cultural heritage and tourism, for instance the Gogoram Fishing Festival which was an important cultural event in Yobe State could not be organized for several years due to the ecological degradation and reduced river flows. In this way, the community also loses the derived income from the festival[21].

A questionnaire survey[22] was carried out by 2009 on Institutions and Establishments where recreational activities involve large water resources. The survey indicated that none understood or appreciated the value of water to recreation. Nobody regulates the usage of water at the tourist sites and none has ever thought of treating the water at their disposal. The survey also indicated that no records are available to know the number of tourist, the quantity of available water or the quantity of water required for recreation. During this survey also was observed that majority of infrastructures have broken and not worked for years, closed restaurants, bad access roads, etc. The majority of foreigners that arrive to Nigeria are for business, for official mission and for family visits. Most come from Western Europe, North America, South-East Asia, and neighboring West African countries. Nigeria had been suffering the lacks accurate statistics on arrivals and departures which are fundamental for the design of tourism development. The domestic tourism has also been very low, as many Nigerians are too poor to vacation and those with resources have not developed a “culture” of tourism[23]. The following Table shows the tourist arrival in Nigeria in the period 2005-2010 as provided by the Nigerian Tourism Development Corporation.

Table S8.1-7 Number of Tourist Arrival in Nigeria by Continent

Nº	Continent/year	2005	2006	2007	2008	2009	2010
1	Africa	1,916,246	2,107,870	3,613,481	4,014,980	4,175,589	4,176,389
2	Americas	116,020	129,219	221,586	244,455	256,055	274,581
3	East Asia/Pacific	160,666	177,001	302,260	337,589	351,092	358,158
4	South Asia	64,796	72,000	123,627	137,364	142,858	178,855
5	Australia	3,675	4,043	5,367	7,663	7,969	8,082
6	Europe	459,985	506,000	867,487	963,874	1,000,604	1,002,737
7	Middle East	56,095	55,104	94,816	105,357	109,565	110,692
8	Other countries	-	8,606	15,191	16,879	17,555	17,779
	Total	2,777,483	3,059,843	5,243,815	5,828,161	6,061,287	6,127,273

New Investment Initiatives for the Tourism Sector

The Federal Government is aware of that Nigeria would be making a lot of money if developing the tourism sector rather than depending only on oil revenue. To promote the sector, the Federal Government is now planning to set up a tourism bank in order to encourage greater participation of both local and foreign investors in the tourism sector in Nigeria. This Bank, which is now at an advanced stage, will provide soft loans to tourism practitioners in Nigeria[24].

19 "Nigeria starts taking tourism sector seriously". *afrol.com* (afrol News). Retrieved 2007-06-21.
20 Peace and Tourism in Nigeria by Bola Olusola Adeleke, Redeemer’s University, Nigeria, page 2. http://ww.responsibletravel.org/resources/documents/reports/TPhil_Conference_Nigeria.pdf
21 Draft Final Report on the Status of Water Resources Management in Nigeria, page 63.
22 Draft Report on Water Related Recreation and Tourism and Integrated Water Resourc Management, 2009, page 21, 32- 33
23 Peace and Tourism in Nigeria by Bola Olusola Adeleke, Redeemer’s University, Nigeria, page 2. http://ww.responsibletravel.org/resources/documents/reports/TPhil_Conference_Nigeria.pdf
24 "Nigeria starts taking tourism sector seriously". *afrol.com* (afrol News). Retrieved 2007-06-21

Touristic Resources in Nigeria

(i) General

The touristic resources in Nigeria is largely focused in cultural events since the country has about 250 ethnic groups, rain forest, savannah, waterfalls, national parks and other natural attractions. The cultural events include festivals and cultural celebrations such as Durbar festivals organized in many cities of the country including Kano, Katsina, etc., as for natural attractions it can be mentioned the national parks such Old Oyo, Cross river and Yankari. On the other hand, the country has many other physical attractions, which include hills, caves, springs, lakes and mountains, an example of these are the Aso Rock in Abuja.

(ii) Water Related Recreational Sites and Tourism Attractions

The bellow table shows the main water related recreational sites and tourism attractions in Ogun-Oshun Basin[25].

Table S8.1-8 Main Water Related Recreational Sites and Tourism Attractions in Ogun-Oshun Basin

State	Name	Description
Lagos	Maiyegun Beach	The beach is popular for relaxation and host the popular Lekki Sunsplash Musical Concert.
Osun	Osun Shrine	It is the domicile of Osun, the Yoruba goddess of fertility. The site consists of 40 shrines, 2 palaces and many sculptures and other works of art. Every year, many people travel from all part of the world to attend the Osun Oshogbo festival which is sponsored by the Federal Government, the Osun State and various multinational companies.
Oyo	Old Oyo National Park	It is rich in fauna and flora resources. Facilities available include chalets, tourist camps, standard restaurant, for boat cruise and sport fishing.

Usually reservoirs are designed for water supply, irrigation and power generation. However, most of the reservoirs provide recreational activities which component was not included in the design. Direct use of water for recreation include boating, swimming, fishing and indirect use of water are those activities that are carried out in the proximity of the water sources such as camping, picnicking and hiking[26]. Recreational facilities are not provided in the older water resources projects and recreation benefits were not accounted for in the socio-economic benefit of such projects[27].

[25] Final Draft Report on Water Related Recreation and Tourism and Integrated Water Resources Management, 2009, pages 8, 10-20.
[26] Draft Report on Water Related Recreation and Tourism and Integrated Water Resources Management, 2009, page 34
[27] Draft Final Report on the Status of Water Resources Management in Nigeria, page 63

S8.1.2 Water Quality Management

(1) Water Pollution Control

General

Surface and underground water pollution has become of increasing concern in Nigeria, especially for those places underlying industrialized and agricultural areas and for those receiving water bodies[28]. Domestic and industrial wastewater in Nigeria is to a large extent still discharged untreated into open drains, streams and other watercourses. Irresponsible effluent disposal by industries in Nigeria is common. For example, by 2001, researchers observed that all textile mills wastewater are emptied into natural water ways via public drainage with little or no treatment[29].

In the Oil Sector, a serious pollution of the environment due to oil spillage was confirmed by a Study[30] conducted by UNEP in a village named Ogoniland (Rivers State, Southern Nigeria). This village covering around 1,000 km^2 has been the site of oil industry operations since the late 1950s. Even though the oil industry is no longer active in Ogoniland, oil spills continue to occur regularly. The Study concluded that pollution in Ogoniland due to oil is widespread and severely impacting many components of the environment such as soil, groundwater, vegetation, aquatic organism. In addition, the Ogoni community is exposed to petroleum hydrocarbons in outdoor air and drinking water, some time at elevated concentrations, for example, community members at Nisisioken Ogale are drinking water from wells that is contaminated with benzene, a known carcinogen, at levels over 900 times above the WHO guidelines. The Study also found in 28 wells that serves to 10 communities, high level of hydrocarbon. The Study finally concluded that the environmental restoration of Ogoniland is possible but may take 25 to 30 years.

Pollution coming from fixed places belong to point pollution sources, meanwhile, such land areas as agricultural lands, urban areas, etc., which discharge sorts of pollutants belong to non-point pollution sources. In Nigeria the pollution derived from non-point sources is significant, because the country has vast lands for agricultural and livestock activities. Therefore, this could become major issues in water quality management. Nevertheless, there is not information or studies and measures for controlling pollution from non-point sources.

Policies on Water Pollution Control

The Federal Ministry of Environment, FME, has the responsibility of preparation of the Policies for water pollution control in the country. To design the Policies for the sector, they need to know the status of water pollution in all the States and this is still lacking.

Responsible Agency for Water Pollution Control

(i) NESREA

The National Environmental Standards and Regulations Enforcement Agency (NESREA), parastatal organization from the FME, is the institution responsible in Nigeria for the elaboration of Environmental Standards and Regulations and its enforcement at country level. Besides, NESREA is to enforce compliance with provisions of international agreements, protocols, conventions and treaties on the environment.

NESREA has its main office at Abuja, six (6) Zonal Headquarters with its eighteen (17) State Offices and two National Environmental Reference Laboratories located in Kano and Port-Harcourt cities[31]. As for water pollution, NESREA recently has promulgated the National Environmental (Surface and Groundwater Quality Control) Regulation, 2011. According to these Regulations, a person shall not release any substance into, or conduct any activity which will likely cause or contribute to pollution or adversely affect species of the water of the nation (surface water and groundwater); without having obtained all required approvals and permits from NESREA. Such activities include but not limited to:

- Secure a quality of environment adequate for good health and well-being;
- discharge of wastewater

[28] Studies for Industrial Effluent Treatment Facilities in Kano, Volume 1, page 18.
[29] Studies for the construction of industrial effluent waste treatment facilities in Aba, Report Nº1, page 12
[30] Environmental Assessment of Ogoniland, UNEP, 2011.
[31] Magazine of NESREA, Volume 10.

- discharge of pollutants
- dredging of surface water
- dredging and dredged material disposal
- filling of surface water of the nation
- construction activities
- mining activities
- any commercial, industrial, state or municipal land development that results in the creation of 3700 m^2 or more of additional impervious area
- two hectares or more of land disturbance
- marinas-construction of new facilities or expansion of existing facilities
- flow alterations
- harbor management plans for those elements which will likely affect water quality
- a point source discharge of pollutants
- any other activity that may produce a measurable change in a water

The application for permits shall be submitted and processed in accordance with the National Environmental (Permitting and Licensing System) Regulations, 2009.

NESREA, for water pollution control, operates two National Environmental Reference Laboratories located in Kano and Port-Harcourt cities. However, the number of laboratories is insufficient and the existing equipments are now obsolete and needs to be replaced in order to enhance compliance monitoring.Most of the major constraints as stated by NESREA authorities in carrying out enforcement duties are as follows:

- Lack of willingness by the facilities to comply with environmental laws;
- Low level of awareness on environmental sanitation and waste in the society;
- Facilities claimed that they are hampered from acquiring appropriate pollution abatement technologies as recommended by NESREA due to financial constraint;
- Insufficient number of laboratories and equipment to develop standards for compliance monitoring;
- Inadequate laboratory equipment; the existing ones are now obsolete and needs to be replaced;
- Inadequate equipment to enhance compliance monitoring;
- Inadequate capacity building programmes for staff; and
- Inadequate operational vehicles to carry out compliance monitoring including non motorable areas

(ii) Department of Pollution Control and Environmental Health

This Department that belongs to the FME is responsible for the elaboration of policies and strategies for environmental pollution control at country level

(iii) Ministry of Mines

The Ministry of Mines through its EIA Division implements inspection of mines licensed by them in order to check environmental compliance

(iv) State Ministry of Environment

In Ogun-Oshun Basin the Ministries of Environment for Lagos, Ogun, Osun and Oyo States are responsible to formulate the policies and regulations or standards and implementation of programs for environmental control and management at State level. In addition the States Ministries of Environment of Lagos and Ogun have established their own Environmental Protection Agency to deal with pollution control as described below.

(iv-1) Lagos Environment Protection Agency (LASEPA)

This Agency is to implement programs for environmental pollution control in Lagos State. The Agency is a regulatory institution of the Lagos State Government with the main following responsibilities:

- Enforce compliance with laws, guidelines, policies and standards on environmental aspects
- Enforce Environmental Control Measures through registration, licensing and permitting systems

- Outdoor pollution control and monitoring
- Monitor and control disposal of solid, gaseous and liquid wastes generated by both Government and private facilities in the State
- Monitor and control all forms of environmental degradation from agricultural, industrial and Government operations
- Survey and monitor surface, underground and potable water, air, land and soil environments in the State to determine pollution level in them and collect baseline data
- Control of hazardous substances and disposal methods
- Monitor and control of air and noise pollution
- Monitor and enforce standards and guidelines on vehicular emission
- Setting of standards and guidelines on environmental matters
- Appraisal and evaluation of all technical documents such as Environmental Impact Assessment, Environmental Audit Report, Post Impact Assessment, etc. on the new and existing facilities
- Monitor and control of water hyacinth
- Laboratory Services for environmental matters
- Carry out public enlightenment and educate the general public on sound methods of environmental sanitation and management

LASEPA focus mainly to ensure that all industries in the State comply with the environmental guidelines and standards for wastewater discharge and emission into the environment. The bellow table shows summary results of samples analyzed by the Laboratory of LASEPA.

Table S8.1-9 Summary of Samples Results Analyzed by LASEPA in 2011

Laboratory	Nº of samples	Total Satisfactory	Total non-compliance	Compliance concern
Microbiology	1910	1077	833	Presence of feacal coliform, high microbial load
Potable	1404	430	974	High/low pH, colour, TSS, TDS, Hardness, Turbidity
Wastewater	365	61	304	High TSS, TDS, colour, COD, BOD, pH, etc.
Air/noise	437	57	380	Particulate matter, high noise, green house gas emission
Land & soil	19	2	17	Heavy metals, oil & grease, TOC
Toxicology	16	4	12	High toxicity cannot support aquatic life
Sensitive	1695	No data	No data	Heavy metals determination e.g. Fe, Mg, Pb, Cd, Hg, ect.

Seven Laboratories own LASEPA to perform its activities as follows: potable water laboratory; microbiology laboratory; toxicology laboratory; air and noise laboratory; land and soil laboratory; wastewater laboratory and; heavy metal/sensitive equipment laboratory. Samples are taken from effluents of industries, potable water from manufacturing companies, public taps, Lagos State Water Works, packaged water facilities, private boreholes and wells. LASEPA also monitor the rivers, streams, lagoons, etc. in the State for advisory and decision making purposes.

LASEPA had concluded that major sources of water pollution in Lagos State are:

- Industrial wastewater discharge: categorized by LASEPA has the greatest threat to water sources in Lagos. Wastewater is discharged directly from these industries either untreated or partially treated, on land, water bodies or into public drains resulting in the pollution of surface and groundwater. Lagos is the industrial and commercial nerve of the federation with the location of about 70% of the nation’s industries. Industrial sectors comprises of domestic and industrial plastics & rubber; food, beverages and tobacco; textiles, wearing apparel, carpet, leather; basic metal, iron & steel and fabricated metal products; wood & furniture products; chemical and pharmaceutical; pulp, paper & paper products, printing and publishing; motor vehicle and miscellaneous assembly; electrical & Electronics. The following parameters usually exceed standard limits stipulated by the State for industrial effluent outfall for most of the sector: TSS, TDS, TS, pH, Turbidity, DO, BOD, COD, NO3, SO4, PO3, Heavy metals and Microbial loads.

- Petroleum products: Lagos State with the highest number of petroleum product usage in the country has Nigeria National Petroleum Company largest oil depot and major distribution point (Atlas cove and Ejigbo). Within a span of ten years, serious leakage has occurred several times from the pipeline conveying petroleum products from from Atlas cove to Ejigbo due to vandalization or rupture due to corrosion of pipelines. Three main local governments have been affected; Amuwo-Odofin, Alimosho and Eti-Osa local government areas which faced groundwater pollution problems.
- Municipal solid waste: illegal waste dumping sites and untreated leachate pollutes surface and groundwater.
- Other sources of water pollution are: untreated domestic wastewater and careless disposal of feacal matter; discharge of domestic sewage by Dislodgers into the lagoon, building lavatories and urinaries over running water or canal; pollution of groundwater through drilling and mining activities; oil spillage from mechanic workshop; etc.

According to LASEPA' statement, some of the necessities to be covered to improve the environmental protection in Lagos State are:

- Capacity building for staff of LASEPA to adequately address water pollution in Lagos
- Enhanced technology upgrade in terms of modern analytical equipment and in-situ test meters
- Installation of adequate abatement technology by industries/introduction of clean technology practice
- Effective Sewage Treatment Plants in the five (5) divisions of the State
- Construction of Sanitary Landfill sites in the three (3) Senatorial Districts of the State

(iv-2) Ogun Environment Protection Agency (OGEPA)

This Agency is to implement programs for environmental pollution control in Ogun State.
As for industrial wastewater management, they visit the industries and takes effluent samples to be analyzed in their own Laboratory to verify if the parameters are within the permissive level given by NESREA standards.
So far no sewage treatment facility exists in Ogun State to treat wastewater.
The industries in Ogun State are in the following sectors: (a) Food, beverages; (b) Chemical, pharmaceutical, textiles; (c) Plastic, Rubber; (d) Basic metal, iron, steel; (e) Pulp, paper products; (f) Electrical & electronic; (g) Wood & wood products furniture; (h) Non-metallic mineral products and; (i) Motor vehicle & miscellaneous assembly. The list of industries is presented in Annex S.8.1-2.
According to officer of OGEPA less than 5% of registered industries in Ogun State have wastewater treatment plants. Samples from industries are taken quarterly and as example are presented the results of two effluents analyzed from two factories:

Table S8.1-10 Summary of Two Samples Results Analyzed by OGEPA in 2013

Factory Type	pH	BOD	COD	TDS	TSS	Availability of Treatment Plant
Chemical	6.18	75	250	3954	70	Available but no operational
Soap	6.6	340	1142	3002	104	No
Standard*	6-9	30	-	2000	30	

*National Environmental Protection (Effluent Limitation) Regulation, 1991, FEPA

From the table can be concluded that wastewater management needs to be improved in order to protect the water resources in Ogun State.

Among the main problems that face the Water Laboratory of OGEPA with regard to wastewater management are:

- Lack of reagent
- Lack of equipment
- Most of equipment are not functional and many of parameters are outsourced
- Broken equipment or lack of maintenance
- Lack of sufficient personnel
- Lack of funds to operate the Laboratory
- Lack of training of the staff
- Lack of potable water in the Laboratory

As for solid waste management, they implement a Community Based Waste Management Program that consists of house to house collection to final dumpsite. Industrial waste is managed by an accredited Contractor who evacuates the waste from the industries to the designated dumpsite.

Relevant Program for Water Pollution Control

(i) Water Pollution Control in Four Cities of Nigeria

The Federal Government through the FME has decided to implement the setting up of joint effluent treatment facilities in four industrial cities in Nigeria including Kano, Aba, Lagos and Kaduna. As a first step to achieve it, the FME had entrusted to some private consultant companies the studies for the treatment of industrial effluents in these four (4) cities. These studies were completed by 2002 year and still are lacking their implementations.

These studies showed that most of the industries located in these cities are polluting the watercourses. Since Lagos State is part of the Ogun-Oshun Basin, in the bellow table is presented the conclusion for this State.

Table S8.1-11 Summary of FME Studies for Industrial Effluent Treatment in Lagos State

Lagos	Lagos city is the most prosperous city of Nigeria with high economical activity and holding one of the highest standards of living as compared with other cities of Nigeria. Lagos State has the greatest concentration of industry in the country. A study made in 1997 indicated that there were about 2,000 industries in Lagos State. The major polluting industries are in plastics, rubber, dyes, textiles, foods, metallurgical, chemicals and pharmaceutical sectors.	Lagos State has many water courses that receive these industrial wastewaters and ultimately drain to the Lagos lagoon Almost all samples values of BOD do not meet the Standard for their discharge into surface water.	The impact of untreated effluent was very serious on the receiving rivers in terms of chemical & organic loads. Many streams and big rivers from the hinterland flow into the ocean. Many monitoring studies of the aquatic system in the City of Lagos have been carried out which had shown that the water bodies are contaminated with a variety of pollutants. Research made on the Lagos lagoon detected the presence of heavy metals such as mercury, cadmium, nickel, lead, chromium, copper and zinc as well as hydrocarbons in the water and sediment.

Source:
FME:Study of Industrial Effluent Treatment Facilities in Lagos City, 2002

(ii) Water Pollution Control by Lagos State

Some of the reforms in the environmental sector implemented by Lagos State are:

- Creation of LASEPA saddled with the protection of the environment
- Rehabilitation of existing sewage treatment plant
- Acquisition of a brand new Mobile Sewage Laboratory to improve on efficient sewage management in the State
- Procurement of over 500 waste sorting bins for public schools to teach the students on how to sort their wastes
- Upgrading of Landfill/Dumpsites at Olusosun, Abule-Egba, Solous sites along Lasu-Iba road
- Building of two landfill sites that will produce energy from landfill gas.

(iii) Enforcement of Standards and Regulations

Some of the actions made by NESREA for improving the enforcement of Standards and Regulations for water resources protection in Nigeria include:

- Promulgation of twenty four (24) Environmental Regulations;
- Provision Guideline for Environmental Audit in Nigeria;
- Delineation of roles and responsibilities to relevant stakeholders to implement Regulations;
- Dialoguing with State Ministries, Departments and Agencies and relevant stakeholders;
- Accreditation of competent environmental auditors;
- Establishment of the NESREA Green Corps;
- Advocacy and creation of awareness on the Environmental Regulations; and
- Capacity building of staff on natural resources protection and conservation.

(2) Water Quality Monitoring

Water Quality Monitoring System by FMWR

The FMWR is the main agency responsible for water quality monitoring of drinking water and water sources (surface and groundwater). In addition, surface water samples are taken upstream of water intakes in order to know the current status and tendency of the water quality.

(i) Policy of FMWR on Water Quality Monitoring

The Department of Water Quality and Sanitation of FMWR follows the National Water Supply and Sanitation Policy which objective is the provision of sufficient potable water and adequate sanitation to all Nigerians in an affordable and sustainable way through participatory investment by the three tiers of government, the private sector and the beneficiary.

The component of the Policy objective on water quality states that water supply undertakings must ensure good water quality standards using the following strategies:

- The WHO drinking water quality standards shall be the baseline for the national drinking water quality standard
- All water works serving 5,000 citizens and above to be equipped with a functional water quality laboratory of appropriate capacity
- Maintain a national water quality reference laboratory network
- Monitor and protect the quality of raw water sources for drinking
- Monitor the output of water supply undertakings for conformity with drinking water quality standards
- Traditional water supply sources shall be protected and traditional water quality practices promoted

(ii) Current Conditions on Water Quality Monitoring in Ogun-Oshun Basin

The status of drinking water quality and water source is currently monitored by FMWR through its Water Quality and Sanitation Department. For this purpose, the FMWR is running in the Ogun-Oshun Basin two (2) Laboratories as follows: one (1) Reference and one (1) Regional Laboratory as indicated in the bellow table.

Table S8.1-12 Existing FMWR Water Quality Laboratories and Operational Areas

Nº	Laboratory	States	River basins
1	Lagos*	Lagos, Ogun, Oyo, Kwara	Ogun-Oshun, Lower Niger
2	Akure**	Ekiti, Ondo, Osun, Kogi, Kwara	Benin-Owera, Lower Niger

*: Reference Laboratory; **: Regional Laboratory

Reference Laboratory is more equipped and can carry out more detailed analysis than the called Regional Laboratory. Main constraints of the water quality monitoring system are financial, lack of some equipment and lack of sufficient human power according to some technicians interviewed at FMWR. Due to this fact, the Laboratories cannot cover the operational areas efficiently and the number of samples analyzed is very poor. The following table shows the number of samples analyzed by each laboratory in the Ogun-Oshun Basin during the year 2010.

Table S8.1-13 Numbers of Samples at FMWR Water Quality Laboratories in 2010 year (Ogun-Oshun Basin)

Nº	Laboratory	Covered States	Number of Samples Analyzed
1	Lagos	Not reported	115
4	Akure	Edo, Kwara	39

Source: FMWR

One Laboratory was visited by the JICA Project Team in order to know its current condition for water quality monitoring and the main findings are as follows:

Regional Laboratory of Lagos

1) The Reference Laboratory of Water Quality located at Ikeja, Lagos, have four (4) main sections: i) Physico-chemical Section; ii) Gravimetry Section; iii) Instrument Section and; iv) Microbiology Section.
2) Officers of the Laboratory takes water sample, make in situ-examination for some parameters and transport it to the Laboratory for conducting other detailed analysis. Samples are taken from

surface river and groundwater from boreholes. Not sediment analysis from river bottom is carried out.

3) All data are stored in excel files and sent to the Federal MWR.
4) At present, the following parameters are analyzed: all parameters of the Standard NIS 554, 2007, on Drinking Water Quality, except Al, As, Ba, Cd, Cyanide, H2S, Pb, Hg, Ni, Zn, Detergent, Mineral oil, Pesticides, phenols, Polyaromatic hydrocarbons, Total organic carbon or oxidisability, Trihalom-ethanes, total 2,4,6-trichlorophenol, Radionuclides, and Clostridium perfringens spore.
5) Main problem that face the Laboratory is the lack of maintenance of equipment due to financial constraints. Due to this fact, presently many parameters cannot be analyzed. Even essential field equipment to measure pH and DO are broken.
6) The staff is composed by 3 chemists, 2 microbiologists, 5 administrations and 1 manager, total 11 employees. They asked for two (2) technicians more for the instrument section.
7) The JICA Project Team noted that they need to improve their equipment capability to analyze all parameters required by the standard NIS 554, 2007.
8) The Laboratory staff informed that sometimes iron, copper, etc. overpass the standard, which could be attributable to type of natural minerals found in the area.

Water Quality Laboratory operated by RUWASA/RUWESA

In Ogun-Oshun Basin exists organizations named Rural Water and Sanitation Agency (RUWASA) in Oyo State and Rural Water and Environmental Sanitation Agency (RUWESA) in Osun State. These two organizations have their own Water Quality Laboratory to carry out basic analyze of water from boreholes in the rural area.

Among the main problems facing these two Laboratories are: Lack of reagent, lack of maintenance of equipment or broken equipment, lack of training, lack of funds to operate the Laboratory.

Water Quality Laboratory operated by Water Corporations

In Ogun-Oshun Basin all Water Corporations have their own Water Quality Laboratory to check the potability of treated water and the water quality of the raw water source.

Water Quality Laboratory operated by Central Laboratory in Oyo State

In Oyo State, besides the functional Laboratory operated by Water Corporation, they have the Central Laboratory where can be analyzed more parameters according to the necessity.

Water Quality Laboratory operated by LASEPA

In Lagos State, LASEPA takes water samples from public taps, Lagos State Water Works, packaged water facilities, private boreholes and wells, to analyze portability.

S8.1.3 Problems and Issues on Water Environment Management

Water Environment Management is very poor in Ogun-Oshun Basin permitting an increasing degradation of water resources. Many rivers in Ogun-Oshun Basin especially their Sections passing through local urban centers, like the capital centers of the States, show the tendency of water pollution. Such pollution is caused by wastewater generated in urban and industrial activities, though the degree of pollution varies depending on the locations.

The JICA team through field investigation, stakeholder workshops, review of existing information and interview to relevant officers of various relevant agencies has identified the main problems and issues in the sector of water environment management in the Ogun-Oshun Basin. In addition to this, the water related recreational areas were studied in order to know their current conditions and to propose recommendations for their improvement. Based on these findings recommendations were proposed.

The identified important problems/issues and proposed recommendations are presented in the bellow table.

Table S8.1-14 Important Problems/Issues and Recommendations on Water Environment Management

Important Issues	Recommendations
Drinking Water Quality Monitoring	
Drinking Water Quality Monitoring is very poor in Ogun-Oshun Basin and this present a risk for the public health of the population. Main constraints of the water quality monitoring system are financial, technical capability, lack of equipment and sufficient human power. Due to this fact, the Laboratories cannot cover the operational areas efficiently and the number of samples analyzed is very poor and not adequate for realistic water quality assessment.	A joint-work agreement among stakeholders is proposed to be implemented for improving the existing Drinking Water Quality Monitoring in Ogun-Oshun Basin as follows: For Lagos State: agreement shall be made between FMWR Water Laboratory at Lagos, Lagos Water Corporation and LASEPA for the joint elaboration and implementation of a monitoring program to cover the whole State of Lagos For Oyo State: agreement shall be made between FMWR Water Laboratory at Lagos, Oyo Water Corporation, Central Laboratory and RUWASA for the joint elaboration and implementation of a monitoring program to cover the whole State of Oyo For Ogun State: agreement shall be made between FMWR Water Laboratory at Lagos and Ogun Water Corporation for the joint elaboration and implementation of a monitoring program to cover the whole State of Ogun. For Osun State: agreement shall be made between FMWR Water Laboratory at Akure, Osun Water Corporation and RUWESA for the joint elaboration and implementation of a monitoring program to cover the whole State of Osun. These agreements must include the provision of funds for operation and maintenance of equipment and the training upgrading of the involved personnel. Through these agreements is expected a synergy among stakeholders for a better use of the available financial, human and technical resources.
Water Pollution Control	
Low level of compliance by industrialists for wastewater discharging into water bodies	Awareness creation of industrialist and the establishment of financial mechanism for the installation of wastewater treatment facilities in the industries
There is a poor enforcement of Laws, regulations and standards to control industrial wastewater pollution	A memorandum of understanding should be promoted among FMWR, FME, State Ministries of Environment, LASEPA and OGEPA to prioritize programs for water pollution control of water sources used as domestic source. These programs must include the provision of funds for operation and maintenance of equipment and the training upgrading of the involved personnel.
Lack of awareness of the people on environmental issues, therefore not collaboration from them to avoid water pollution from solid waste and domestic wastewater	Environmental education and awareness campaign on water resources protection from pollution must be implemented for primary & secondary schools and for the general public.
In many urban cities of Ogun-Oshun Basin can be observed illegal disposal of solid waste generally in open spaces, along the roads or in watercourses polluting the environment.	Solid waste management needs to be improved in the Ogun-Oshun Basin to avoid pollution of watercourses or water sources.
Water Environment Conservation	
Management Plans of forest are not implemented and as result there are uncontrolled clearing of forest in many parts of Ogun-Oshun Basin and as results erosion increase affecting water courses	The management plans of forest should be put in place to achieve a sustainable production, protection and conservation of forest resources.
Currently many rivers and dams in Ogun-Oshun Basin are affected negatively by aquatic weeds and plants	In the period 2007-2011, the FME implemented a project for aquatic weeds and plants control in 25 states. A second phase of this project is now under preparation. It is recommended that FMWR takes part actively of the above project to promote a sustainable control of this nuisance in important surface water of Ogun-Oshun Basin.
Nigeria is blessed with many water recreational areas that can be exploited as tourism attractions in the world of tourist industry. Besides, the cultural celebrations by its population composed by diverse cultural groups could represent the best destinations for tourist lovers of the history and culture. However, these potentials of tourism need to be developed adequately to promote the sector in the country	The promotion of tourism in Ogun-Oshun Basin is indispensable for creating jobs and income generation. The best point to start, is implementing the existing Master Plan for the Tourism Sector. The existence of water related recreation places should be considered when water resources development project is proposed. The management of these places should also be considered as a part of watershed conservation activities

Annex S8

Annex S8.1-1 Forest Reserves in Four States of Ogun-Oshun Basin

Nº	Name	HA	State	Latitude	Northing		Longitude	Easting	
					Degrees	Minutes		Degrees	Minutes
1	Ogun Forest Reserve	6	Lagos	6.62568850	6	37.541310	3.4386865	3	26.32119
2	Ogun River	6	Lagos	6.62568850	6	37.541310	3.4386865	3	26.32119
3	Ilaro Forest Reserve (4,608 has; Yewa South L.G.A)*1	6	Ogun	6.78323150	6	46.993890	3.062502	3	3.75012
4	Omo Forest Reserve (136,806 has; Ijebu and Etemi Area)*2	6	Ogun	6.84696150	6	50.817690	4.3714335	4	22.28601
5	Ohumbe Forest Reserve (4,608 has; Yewa North L.G.A)*3	6	Ogun	6.91666700	6	55.000020	2.783333	2	46.99998
6	Eggua Forest Reserve (4,147 has; Yewa North L.G.A)*4	6	Ogun	6.96666700	6	58.000020	2.9	2	54
7	Arakanga Forest Preserve (239 has; Odeda L.G.A)*5	6	Ogun	7.18333300	7	10.999980	3.35	3	21
8	Olokemeji Forest Reserve (5,888 has; Odeda L.G.A)*6	6	Ogun	7.41666700	7	25.000020	3.533333	3	31.99998
9	Aworo (21,299 has; Yewa North L.G.A)*7	6	Ogun						
10	Edun Stream (Ilaro) (79 has; Yewa South L.G.A)*8	6	Ogun						
11	Imeko Forest Reserve (95,488 has; Imeko/Afon L.G.A)*9	6	Ogun						
12	Shasha Forest Reserve	6	Osun	7.08333300	7	4.999980	4.5	4	30
13	Ago Owu Forest Reserve	6	Osun	7.13333300	7	7.999980	4.216667	4	13.00002
14	Ibadan Native Area	6	Osun	7.13333300	7	7.999980	4.216667	4	13.00002
15	Ife Forest Reserve	6	Osun	7.20000000	7	12.000000	4.416667	4	25.00002
16	Ikeji Forest Reserve	6	Osun	7.40000000	7	24.000000	4.933333	4	55.99998
17	Ikeji-Ipetu	6	Osun	7.40000000	7	24.000000	4.933333	4	55.99998
18	Ilesha Native Area	6	Osun	7.40000000	7	24.000000	4.933333	4	55.99998
19	Ede Forest Reserve	6	Osun	7.70000000	7	42.000000	4.416667	4	25.00002
20	Ede Plantation	6	Osun	7.70000000	7	42.000000	4.416667	4	25.00002
21	Ibadan Native Area	6	Osun	7.70000000	7	42.000000	4.416667	4	25.00002
22	Oba Hill Forest Reserve	6	Osun	7.75000000	7	45.000000	4.116667	4	7.00002
23	Oba Hills	6	Osun	7.75000000	7	45.000000	4.116667	4	7.00002
24	Ejigbo Forest Reserve	6	Osun	7.86666700	7	52.000020	4.316667	4	19.00002
25	Gambari Forest Reserve	6	Oyo	7.13333300	7	7.999980	3.833333	3	49.99998
26	Ibadan Native Area	6	Oyo	7.46666700	7	28.000020	3.65	3	39
27	Osho Forest Reserve	6	Oyo	7.46666700	7	28.000020	3.65	3	39
28	Eruwa Forest Reserve	6	Oyo	7.48333300	7	28.999980	3.383333	3	22.99998
29	Eruwa Forest Reserve	6	Oyo	7.53333300	7	31.999980	3.45	3	27
30	Otuma Forest Reserve	6	Oyo	7.56666700	7	34.000020	3.433333	3	25.99998
31	Ijaiye Forest Reserve	6	Oyo	7.66666700	7	40.000020	3.75	3	45
32	Ibadan Native Area	6	Oyo	7.71666700	7	43.000020	3.616667	3	37.00002
33	Lanlate Forest Reserve	6	Oyo	7.71666700	7	43.000020	3.616667	3	37.00002
34	Ibadan Native Area	6	Oyo	7.75000000	7	45.000000	3.083333	3	4.99998
35	Igangan Forest Reserve	6	Oyo	7.75000000	7	45.000000	3.083333	3	4.99998
36	Odo Ogun Forest Reserve	6	Oyo	7.90000000	7	54.000000	3.733333	3	43.99998
37	Iseyin West Forest Reserve	6	Oyo	7.91666700	7	55.000020	3.583333	3	34.99998
38	Iseyin East Forest Reserve	6	Oyo	7.95000000	7	57.000000	3.666667	3	40.00002
39	Iseyin Central Forest Reserve	6	Oyo	7.98333300	7	58.999980	3.55	3	33
40	Ibadan Native Area	6	Oyo	8.03333300	8	1.999980	4.25	4	15
41	Olla Hill Forest Reserve	6	Oyo	8.03333300	8	1.999980	4.25	4	15
42	Olla Hills	6	Oyo	8.03333300	8	1.999980	4.25	4	15
43	Okpara Forest Reserve	6	Oyo	8.08333300	8	4.999980	2.833333	2	49.99998
44	Ogbomosho Forest Reserve	6	Oyo	8.08333300	8	4.999980	4.183333	4	10.99998
45	Ilorin Native Area Number 4	6	Oyo	8.08333300	8	4.999980	4.516667	4	31.00002
46	Oloyan Forest Reserve	6	Oyo	8.08333300	8	4.999980	4.516667	4	31.00002
47	Upper Ogun Forest Reserve	6	Oyo	8.50000000	8	30.000000	3.833333	3	49.99998

Source: (a) Forest reserves in Ogun State provided by Ministry of Forestry, Ogun State (b) Forest reserves in other States provided by FME, Forestry Department

Remarks

*1 Mainly of Gmelina and Teak plantation

*2 Overexploited presently

*3 Mainly of Gmelina and Teak plantation

*4 Mainly of Gmelina and Teak plantation

*5 Teak Plantation. Watershed for Abeokuta Water Supply. Good Recreation Centre in Abeokuta

*6 Overexploited presently. High forest

*7 Part allocated by the Ministry of Agriculture to farmers most of who have abandoned the place . High forest

*8 Water shed for Ilaro water scheme. Located within Ilaro Township

*9 Neglected. Encroachment from Oyo State and Benin Rep. Inaccessible for most part of the year. Was proposed as a Game Reserve but was never developed

Source: Forestry Department, FME

Annex S8.1-2 Corporate Establishments in Ogun State (1/4)

Nº	Name of Company	Product	Sector
1	Adeola Odutola Inds.Ltd	Biscuits (various types)	Food & Beverage & Technology
2	Allied Atlantic Distillers Ltd.	Extra Neutral Alcohol	
3	Consolidated Breweries Plc	Beer	
4	Cocacola Nigeria Limited	Cocacola concentrate	
5	Danico Foods Limited	Santop Orange	
6	De-united Foods Inds. Ltd	Instant noodles	
7	DIL/Maltex Nigeria Plc.	Maltex (Malt drinks)	
8	Deebee Company Ltd.	Black label. La tropicana	
9	Intercontinental Distilleries Ltd.	Gin. Rum. Fruit juice	
10	Kerlin products Nigeria Ltd.	Wines & Alcohol drinks	
11	Multi-Trex Investment Ltd.	Cocoa liquor, cocoa butter	
12	Newage Industries Ltd.	Fruit Juice	
13	Nutri-Food Nigeria Ltd.	Food items	
14	Nestle Nigeria	Maggi cubes. Nido. Nutrend. Milo	
15	National Salt Co.Plc.	Salt	
16	Nigeria Distillers Limited	Schnapps.Tonic wine. Gin	
17	Real Confectioneries Limited	Candies	
18	Sona Breweries Plc.	Beer/Maltonic	
19	Tope Foods Limited	Confectioneries Bread & Biscuits	
20	Unilever Nigeria Plc	Food Beverage	
21	Vitamalt Plc	Vitmalt Drinks	
22	Crown Beverages Limited	Table & Sachet water, Yoghurt, Juice	
23	Arulin Industries Limited	Chocolate drink, custard, cabin bis	
24	Jeruti Distillers Limited	Alcoholic & non-alcoholic beverages	
25	Pardee Foods Nigeria Limited	Parle-G gluco biscuit	
26	Acreage Integrated Foods Co. Ltd	Cocoa beverage, fruit drinks	
27	Tulip Cocoa Processing Ltd.	Cocoa butter, cake & butter	
28	Animal care service konsult Ltd.	Live chicken & eggs	
29	Glaxo-Smithkline Nigeria Plc.	Health drinks	
30	Nigerian-German Chemicals Plc	Health drinks	
31	May & Baker Nigeria Plc	Instant noodles	
32	Pharma-Deko Plc	Health drinks	
33	Tempo Food & Packaging Ltd.		
34	Beloxxi Industries Ltd	Biscuit & Sweet	
35	Daraju Industries Ltd	Detergent, Toothpaste	
36	Euro Gobal Foods & Distilleries	Seaking Schanapps, Gin, Rum	
37	Funman Nigeria Ltd	Fruit Juice	
38	Life Care ventures Ltd	Processing of raw sorghum tonmalted	
39	Kevolinks Industries Ltd.	Fruit Juice	
40	Sosaco Nigeria Ltd.	Powdered	
41	Ault & Wiborg Nigeria Limited	Printing inks	Chemical & Pharmaceutical & Textiles
42	Apex Paints Nigeria Ltd	Decorative wall paints	
43	B&D Industries Limited	Mosquito repellents coils	
44	Evans Medical Plc	Pharmaceuticals	
45	Farmex Meyer Limited	Pharmaceuticals	
46	Fine Chemical Limited	Chemical for Paints	
47	Fidson Healthcare Limited	Pharmaceuticals	
48	Glaxo-Smith Nigeria Plc.	Pharmaceuticals, health drinks	

Annex S8.1-2 Corporate Establishments in Ogun State (2/4)

49	Industrial Project International Nigeria Ltd.	Detergent	Continuation
50	Leady Pharma Industries Ltd.	Pharmaceuticals	
51	Metalcliem Limited	Emulsifying waxes, Textiles	
52	Nigerian-German Chemicals Plc	Pharmaceutical & Chemicals	
53	Metoxide Nigeria Limited	Zinc Oxide	
54	Nycil Limited	PVA emulsion, DOP driers, textile finishing,etc	
55	Nulec Industries Limited	Cassette & Magnetic Tapes	
56	Nulec Industries Limited	Cassette	
57	Olympic Inks Limited	Printing inks	
58	Organic chemicals Ind. Ltd.	Chemical	
59	Purechem Manufacturing Limited	Textile, Chemicals	
60	President Paints Nigeria Limited	Paints	
61	Pharma-Deko Plc	Pharmaceuticals/Drinks	
62	Premier Paints Plc	Decorative paints, wood	
63	Portland paints Plc.	Decorative paints merchandize	
64	Intrachem Limited	Commercial explosives	
65	Reckitt Benckiser Nigeria Limited	Cleaning/washing liquids	
66	Sren Chemicals Limited	Printing inks	
67	Sewell Pharmaceuticals Limited	Pharmaceuticals	
68	Unique Pharmaceuticals Limited	Intravenous liquid	
69	Universal Gases Limited	Industrial/Domestic Gases	
70	Unilever Nigeria Plc	Detergent, soap, foods	
71	Vego Products Limited	Cosmetics	
72	Eko Supreme Resources Limited	Detergent	
73	Ramjasam Investment Nigeria Limited	Cosmetics	
74	Watson Global Pharm. Industries Ltd.	Pharmaceutical	
75	Rotoprint Limited	Flexible packaging	
76	Reliance chemical products Ltd.	Chemicals & Chemical compound	
77	Centra product Ltd.	Pharmaceutical	
78	Classic soaps Industrial Nigeria Ltd.	Soap, detergent	
79	Classic touch cosmetics & toiletries Ltd.	Cosmetics	
80	Fatbell paints Nigeria Ltd.	Paints, chemical supply	
81	Great eagle cement Nigeria Co. Ltd.	Detergent	
82	Purechem Industries Ltd.	Chemicals adhesives & Chemicals	
83	SIL Chemicals Ltd.	Chemicals & Chemical compound	
84	West African Portland Cement Plc.	Cement	
85	Marcity Chemical Industrial Ltd.	Chemicals	
86	Adeola Odutola Inds.Ltd	Retreated tyres, rubber products	Domestic & Industrial Plastic, Rubber & Form
87	Ars Nigeria Limited	Plastics	
88	Aftrade Nigeria Limited	Plastics	
89	Abeokuta Commercial Limited	Mattresses, Cushion, Sheeting, Pillows	
90	Arco Foam Limited	Mattresses, Cushion, Sheeting, Pillows	
91	Enkay Plastics	Jerry cans, cosmetics containers	
92	Pasraj Nigeria Limited	Plastics, water pipes	
93	Geepee Industries Limited	Plastic, water container	
94	Homus Industries Limited	Plastic, Nylon	
95	Lovleen Toys Industries	Toys	
96	Lombardy Plastics Limited	Plastics & water pipes	
97	Lotus Plastics Limited	Plastics	

Annex S8.1-2 Corporate Establishments in Ogun State (3/4)

98	Mercury Mills Limited	Plastics & Nylon	Continuation
99	Nulec Plastics Limited	Plastics	
100	Salient Rubber Products Limited	Rubber parts	
101	Shongai Packaging Industries Ltd.	Plastics packaging	
102	Veepee Industries Limited	Nylon/plastics&flexible packaging materials	
103	Worldcool Nigeria Limited	Plastics bowl	
104	Whip International Ltd.	Rubber slipper, rain boot	
105	Sonar Investment Ltd.	Plastics water storage tank	
106	Sky Platics Industries Ltd.	Plastics, Nylon, PVC pipes	
107	Alucan packaging Ltd.	Pieces of aluminium beverage cans	Basic Metal, Iron & Steel & Fabrication Metal Products
108	GZ Industries Ltd.	Aluminium cans	
109	Metafrique Ltd.	Steel, Ingot	
110	Sparkwest steel industries Ltd.	Galvanized steel products, angles, etc.	
111	Midland Rolling Mills Ltd.	Cold rooled steel coils/sheet	
112	West African Aluminium Prod. Ltd.	Aluminium profiles	
113	Avon Crowncaps & container Nigeria Plc.	Crowncaps, metal container, etc.	
114	Allseasons Industries Limited	Roofing sheet	
115	Architectural products Ltd.	Louvre frames, horrowware	
116	Aluminium Rolling Mills Ltd.	Aluminium, roofing sheet	
117	Golden metal recycling Ltd.	Aluminium cast & metal products	
118	Federated steel mills ltd.	Reinforcing steel rods, angle rods	
119	Frigoglass Industries Ltd.	Crowncaps, metal container, etc.	
120	Homan Industries Ltd.	Steel pipes, galvanized pipes	
121	Kolorkote Nigeria Ltd.	Painted Aluminum Sheet & Steel Straps	
122	MINL Ltd.	Aluminum rolled embossed coils, etc.	
123	Monarch steel Mills Ltd.	Metal ingot, non-ferrous metal alloys, etc.	
124	Midland Galvanizing Products Ltd.	Roofing sheet	
125	Nigerian Foundries Ltd.	Heat resistance alloyed castings, etc.	
126	Orzburn Aluminum Ltd.	Corrugated aluminum roofing sheet	
127	Phoenix steel mills Ltd.	Steel billets, iron rods, angles & channels	
128	Precise Savior Ltd.	Copper, Aluminun, Lead, Zinc&Metal ingots	
129	Comtek Nigeria Limited	Lead ingots	
130	West African Building Material Ltd.	Galvanized iron sheet and steel pipes	
131	Sun & Sand industries Ltd.	Metal ingots & alloys	
132	Geotess Nigeria Ltd.	Copper, Brass & Aluminun bars&ingots	
133	Metec West African Nigeria Ltd.	Sacrificial anodes & corrosion services	
134	Dolphin steels Nigeria Ltd.	Steel ingot, iron rod	
135	Sun Metal Industries Ltd.	Iron steel rods	
136	Lucky Metal industries Ltd.	Aluminun, steel and alloys	
137	Aarti steel Nigeria Ltd.	Galvanized steel, plain sheet, iron roofing	
138	Eagle Package Printing Ltd.	Printing of light packages & labels	Pulp, paper&paper products Printing & Publishing
139	Don Philips Industries Ltd.	Baby Diapers	
140	adosteno Industries Ltd.	Toilet tissue	
141	Fidson Products Ltd.	Baby Diapers & toilet roll	
142	Yanuo Industry Nigeria Ltd.	Traveling bags and bags	
143	Vidax International Ltd.	Tissue paper	
144	Afriprint technologies Ltd.	Thermal paper receipt roll, lottery coupon	
145	Poly products Limited	Paper boxes, carttons	
146	Veevee Industries Limited	Corrugated cartons	

Annex S8.1-2 Corporate Establishments in Ogun State (4/4)

147	Takol Limited	Flexible packaging	Continuation
148	Airflow engineering works Ltd.	Air conditioning	Electrical &
149	Cometstar Manufacturing Co. Ltd.	Aluminun & electric cables	Electronic
150	A&Y Enterprises Ltd.	Particles Board	Wood &
151	Chitra knitting &Manufacturing Ltd.	Leather for furniture, knitting & garment	Wood Products
152	Omowood Industries Ltd.	Treated woods	Furniture
153	Bisrod furniture Co. Ltd	Furniture	
154	Beta Glass Plc	Hollow wares, minerals	Non-metallic
155	Imperial Minerals Product Ltd.	Asbestos flat sheet	Minerals
156	Electrode Nigeria Ltd.	ARC-welding electrode	Products
157	Nispo porcelain Company Ltd.	Granites, vitrified tiles, etc.	
158	Techno Mech. Nigeria Ltd.	Soundproof cabins	
159	Blackstone crushing Co. Ltd.	Binding wire & wire mesh	
160	Industrial Minerals Products Ltd.	Asbestos flat sheet	
161	Prestrest Limited	Poles	
162	Rockwool Products Nigeria Ltd.	Insulating materials	
163	Truluck International Nigeria Ltd.	Quarry operation	
164	Nanfang Motors Nigeria Ltd.	Motorcycles & generators	Motor vehicle &
165	Honda Manufacturing Nigeria Ltd.	Motorcycles & generators	Miscellaneous
166	V.I.P.Merchandize Ent.Ltd.	Motorcycles	Assembly
167	Grand Nikko Company Ltd.	Motorcycles	
168	Trinidan Limited	Tricycle vehicle	
169	Action power company Limited	Compressed Natural Gas	
170	Tower Power Utility Ltd.	Energy generation	

Source: Manufacturers Association of Nigeria-Ogun State Branch

Supplement 10.1 Evaluation from Social and Environmental Aspects

S10.1.1 Objectives of Evaluation from Social and Environmental Aspects

The principal objective of this evaluation is to examine the current condition of the natural and social environment and how the proposed projects in the CMP may influence on them. If negative impacts are forecasted by the project's implementation, then, necessary mitigation measures will be examined.

S10.1.2 Methodology on Evaluation of Environmental and Social Aspects

The projects proposed in the CMP shall be evaluated through the execution of the Initial Environmental Examination (IEE). The term of reference for IEE is presented in Annex S10.1-1.

S10.1.3 Evaluation through IEE

(1) Legal and Institutional Aspects on Environment and Social Considerations

(1-1) Laws and Legislations related to Environment

The laws and legislations related to Environment in Nigeria are summarized as follows.

(a) Law and Legislation for Environment Impact Assessment (EIA)

1. Environment Impact Assessment, Decree 86, 1992
   This Decree makes EIA mandatory for any major development project likely to have adverse impacts on the environment.

2. EIA Procedural Guideline, 1992
   It indicates the steps to be followed in the EIA process from the project conception to commissioning. It assists to project proponents in conforming to the requirements of Decree 86, 1992 and to obtain certification from the Federal Government of Nigeria through the FME.

3. EIA Sectorial Guidelines for Agriculture and Rural Development, 1995, FEPA
   These guidelines assist project proponents in conducting detailed environmental assessment of projects and in the preparation of EIA reports for agricultural and rural development projects which includes among others Dams and Reservoirs, Irrigation and Drainage, etc.

(b) Law and Legislation related to Environmental Management

1. The Constitution of the Federal Republic of Nigeria
   It recognizes the importance of improving and protecting the environment and makes provision for it.

2. Nigeria Water Resources Decree 101, 1993
   By this Decree, the FG has the right to use and control all surface and groundwater and of all water in any water course affecting more than one State.

3. Federal Environmental Protection Agency (FEPA) Act, 1988 (Decree Nº 58)
   FEPA was created by this Decree as a parasternal of the Federal Ministry of Works and Housing

4. FEPA (amendment) Decree Nº 59 of 1992
   By this Decree, FEPA was strengthened and transferred to the Presidency and expanded its mandate to include the conservation of biodiversity and sustainable use of Nigeria's natural resources as well as the preparation of a comprehensive national policy for the protection of the environment and conservation of natural resources, including procedure for environmental impact assessment for all development projects.

5. National Environmental Standard and Regulation Enforcement Agency (NESREA) Act, 2007
   By this Act, NERSREA was established as a parasternal of the Federal Ministry of Environment, Housing and Urban Development. By the NESREA Act, the FEPA Act has been repealed.

6. The Nigerian Minerals and Mining Act, 2007
   This gives provisions for regulating the exploration and exploitation of solid materials in Nigeria. The Act also gives provision on environmental management aspects including prohibition of pollution of watercourses.

7. Nigeria Industrial Standards 554, 2007
   Provide standard for drinking water quality.

8. National Effluent Limitation regulation, S.I.8 of 1991, FEPA
   This makes it mandatory for industrial facilities to install anti-pollution equipment, make provision for effluent treatment and prescribes maximum limits for effluent discharging.

9. Pollution Abatement in Industries and Facilities Generating Wastes Regulations, S.I.9 of 1991, FEPA
   Among other thing, this Regulation imposes restrictions on the release of toxic substances and stipulates requirements for monitoring the pollution and gives directions on how to proceed before unusual or accidental discharges

10. National Environmental Protection Management of Solid and Hazardous Wastes Regulations 1991, FEPA
   Give provisions for the appropriate management of solid and hazardous wastes not to pollute the environment with special emphasis to groundwater protection.

(c) Environmental Regulations

1. National Environmental (Permitting and Licensing Systems) Regulations, 2009, NESREA
   The purpose of the Regulation is among others, to enable consistent application of environmental laws, regulations and standards in all sectors of the economy and geographical regions.

2. National Environmental (Sanitation and Waste Control) Regulations, 2009, NESREA
   This Regulation is to minimize pollution through sustainable and environmental friendly practices in environmental sanitation and waste management.

3. National Environmental (Chemical, Pharmaceutical, Soap and Detergent Manufacturing Industries) Regulations, 2009, NESREA

4. National Environmental (Food, Beverages and Tobacco Sector) Regulations, 2009, NESREA

5. National Environmental (Textile, Wearing Apparel, Leather and Footwear Industry) Regulations, 2009, NESREA
   These Regulations are to prevent and minimize pollution from all operations and ancillary activities of the Sector to the environment. It also provides standards for effluents, air pollutants, soil quality and noise.

6. National Environmental (Mining and Processing of Coal, Ores and Industrial Minerals) Regulations, 2009, NESREA
   The purpose of this Regulation is to minimize pollution from the Sector. It provides standards for effluents, air pollutants and noise.

7. National Environmental (Noise Standard and Control) Regulations, 2009, NESREA
   This Regulation is to ensure maintenance of a healthy environment through limiting noise levels.

8. National Environmental (Ozone Layer Protection) Regulations, 2009, NESREA
   By this Regulation is controlled the management of ozone-depleting substances.

9. National Environmental (Access to Genetic Resources and Benefit Sharing) Regulations, 2009, NESREA
   The Regulation intends to prevent and control the depletion of the biodiversity of Nigeria.

10. The National Environmental (Wetlands, River Banks and Lake Shores Protection) Regulations, 2009, NESREA
   This Regulation is for conservation and wise use of wetlands and for sustainable utilization and conservation of resources on river banks and lake shores.

11. The National Environmental (Watershed, Mountainous, Hilly and Catchment Areas) Regulations, 2009, NESREA
   This regulation gives provisions for the well use and conservation of watershed, mountainous, hilly and catchment areas.

12. National Environmental (Coastal and Marine Area Protection) Regulations, 2011, NESREA

This Regulation intent to preserve the natural ecological conditions of the estuarine system, the barrier islands system and the beaches through a sustainable use of resources and control of activities that could degrade the coastal and marine environment.

13. National Environmental (Protection of Endangered Species in International Trade) Regulations, 2011, NESREA

This Regulation is to controls the international trade of wildlife species listed in the Convention on International Trade in Endangered Species (CITES).

14. National Environmental (Soil Erosion and Flood Control) Regulations, 2011, NESREA

It gives standards and procedures to abate soil erosion and the sustainable protection and enhancement of the ecological integrity of flood plains as well as vulnerable lands and waters from significant adverse effects of environmental degradation resulting from soil erosion, flooding and deposition of sediments.

15. National Environmental (Desertification Control and Drought Mitigation) Regulations, 2011, NESREA

It gives regulatory framework for the sustainable use of all areas already affected by desertification and the protection of vulnerable lands.

16. National Environmental (Surface and Groundwater Quality Control) Regulation, 2011 by NESREA

This Regulation intent to restore, enhance and preserve the water quality of surface waters and its existing water uses by regulating pollutants discharges. Also to protect groundwater sources by regulating the discharge and underground injection of hazardous wastes, fluids used for extraction of minerals, fossil fuels energy, etc.

17. National Environmental (Control of Bush, Forest Fire and Open Burning) Regulations, 2011, NESREA

Its main objective is to prevent and minimize the destruction of ecosystem through fire outbreak and burning of any material that may affect the health of the ecosystem due to the emission of hazardous air pollutants.

18. National Environmental (Standards for Telecommunications and Broadcast Facilities) Regulations, 2011, NESREA

Main objective of this regulation is to protect the environment and human health, ensure safety and general welfare, eliminate or minimize public and private losses due to activities of the telecommunication and broadcast industry.

19. National Environmental (Domestic and Industrial Plastic, Rubber and Foam Sector) Regulations, 2011, NESREA

20. National Environmental (Base Metal, Iron and Steel Manufacturing/Recycling Industries Sector) Regulations, 2011, NESREA

21. National Environmental (Non-metallic Minerals Manufacturing Industries Sector) Regulations, 2011, NESREA

22. National Environmental (Electrical/Electronic Sector) Regulations, 2011, NESREA

These Regulations is to prevent and minimize pollution from all operations and ancillary activities of the Sector to the environment. It also provides standards for effluents and air pollutants.

23. National Environmental (Construction Sector) Regulations, 2011, NESREA

This Regulation is to prevent and minimize pollution from construction, decommissioning and demolition activities to the environment. The Regulations requires the minimization of dust and prohibition of open burning of solid waste and also provides standards for noise and illumination intensity.

24. National Environmental (Control of Vehicular Emission from Petrol and Diesel Engines) Regulations, 2011, NESREA

This Regulation is to restore, preserve and improve the quality of air. Standards are given for the protection of the air from pollutants coming from vehicular emissions.

(1-2) Environmental Impact Assessment

(a) General

The Environmental Impact Assessment in Nigeria is governed by the Decree 86 of 1992 and it is mandatory for all projects that are considered potentials to affect the Environment. Such study must include all the impacts to be generated by the implementation of the project and the analysis of alternatives as well as the mitigation proposal for the negative impacts.

An Environmental Impact Assessment Study shall include a least the following subjects as stated in the above Decree.

1. A description of the proposed activities
2. A description of the potential affected environment including specific information necessary to identify and assess the environmental effects of the proposed activities
3. A description of the practical activities, as appropriate
4. An assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and long-term effects
5. An identification and description of measures available to mitigate adverse environmental impacts of proposed activity and assessment of those measures
6. An indication of gaps in knowledge and uncertainly which may be encountered in computing the required information
7. An indication of whether the environment of any other State, Local Government Area or areas outside Nigeria is likely to be affected by the proposed activity or its alternatives
8. A brief and non technical summary of the information provided under paragraph (1) to (8).

(b) Projects covered by EIA

According to the Decree 86 of 1992 that governs EIA, exists three categories of projects as follows: (a) Category I for which EIA is mandatory; (b) Category II for which a partial EIA will be required and, (c) Category III for which EIA is not required. The lists of projects that are related to water resources development in the said Categories are presented in the bellow Tables S10.1-1, S10.1-2, and S10.1-3, respectively.

Table S10.1-1 Projects related to Water Resources Development that Falls under Category 1 Full-Scale EIA is required

I-1 Agriculture	I-1-1	Land development schemes covering an area of 500 hectares or more to bring forest into agricultural production
	I-1-2	Agricultural programmes necessitating the resettlement of 100 families or more.
	I-1-3	Development of agricultural estates covering an area of 500 hectares or more involving changes in type of agricultural
I-2 Drainage and Irrigation	I-2-1	Construction of dams and man-made lakes and artificial enlargement of lakes with surface areas of 200 hectares or more
	I-2-2	Drainage of wetland, wild-life habitat or of virgin forest covering an area of 100 hectares or more.
	I-2-3	Irrigation schemes covering an area of 5,000 hectares or more.
I-3 Fishery	I-3-1	Construction of fishing harbours
	I-3-2	Harbour expansion involving an increase of 50 per cent or more in fish landing capacity per annum
	I-3-3	Land based aquaculture projects accompanied by clearing of mangrove swamp forests covering an area of 50 hectares or more
I-4 Forestry	I-4-1	Conversion of hill forest land to other land use covering an area of 50 hectares or more
	I-4-2	Logging or conversion of forest land to other land use within the catchment area of reservoirs used for municipal water supply, irrigation or hydro power generation or in areas adjacent to state and national parks and national marine parks
	I-4-3	Logging covering an area of 500 hectares or more.
	I-4-4	Conversion of mangrove swamps for industrial, housing or agricultural use covering an area of 50 hectares or more
	I-4-5	Clearing of mangrove swamps on islands adjacent to national marine parks
I-5 Mining	I-5-1	Sand dredging involving an area of 50 hectares or more
I-6 Power generation	I-6-1	Dams and hydroelectric power schemes with either or both of the following: (a) dams over 15 metres high and ancillary structures covering a total area in excess of 40 hectares; (b) reservoirs with a surface area in excess of 400 hectares
I-7 Waste Treatment and Disposal	I-7-1	Municipal sewage: (a) construction of wastewater treatment plant; (b) construction of marine outfall
I-8 Water Supply	I-8-1	Construction of dams, impounding reservoir with a surface area of 200 hectares or more.
	I-8-2	Groundwater development for industrial, agricultural or urban water supply of greater than 4,500 cubic metres per day

Table S10.1-2 Projects related to Water Resources Development that Falls under Category 2 Partial EIA will be required*

II-1 Agriculture and Rural Development	II-1-1	Any reforestation/afforestation project
	II-1-2	Smale scale irrigation and drainage
	II-1-3	Smale scale aquaculture/mariculture
II-2 Infrastructure	II-1-1	Mini hydropower development
	II-1-2	Rural water supply and sanitation
	II-1-3	Any form of quarrying or mining

*If the project is located in or close to Environmental Sensitive Areas a full-scale EIA will be required

Table S10.1-3 Projects related to Water Resources Development that Falls under Category 3 EIA is not required*

III-1 Institutional Development
III-2 Health programs
III-3 Educational Programs
III-4 Environmental Awareness

*If the project involves physical interventions in the environment then the project is in Category II
Note: The Agency will issue the Environmental Impact Statement for Projects in Category III which are expected to have essentially beneficial impacts on the environment

(c) Sensitive Areas in Nigeria

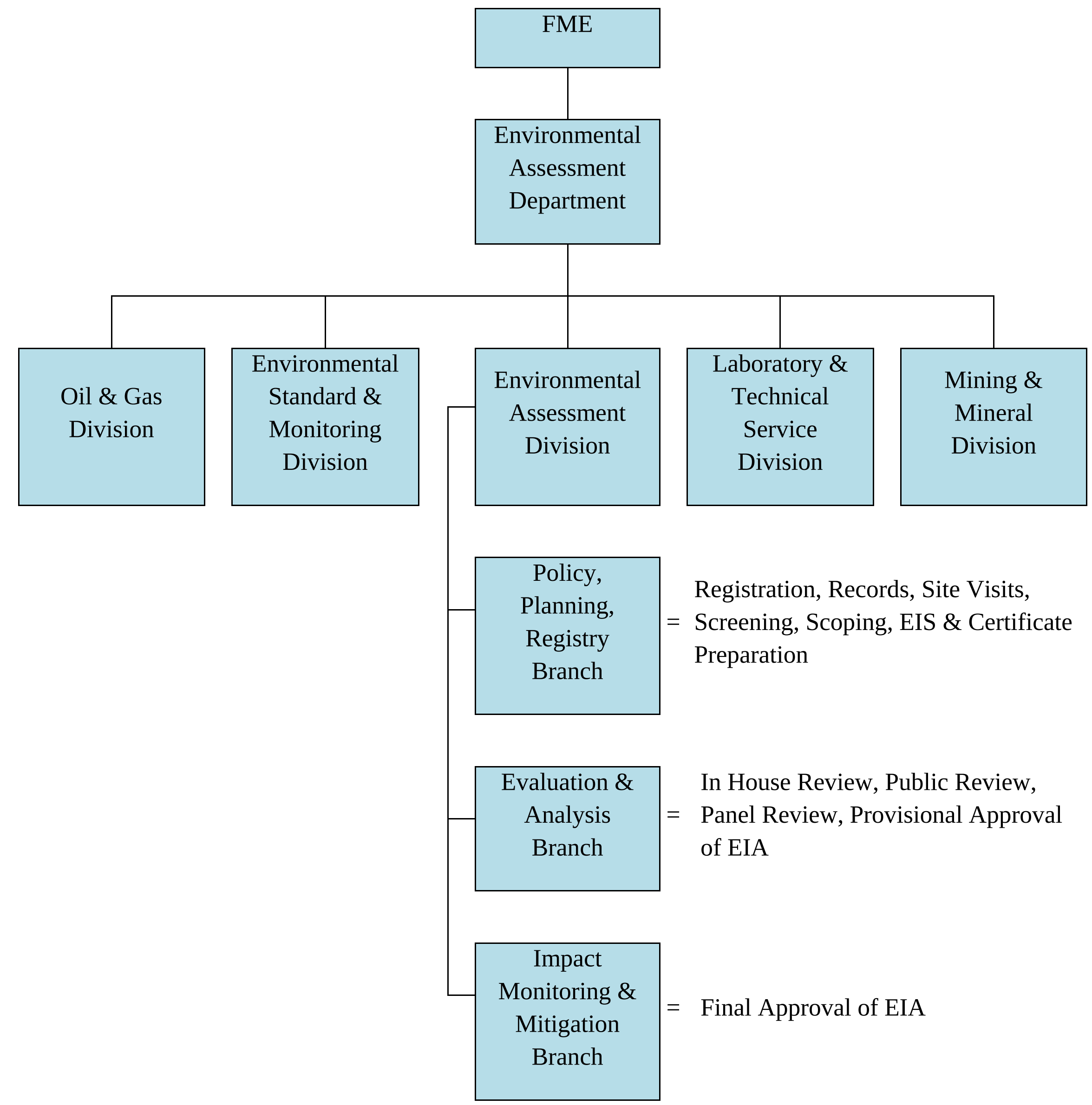
The same Decree 86, 1992, establishes the list of Sensitive Areas in Nigeria as shown in the bellow Table S10.1-4.

Table S10.1-4 Environmental Sensitive Areas in Nigeria

S-1 Coral reefs
S-2 Mangrove swamps
S-3 Small islands
S-4 Tropical rainforest
S-5 Areas with erosion prone soils
S-6 Montain slopes
S-7 Areas prone to desertification (and semi arid zones)
S-8 Natural conservation areas
S-9 Wetland of national or international importance
S-10 Areas with harbour protected and or endangered species
S-11 Areas of unique scenary
S-12 Areas of particular scientific interest
S-13 Areas of history or archeological interest
S-14 Areas of importance to threatened ethnic groups

(d) Outline of the Organization in charge of EIA

The Environmental Assessment Department through its Environmental Impact Assessment Division is in charge of EIA studies in Nigeria. Figure S10.1-1 shows the flowchart of the Organization and the main functions of EIA Division.



Source: FME-EIA

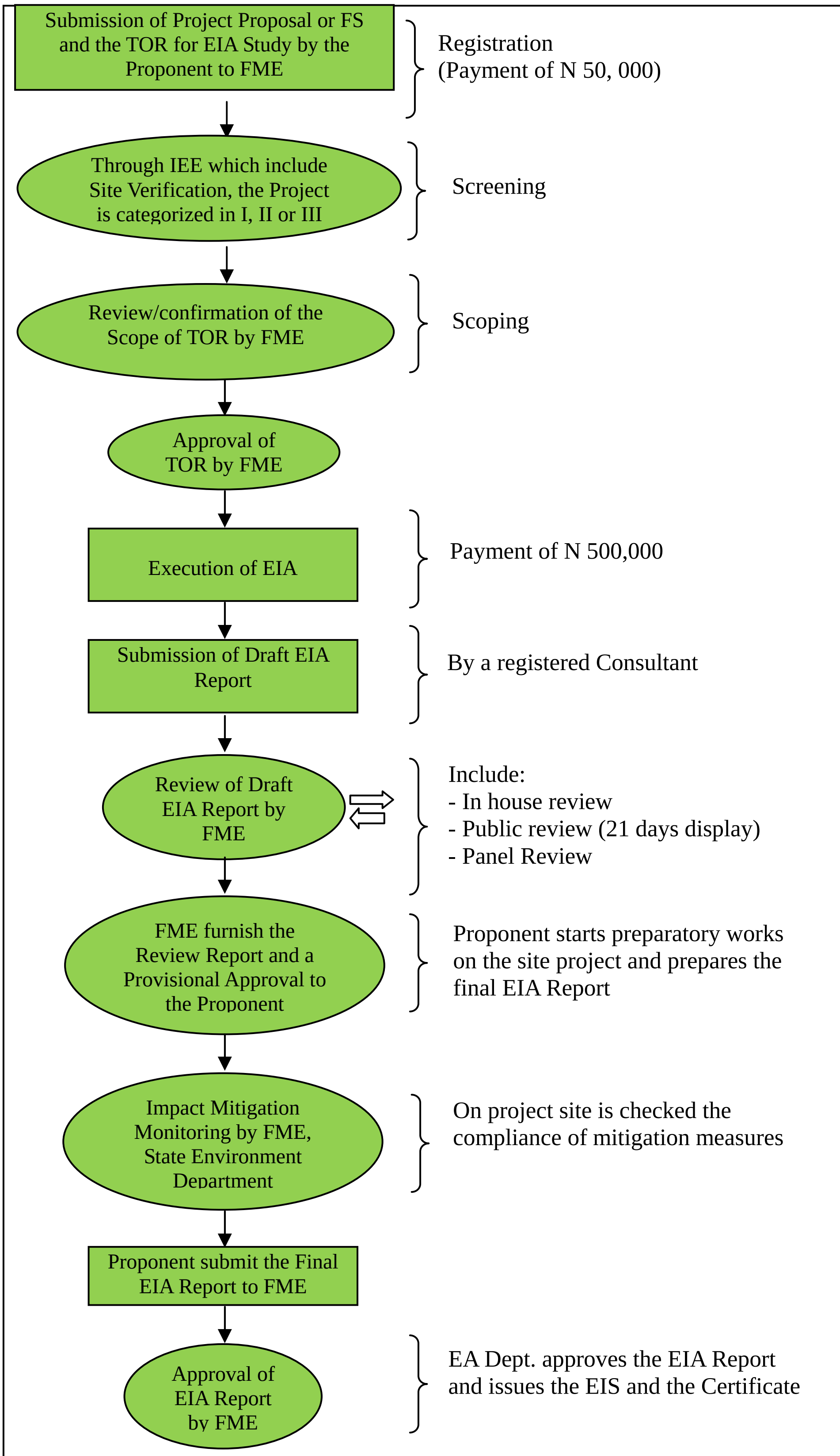
Figure S10.1-1 Organizational Structure for EIA Study

(e) Procedure for EIA

Figure S10.1-2 shows the EIA process flowchart in Nigeria. The current procedure for conducting EIA in Nigeria starts with the submission of the Project Proposal or the Feasibility Study conjointly with the Terms of Reference (TOR) for EIA Study to the FME. In this step, the proponent pays the sum of 50,000 Naira and gets the Registry of the Project. The Terms of Reference must be prepared by a registered consultant before the EA Department of FME.

Then, officers of EA Department make an Initial Environmental Evaluation through visiting the project area verifying the present condition which will serve as a base to categorize the proposed project (screening process).

After visiting the site, the TOR is reviewed or confirmed and in this last case receive the approval by the EA Department. With this approval, the registered Consultant may start the implementation of the EIA study.



Source：FME-EIA

Figure S10.1-2 Current EIA Process Flowchart

When the draft EIA report is completed, the proponent must submit it to EA Department for review and must pay the sum of 500,000 Naira. The review is made through the following mechanism:

In-house Review

Report analysis by officers of EA Department only

Public Review

In this case, the public is advertised through three newspaper (at national and State/local level) to come to a certain public institution in order to review the report for a period of 21 days; the advertisement cost is paid by the proponent of the project.

Panel Review

Inviting independent panellist for 2 days review in the State Capital where the project is proposed to be implemented, being the first day used for site observation and the second day for meeting; the panellist shall be integrated by various experts such as hydrologist, hydro-biologist, geologist, socio-economy, and representatives from local government council and from the FME. The logistic for holding this panel review is paid by the proponent of the project.

The Review Report then is furnished by EA Department conjointly with a Six Months Provisional Approval to the proponent. The Provisional Approval allows the proponent to start preparatory works in the site while preparing the EIA Final Report which must incorporate all subjects appointed in the Review Report. In this interim, the officers of EA Department and State Environment will make a site visit to check the compliance of mitigation measures for predicted impacts.

After the submission of the EIA Final Report by the proponent and the verification of compliance of mitigation measures during preparatory works at the site, the EA Department shall make its final approval by issuing the Environmental Impact Statement and the Certificate in which is stated that an environmental assessment of a project has been completed.

After three years of the project implementation, the EA Department will make the Environmental auditing of the project to assess the positive and negative impacts of the project.

As for the timing frame for conducting EIA studies on the sector of water resource development, the tentative schedule is shown in Table S10.1-5.

Table S10.1-5 Tentative Schedules for EIA Execution on Water Resources Development

Activities	Month / Week	1	2	3	4	5	6	7	8
		1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
1	Submission of Project Proposal or FS and the TOR for EIA Study by the Proponent to FME- Registration	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
2	Screening	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
3	Review/confirmation of the Scope of TOR by FME	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
4	Approval of TOR by FME	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
5	Execution of EIA including Public Hearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
6	Submission of Draft EIA Report to FME	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
7	Review of Draft EIA Report by FME	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
7.1	In house review	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
7.2	Public Review (21 days display)	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
7.3	Panel Review	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
8	FME furnish the Review Report and a Provisional Approval to the Proponent	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
9	Impact mitigation monitoring by FME, State Environment Dept.	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
10	Proponent submit the Final EIA Report to FME	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
11	Approval of Final EIA Report by FME (Include Issuance of EIS and Certificate)	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Source: FME-EIA

(2) Natural and Social-Environmental Condition of the Study Area

The Study Area is composed of Lagos, Ogun, Oyo and Osun States that falls under the Ogun-Oshun Basin in the HA-6. An initial assessment of the current state of the environment in the Study Area considering relevant environmental components to this CMP study was made and presented in the bellow table.

Table S10.1-6 Initial Assessment of the Current State of Environment in the Study Area

Component	Assessment
Surface water quality	In the four States (Lagos, Ogun, Osun and Oyo), the water quality of rivers is good both in the wet season and dry season judging from the fact that the concentrations of BOD and DO are maintained within the standards to support the aquatic living environment Presence of heavy metals had been detected in some rivers that call to a detailed further water monitoring research. The tendency of surface water quality is of good to moderate quality near its source and is degraded when passing through urban centers, industrial and agricultural areas, in general. Aquatic weeds affects negatively Ogun river, Yewa river, Ojumo Dam in Lagos, Ogun and Oyo States. During a field observation conducted on wet season (July 2013), it was noted high turbidity on the Ogun River, water source for drinking water supply. This high turbidity, which maximum value could reach 250 NTU according to operators of Ogun Water Corporation, demands high consumption of chemicals for flocculation.
Groundwater quality	Generally is good except for the presence of Arsenic, Iron, Manganese and Fluorine in some localities and pollution introduced by human activities like application of agrochemicals in farming and oil spillage
Drinking water quality	A Study was conducted in 2011 by FMWR through a local contractor on water sources quality nation-wide. Groundwaters used for drinking were analyzed in the 4 States of HA-6 and a preliminary evaluation was made in terms of its compliance with the Nigerian Drinking Water Quality Standard. As for E. coli, high compliance of the samples were obtained in the four States, however, some elements are of concern, especially heavy metals that were found in all samples. Since the number of samplings were limited, it is necessary to continue the survey and accumulate more water quality data to assess scientifically the origin of these metals and to propose alternatives for those confirmed water sources with elements that are beyond the standard.
Water Pollution	In the Study Area the treatment of wastewater is poorly managed and most of them reach watercourses without any treatment causing water pollution. Sources of pollution are from domestic, industrial, agricultural lands, mining activities and oil spillage. A study conducted for Lagos City in 2002 indicated a strong pollution of rivers with industrial wastewater discharges. During the field observation conducted by the JICA team on July, 2013, in Lagos State, it was noted that some drainage channels constructed by the State Ministry of Environment to drain storm water were converted in sewage open channel that finally discharge into the lagoons without any treatment. The fact is that Water Corporation of Lagos State is planning to use the lagoon as a water source in the future. The construction of shallow wells is popular in Nigeria in rural and urban areas. A bacteriological survey of 40 shallow wells was conducted in Abeokuta (Ogun State) by 2008 and the results showed that the wells were highly contaminated with fecal bacteria. The location of wells was close to sanitation system
Fauna and Flora	Nigeria has a very rich fauna and flora. Faunal resources include 274 species of mammals, 839 species of birds, 648 species of fish, etc. Floral resources include 7,895 species of plants. However, new research must be conducted to update the above figures.
Vegetation	Three categories of vegetation can be found in the Study Area: the swamps and other coastal vegetation, tropical rainforests and Guinea savanna.
Protected Areas	Five categories of protected areas recognized in Nigeria as follows: national parks; game reserves; forest reserve; biosphere reserves and strict nature reserves; and special ecosystems and habitats. Although wetlands are not included in the category, in this Study it will be considered as protected area since they are home of many rich species of fauna and flora in the country. Distribution of forest reserves in the four States are: Lagos (2), Ogun (9), Osun (13), Oyo (23). Oyo State is the only State that has a National Park named Old Oyo. Illegal cutting of trees and poaching are the major threat of protected areas.
Land use Change	Yearly average loss of vegetation (tropical forest and savannahs) across the geopolitical zones presents its highest value in the south-south zone (3.63%) and its lowest value in north-east zone (2.29%). Soil erosion also faces Ogun-Oshun Basin due to the land degradation.
Socio-economy	The agriculture sector employs the majority of the people in Nigeria especially in the rural area. Unemployment rates by 2011 in the Study area are as follows: Lagos (8.3%), Ogun (22.9%), Osun (3%) and Oyo (8.9%)
Water related diseases	By 2010 from all cases reported having water related diseases, about 55% were due to diarrheal diseases which were reported in 33 States of the country. From all diarrheal diseases cases reported at national level, Lagos accounted for 6 %, Ogun and Osun for 1% and Oyo for 5%. The diarrheal diseases may be attributable to poor or inadequate sanitary facilities and hygienic practices.

(3) List of Projects and Brief Description

Projects were classified into same type of projects by Sector i.e. Sector Dams; Sector Irrigation and so on. In addition projects were classified according to its current status of implementation (e.g. ongoing project and proposed projects).

Two sceneries were developed as follows: Scenery-A in which projects were analyzed and proposed using the National Master Plan 2013 elaborated by the JICA Project Team and; Scenery-B in which projects were analyzed and proposed using water demand projections provided by the States belonging to the Study Area.

(3-1) Scenario-A

The list of projects is composed of four (4) sectors including 8 ongoing and 165 proposed projects as listed below. The complete list of the projects with a brief description of the main activities is given in Annex S10.1-2 for Dam Sector, Annex S10.1-3 for Municipal Water Supply Sector; Annex S10.1-4 for Irrigation/Drainage Sector and; S10.1-5 for Sanitation Sector.

Table S10.1-7 Number of Projects under Scenario-A

Sector	Ongoing Projects	Proposed Projects*	Total
1. Dam	4	4	8
2. Municipal Water Supply**	0	120	120
3. Irrigation and Drainage	4	10	14
4. Sanitation	0	31	31
Total	8	165	173

Note (*): Proposed by JICA Project Team based on existing proposed projects by Nigerian government as well as necessary measures for achieving the CMP in Ogun-Oshun Basin for Scenario-A, (**): The projects for groundwater development are included in the projects for Municipal Water Supply for the purpose of conducting IEE, (***): This table does not include the project on water resources management.

Source: JICA Project Team

(3-2) Scenario-B

The list of projects is composed of four (4) sectors including 8 ongoing and 167 proposed projects as listed below. The complete list of the projects with a brief description of the main activities is given in Annex S10.1-6 for Dam Sector, Annex S10.1-7 for Municipal Water Supply Sector; Annex S10.1-8 for Irrigation/Drainage Sector and; S10.1-9 for Sanitation Sector.

Table S10.1-7 Number of Projects under Scenario-B

Sector	Ongoing Projects	Proposed Projects*	Total
1. Dam	4	6	10
2. Municipal Water Supply**	0	120	120
3. Irrigation and Drainage	4	10	14
4. Sanitation	0	31	31
Total	8	167	175

Note (*): Proposed by JICA Project Team based on existing proposed projects by Nigerian government as well as necessary measures for achieving the CMP in Ogun-Oshun Basin for Scenario-B, (**): The projects for groundwater development are included in the projects for Municipal Water Supply for the purpose of conducting IEE, , (***): This table does not include the project on water resources management.

Source: JICA Project Team

It is opportune to mention here that for IEE purposes the Sector Municipal Water Supply includes projects for construction and rehabilitation of boreholes since the categorization depend on the volume to be abstracted from the water source.

(4) Categorization of Projects (Screening)

The categorization (screening) was made on on-going and proposed projects following Nigerian EIA guidelines. On-going projects were included in this CMP study since majority of them still had not passed through EIA study. The procedure for categorization is presented here down:

- Screening by list of projects for which EIA is mandatory (Category I)
- Screening by list of projects for which a partial EIA will be required (Category II)
- Screening by list of projects for which EIA is not required (Category III), specifically those which only involve preparation of studies, environmental awareness programs, institutional development, etc.

The screening of projects was made based on the Categories List stipulated in the Procedural

Guidelines on Environmental Impact Assessment, Decree 86, 1992 (Federal Environmental Protection Agency). Categories List is shown in Tables S10.1-1, S10.1-2 and S10.1-3.

(4-1) Scenario-A

The result of the screening is shown in Annex S10.1-2 to Annex S10.1-5 and summarized in the bellow Table.

Table S10.1-8 Categorization of Projects in Scenery-A subjected to IEE/EIA Study

EIA Category	Description	Documents Required For Application to EIA Division	Projects affected	
			Sector	Number
1	Full EIA is required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	33
			Irrigation/Drainage	3
			Sanitation	7
			Total Category 1	47
2	Partial EIA may be required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	83
			Irrigation/Drainage	10
			Sanitation	8
			Total Category 2	105
3	Not require EIA	Application letter for EIS	Dam	0
			Municipal Water Supply	4
			Irrigation/Drainage	0
			Sanitation	16
			Total Category 3	20
	Disregarded projects*		Irrigation/Drainage	1
Total Projects in Ogun-Oshun Basin (Scenario-A)				173

*: One (1) project was disregarded in the Sector of Irrigation/Drainage and not proposed in this CMP due to unavailability of water for its implementation. Project's Code is IP109.
Source: JICA Study Team

Projects in Category 3 such as capacity development, awareness creation, etc. do not require EIA therefore these projects are not scoped for IEE.

From the above table, 47 projects in Category I and 105 projects in Category II are subject to scoping at IEE study level (total=152) in four (4) Sectors (Dams, Municipal Water Supply, Irrigation/Drainage and Sanitation). This is in compliance with the Guidelines for EIA and JICA guidelines for environmental and social considerations.

(4-1) Scenario-B

The result of the screening is shown in Annex S10.1-6 to Annex S10.1-9 and summarized in the bellow Table.

Table S10.1-9 Categorization of Projects in Scenery-B subjected to IEE/EIA Study

EIA Category	Description	Documents Required For Application to EIA Division	Projects affected	
			Sector	Number
1	Full EIA is required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	6
			Municipal Water Supply	37
			Irrigation/Drainage	3
			Sanitation	7
			Total Category 1	53
2	Partial EIA may be required	Submission of Project Proposal or FS and the TOR for EIA Study	Dam	4
			Municipal Water Supply	80
			Irrigation/Drainage	10
			Sanitation	8
			Total Category 2	102
3	Not require EIA	Application letter for EIS	Dam	0
			Municipal Water Supply	3
			Irrigation/Drainage	0
			Sanitation	16
			Total Category 3	19
	Disregarded projects*		Irrigation/Drainage	1
Total Projects in Ogun-Oshun Basin (Scenerio-A)				175

*: One (1) project was disregarded in the Sector of Irrigation/Drainage and not proposed in this CMP due to unavailability of water for its implementation. Project's Code is IP109.
Source: JICA Study Team

Projects in Category 3 such as capacity development, awareness creation, etc. do not require EIA therefore these projects are not scoped for IEE.

From the above table, 53 projects in Category I and 102 projects in Category II are subject to scoping at IEE study level (total=155) in four (4) Sectors (Dams, Municipal Water Supply, Irrigation/Drainage and Sanitation). This is in compliance with the Guidelines for EIA and JICA guidelines for environmental and social considerations.

(5) Identification of Impacts and Its Significance

For projects that have been scoped for IEE study for the two Sceneries as shown in the Annex S10.1-2 to Annex S10.1-9, the identification of impacts and its significance were made based on scoping matrix. To realize this, each Sector of projects was divided into several groups since scoping outcome would be similar for each group. The criteria applied for this grouping is as follows:

Table S10.1-10 Grouping of Projects subject to IEE Study

Sector	Criteria	Group	Nº Projects	
			Scenery-A	Scenery-B
Dam	Dam with surface area more than 200 has	1	4	5
	Dam with surface area less than 200 has	2	4	4
	Dam with surface area more than 200 has located in Protected Areas	3	0	1
	Dam with surface area less than 200 has located in Protected Areas	4	0	0
Municipal Water Supply	Water Treatment Plant with capacity more than 4,500 m3/h	1	20	24
	Water Treatment Plant with capacity less than 4,500 m3/h	2	8	8
	Well Field with capacity more than 4,500 m3/h	3	1	1
	Single Borehole Equipped with Electrical-mechanical Pump	4	4	3
	Single Borehole Equipped with Hand pump	5	4	3
	Rehabilitation of water system (big scale activities including important civil works)	R1	12	12
	Rehabilitation of water system (small scale activities including minor civil works)	R2	67	66
Irrigation/ Drainage	Irrigation Scheme with area more than 5,000 has	1	1	1
	Irrigation Scheme with area less than 5,000 has	2	10	10
	Irrigation Scheme with area more than 5,000 has located in Protected Area	3	0	0
	Irrigation Scheme with area less than 5,000 has located in Protected Area	4	2	2
Sanitation	Construction of Sewerage	1	3	3
	Construction of Septage Treatment System	2	4	4
	Construction of Public Toilets	3	8	8
		Total Projects for IEE	152	155

The results are presented here down for each Sector:

(5-1) Sector Dam

The identification of impacts and its significance were made for the following four (4) Groups as shown in the bellow tables:

Table S10.1-11 Matrix for Scoping (Sector Dams- Group 1)

	Nº	Likely Impact Items	Overall Rating	Planning Phase		Construction Phase			Operation Phase	
				Land Acquisition	Change of land use plan	Clearance of vegetation from inundation zone	Construction of Embankment, apportunances, etc.	Operation of Equipment for construction and vehicles	Storage of Water into the Dam	Operation of intake and gates for water use
Social Environment	1	Involuntary resettlement	A-	A-	A-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	-	-
	3	Land use and utilization of local resources	A-	-	-	-	A-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making	C-	C-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	-	-	-	A-	A-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	C-
	11	Water supply and/or Irrigation with Potential Power generation	A+	-	-	-	-	-	-	A+
	12	Vector of diseases	A-	-	-	A-	-	-	A-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	A-	-	-	A-	A-	A-	-	-
Natural Environment	14	Topography and geographical features	C-	-	-	C-	C-	-	-	-
	15	Accumulation of sediment into Dams	B-	-	-	-	-	-	B-	-
	16	Protected Area	-	-	-	-	-	-	-	-
	17	Ground water	C-/C+	-	-	-	-	-	C-/C+	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	A-	-	-	A-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	-	-
	27	Soil pollution	-	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	-	-
	29	Noise and vibration	B-	-	-	-	B-	B-	-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-
	32	Bottom sediment	C-	-	-	-	C-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	-	C-

Group 1: Dams with surface area more than 200 has

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-12 Matrix for Scoping (Sector Dams- Group 2)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Planning Phase: Change of land use plan	Construction Phase: Clearance of vegetation from inundation zone	Construction Phase: Construction of Embankment, apportunances, etc.	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Storage of Water into the Dam	Operation Phase: Operation of intake and gates for water use
Social Environment	1	Involuntary resettlement	B-	B-	B-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	-	-
	3	Land use and utilization of local resources	B-	-	-	-	B-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making	C-	C-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	-	B-	B-	-	-
	6	The poor, indigenous and ethnic people	C-	-	C-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	C-
	11	Water supply and/or Irrigation	A+	-	-	-	-	-	-	A+
	12	Vector of diseases	A-	-	-	A-	-	-	A-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	B-	-	-	-	-	-	B-	-
	15	Accumulation of sediment into Dams	B-	-	-	-	-	-	B-	-
	16	Protected Area	-	-	-	-	-	-	-	-
	17	Ground water	C-/C+	-	-	-	-	-	C-/C+	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	B-	B-	-	-	B-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-		B-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	-	-
	27	Soil pollution		-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	-	-
	29	Noise and vibration	B-	-	-	-	B-	B-	-	-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-
	32	Bottom sediment	C-	-	-	-	C-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	-	C-

Group 2: Dams with surface area less than 200 has

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・ -: No impact is expected.

Source: JICA Study Team

Table S10.1-13 Matrix for Scoping (Sector Dams- Group 3)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Planning Phase: Change of land use plan	Construction Phase: Clearance of vegetation from inundation zone	Construction Phase: Construction of Embankment, apportunances, etc.	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Storage of Water into the Dam	Operation Phase: Operation of intake and gates for water use
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	-	-
	3	Land use and utilization of local resources	A-	-	-	-	A-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making	C-	C-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	-	-	-	A-	A-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	C-	C-	-	-	-	-	-	-
	9	Local conflict of interests	A-	A-	A-	-	-	-	-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	C-
	11	Water supply and/or Irrigation with Potential Power generation	A+	-	-	-	-	-	-	A+
	12	Vector of diseases	A-	-	-	A-	-	-	A-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	A-	-	-	A-	A-	A-	-	-
Natural Environment	14	Topography and geographical features	B-	-	-	-	-	-	B-	-
	15	Accumulation of sediment into Dams	B-	-	-	-	-	-	B-	-
	16	Protected Area	A-	A-	A-	A-	A-	A-	-	-
	17	Ground water	C-/C+	-	-	-	-	-	C-/C+	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	A-	-	-	A-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-		B-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	-	-
	27	Soil pollution		-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	-	-
	29	Noise and vibration	B-	-	-	-	B-	B-	-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-
	32	Bottom sediment	C-	-	-	-	C-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	-	C-

Group 3: Dams with surface area > 200 ha located in Protected Area

<u>Rating Criteria</u>

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-14 Matrix for Scoping (Sector Dams- Group 4)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Planning Phase: Change of land use plan	Construction Phase: Clearance of vegetation from inundation zone	Construction Phase: Construction of Embankment, apportunances, etc.	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Storage of Water into the Dam	Operation Phase: Operation of intake and gates for water use
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	-	-
	3	Land use and utilization of local resources	B-	-	-	-	B-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making	C-	C-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	-	B-	B-	-	-
	6	The poor, indigenous and ethnic people	C-		-	C-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	C-	C-	-	-	-	-	-	-
	9	Local conflict of interests	A-	A-	A-	-	-	-	-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	C-
	11	Water supply and/or Irrigation with Potential Power generation	A+	-	-	-	-	-	-	A+
	12	Vector of diseases	A-			A-			A-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	B-	-	-	-	-	-	B-	-
	15	Accumulation of sediment into Dams	B-	-	-	-	-	-	B-	-
	16	Protected Area	A-	A-	A-	A-	A-	A-	-	-
	17	Ground water	C-/C+	-	-	-	-	-	C-/C+	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	A-	-	-	A-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	-	-
	27	Soil pollution		-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	-	-
	29	Noise and vibration	B-	-	-	-	B-	B-	-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-
	32	Bottom sediment	C-	-	-	-	C-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	-	C-

Group 4: Dams with surface area < 200 ha located in Protected Area

<u>Rating Criteria</u>

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

(5-2) Sector Municipal Water Supply

The identification of impacts and its significance were made for the following seven (7) Groups as shown in the bellow tables:

Table S10.1-15 Matrix for Scoping (Sector Municipal Water Supply- Group 1)

	Nº	Likely Impact Items	Overall Rating	Planning: Land Acquisition	Planning: Change of land use plan	Construction Phase: Land Reclamation	Construction Phase: Construction of intake, pumping station, etc.	Construction Phase: Construction of water plant, distribution system, etc.	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Operation of water intake	Operation Phase: Operation of water plant, etc.	Operation Phase: Operation of water distribution
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	A+	B+	B+	B+
	3	Land use and utilization of local resources	B-	-	-	B-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	-	-	A-	B-	A-	A-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-	-	-	
	11	Sanitation (water supply)	A+	-	-	-	-	-	-	A+	A+	A+
	12	Vector of diseases	-	-	-	-	-	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	B-	-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-	-
	16	Protected Area	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+
	17	Ground water	-	-	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-		-
	20	Coastal zone	C-	C-	C-	C-	C-	C-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	-	-	-	-	B-	-	-
	22	Meteorology	-	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	-	B-	B-	B-	B-
	26	Water pollution	B-	-	-	-	B-	B-	B-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	C-	C-

Group 1: Water Supply with Treatment Plant Capacity more than 4,500 m3/d

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-16 Matrix for Scoping (Sector Municipal Water Supply - Group 2)

	Nº	Likely Impact Items	Overall Rating	Planning: Land Acquisition	Planning: Change of land use plan	Construction Phase: Land Reclamation	Construction Phase: Construction of intake, pumping station, etc.	Construction Phase: Construction of water plant, distribution system, etc.	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Operation of water intake	Operation Phase: Operation of water plant, etc.	Operation Phase: Operation of water distribution
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	B+	B+	B+	B+
	3	Land use and utilization of local resources	B-	-	-	B-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	B-	B-	B-	B-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-	-	-	
	11	Sanitation (water supply)	A+	-	-	-	-	-	-	A+	A+	A+
	12	Vector of diseases	-	-	-	-	-	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	B-	-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-	-
	16	Protected Area	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+
	17	Ground water	-	-	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	-	B-		-
	20	Coastal zone	C-	C-	C-	C-	C-	C-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	-	-	-	-	B-	-	-
	22	Meteorology	-	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	-	B-	B-	B-	B-
	26	Water pollution	B-	-	-	-	B-	B-	B-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	C-	C-

Potential conflitct impact are predicted in some projects among water users due to not enough water (for the report), then delete from here

Group 2: Water Supply with Treatment Plant Capacity less than 4,500 m3/d

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

- -: No impact is expected.

Source: JICA Study Team

Table S10.1-17 Matrix for Scoping (Sector Municipal Water Supply- Group 3)

	Nº	Likely Impact Items		Planning Phase		Construction Phase		Operation Phase	
			Overall Rating	Land Acquisition	Change of land use plan	Construction of Borehole	Construction of power house and for setting disinfection facility	Operation of generator and pumps for water abstraction	Operation of distribution system (pumping station, disinfection system, etc.)
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	B+
	3	Land use and utilization of local resources	-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	-	-	-	-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-
	11	Sanitation (water supply)	A+	-	-	-	-	A+	A+
	12	Vector of diseases		-	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-
	16	Protected Area	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+
	17	Ground water	-	-	-	-	-	-	-
	18	Soil erosion	-	-	-	-	-	-	-
	19	Hydrological situation (flow regime)	C-	-	-	-	-	C-	-
	20	Coastal zone	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-	-	-	-
	22	Meteorology	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	B-	B-	B-	B-
	26	Water pollution	B-	-	-	B-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-
	28	Waste	B-	-	-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-
	32	Bottom sediment	-	-	-	-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	C-

Group 3: Water Supply with Field Motorized Boreholes Capacity > 4,500 m3/d

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-18 Matrix for Scoping (Sector Municipal Water Supply - Group 4)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Planning Phase: Change of land use plan	Construction Phase: Construction of Borehole	Construction Phase: Construction of power house and for setting disinfection facility	Operation Phase: Operation of generator and pump for water abstraction	Operation Phase: Operation of distribution system (pumping station, disinfection
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	-	-	-	-	-	-	-
	3	Land use and utilization of local resources	-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	-	-	-	-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-
	11	Sanitation (water supply)	A+	-	-	-	-	A+	A+
	12	Vector of diseases	-	-	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-
	16	Protected Area	-	-	-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-
	18	Soil erosion	-	-	-	-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-	-	-
	20	Coastal zone	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-	-	-	-
	22	Meteorology	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	B-	B-	B-	B-
	26	Water pollution	B-	-	-	B-	B-	B-	B-
	27	Soil pollution		-	-	-	-	-	-
	28	Waste	B-	-	-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-
	32	Bottom sediment	-	-	-	-	-	-	-
	33	Accident	C-	-	-	C-	C-	C-	C-

Group 4: Water Supply with Single Motorized Borehole

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-19 Matrix for Scoping (Sector Municipal Water Supply - Group 5)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Construction Phase: Construction of well	Operation Phase: Operation of hand pump for water abstraction
Social Environment	1	Involuntary resettlement	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	-	-	-	-
	3	Land use and utilization of local resources	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-
	8	Cultural heritage	-	-	-	-
	9	Local conflict of interests	-	-	-	-
	10	Water use right and common land use right	-	-	-	-
	11	Sanitation (water supply)	A+	-	-	A+
	12	Vector of diseases	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	B-	-
Natural Environment	14	Topography and geographical features	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-
	16	Protected Area	-	-	-	-
	17	Ground water	-	-	-	-
	18	Soil erosion	-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-
	20	Coastal zone	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-
	22	Meteorology	-	-	-	-
	23	Landscape	-	-	-	-
	24	Global warming	-	-	-	-
Pollution	25	Air pollution	B-	-	B-	-
	26	Water pollution	B-	-	B-	-
	27	Soil pollution	-	-	-	-
	28	Waste	-	-	-	-
	29	Noise and vibration	B-	-	B-	-
	30	Ground subsidence	-	-	-	-
	31	Offensive odor	-	-	-	-
	32	Bottom sediment	-	-	-	-
	33	Accident	C-	-	C-	C-

Group 5: Water Supply with Single Borehole with Hand Pump

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

- -: No impact is expected.

Source: JICA Study Team

Table S10.1-20 Matrix for Scoping (Sector Municipal Water Supply - Group R1)

	Nº	Likely Impact Items	Overall Rating	Rehabilitation: Rehabilitation of Well Field boreholes	Rehabilitation: Reparation of intake structure, replacement of equipment, etc.	Rehabilitation: Reparation of structures of water plant, storage	Rehabilitation: Reparation of Water Tank	Rehabilitation: Reparation of main, secondary and tertiary pipelines	Rehabilitation: Operation of Equipment for rehabilitation and vehicles
Social Environment	1	Involuntary resettlement	-	-	-	-		-	-
	2	Local Economy such as Employment & Livelihood, etc.	A+	A+	A+	A+	A+	A+	A+
	3	Land use and utilization of local resources	-	-	-	-		-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-		-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	B-	B-	B-	B-	A-	A-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-
	11	Sanitation (water supply)	-	-	-	-	-	-	-
	12	Vector of diseases	-	-	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	B-	B-	B-	B-	B-	B-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-
	16	Protected Area	-	-	-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-
	18	Soil erosion	-	-	-	-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-	-	-
	20	Coastal zone	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-	-	-	-
	22	Meteorology	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-
	24	Global warming	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-		B-
	26	Water pollution	B-	B-	B-	B-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-
	28	Waste	B-	B-	B-	B-	B-	B-	B-
	29	Noise and vibration	B-	B-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-
	32	Bottom sediment	-	-	-	-	-	-	-
	33	Accident	C-	C-	C-	C-	C	C-	C-

Group R1: Rehabilitation of Water Supply System with big scale activities including important civil works

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-21 Matrix for Scoping (Sector Municipal Water Supply - Group R2)

	Nº	Likely Impact Items	Overall Rating	Rehabilitation: Rehabilitation of Boreholes	Rehabilitation: Reparation of Water Tank	Rehabilitation: Reparation of main, secondary and tertiary pipelines	Rehabilitation: Operation of Equipment for rehabilitation and vehicles
Social Environment	1	Involuntary resettlement	-	-		-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	B+	B+	B+	B+
	3	Land use and utilization of local resources	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	B-	B-
	6	The poor, indigenous and ethnic people	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-
	11	Sanitation (water supply)	-	-	-	-	-
	12	Vector of diseases	-	-	-	-	-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	B-	B-	B-	B-
Natural Environment	14	Topography and geographical features	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-
	16	Protected Area	-	-	-	-	-
	17	Ground water	-	-	-	-	-
	18	Soil erosion	-	-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-
	20	Coastal zone	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-	-
	22	Meteorology	-	-	-	-	-
	23	Landscape	-	-	-	-	-
	24	Global warming	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	B-
	26	Water pollution	B-	B-	B-	B-	B-
	27	Soil pollution		-	-	-	-
	28	Waste	B-	B-	B-	B-	B-
	29	Noise and vibration	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-
	32	Bottom sediment	-	-	-	-	-
	33	Accident	C-	C-	C	C-	C-

Group R2: Rehabilitation of Water Supply System with smale scale activities including minor civil works

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further projec

・ -: No impact is expected.

Source: JICA Study Team

(5-3) Sector Irrigation/Drainage

The identification of impacts and its significance were made for the following four (4) Groups as shown in the bellow tables.

Table S10.1-22 Matrix for Scoping (Sector Irrigation/Drainage - Group 1)

	Nº	Likely Impact Items	Overall Rating	Planning: Land Acquisition	Planning: Change of land use plan	Construction Phase: Deforestation	Construction Phase: Land preparation and irrigation facilities	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Operation of intake for irrigation including pumping	Operation Phase: Application of fertilizers, pesticides	Operation Phase: Distribution of water in channels
Social Environment	1	Involuntary resettlement	A-	A-	A-	-	-	-	-	-	
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	B+	B+	-
	3	Land use and utilization of local resources	A-	-	-	-	A-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	-	-	-	A-	A-	-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples		-	-	-	-	-	-	-	-
	8	Cultural heritage		-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	C-	-
	10	Water use right and common land use right	B-	C-	-	-	-	-	B-	-	-
	11	Sanitation	-	-	-	-	-	-	-	-	-
	12	Vector of diseases	A-			A-	-	-	-	-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-	
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-
	16	Protected Area	-	-	-	-	-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	B-	-	-
	20	Coastal zone	-	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	-		A-	A-	
	22	Meteorology	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	-	-
	26	Water pollution	A-	-	-	-	B-	B-	B-	A-	-
	27	Soil pollution	B-	-	-	-	-	-	-	B-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	-	-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	-

Potential conflitct impact is predicted among water users due to not enough water (Project Codes IP35, IP38)

Group 1: Irrigation shemes with area more than 5,000 has

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No negative impact is expected.

Source: JICA Study Team

Table S10.1-23 Matrix for Scoping (Sector Irrigation/Drainage - Group 2)

	Nº	Likely Impact Items	Overall Rating	Planning: Land Acquisition	Planning: Change of land use plan	Construction Phase: Deforestation	Construction Phase: Land preparation and irrigation facilities	Construction Phase: Operation of Equipment for construction and vehicles	Operation Phase: Operation of intake for irrigation including pumping	Operation Phase: Application of fertilizers, pesticides	Operation Phase: Distribution of water in channels
Social Environment	1	Involuntary resettlement	B-	B-	B-	-	-	-	-	-	
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	B+	B+	-
	3	Land use and utilization of local resources	B-	-	-	-	B-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	-	-	B-	-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	C-	-
	10	Water use right and common land use right	B-	B-	-	-	-	-	B-	-	-
	11	Sanitation	-	-	-	-	-	-	-	-	-
	12	Vector of diseases	B-			B-	-	-	-	-	B-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-	
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-
	16	Protected Area	-	-	-	-	-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	B-	-	-
	20	Coastal zone	-	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	B-	-	B-	B-	B-	
	22	Meteorology	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	B-	B-	-
	27	Soil pollution	B-	-	-	-	-	-	-	B-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	-	-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	-

Potential conflitct impact is predicted among water users due to not enough water (Project's Codes: IG2, IG4)

Group 2: Irrigation shemes with area less than 5,000 has

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-24 Matrix for Scoping (Sector Irrigation/Drainage - Group 3)

				Planning		Construction Phase			Operation Phase		
	Nº	Likely Impact Items	Overall Rating	Land Acquisition	Change of land use plan	Deforestation	Land preparation and irrigation facilities	Operation of Equipment for construction and vehicles	Operation of intake for irrigation including pumping	Application of fertilizers, pesticides	Distribution of water in channels
Social Environment	1	Involuntary resettlement	C-	C-	C-	-	-	-	-	-	
	2	Local Economy such as Employment & Livelihood, etc.	A+	-	-	A+	A+	A+	B+	B+	-
	3	Land use and utilization of local resources	A-	-	-	-	A-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	A-	-	-	-	-	A-	-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	C-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	-	-
	11	Sanitation	-	-	-	-	-	-	-	-	-
	12	Vector of diseases	A-			A-	-	-	-	-	A-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	A-	-	-	A-	A-	A-	-	-	
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-
	16	Protected Area	A-	A-	A-	A-	A-	-			
	17	Ground water		-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	B-	-	-
	20	Coastal zone	-	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	-	-	A-	A-	
	22	Meteorology	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	-	-
	26	Water pollution	A-	-	-	-	B-	B-	B-	A-	-
	27	Soil pollution	B-	-	-	-	-	-	-	B-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	-	-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	-

Potential conflitct impact is predicted among water users due to not enough water (Project Code: IP37)

Group 3: Irrigation shemes with area more than 5,000 has located in Protected Area

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

Table S10.1-25 Matrix for Scoping (Sector Irrigation/Drainage - Group 4)

	Nº	Likely Impact Items	Overall Rating	Planning		Construction Phase			Operation Phase		
				Land Acquisition	Change of land use plan	Deforestation	Land preparation and irrigation facilities	Operation of Equipment for construction and vehicles	Operation of intake for irrigation including pumping	Application of fertilizers, pesticides	Distribution of water in channels
Social Environment	1	Involuntary resettlement	C-	C-	C-	-	-	-	-	-	
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	B+	B+	-
	3	Land use and utilization of local resources	B-	-	-	-	B-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	C-	C-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	-	-	B-	-	-	-
	6	The poor, indigenous and ethnic people	C-	-	-	C-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-	-
	9	Local conflict of interests	C-	C-	C-	-	-	-	-	C-	-
	10	Water use right and common land use right	C-	C-	-	-	-	-	-	-	-
	11	Sanitation	-	-	-	-	-	-	-	-	-
	12	Vector of diseases	B-			B-	-	-	-	-	B-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-	
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-	-
	16	Protected Area	A-	A-	A-	A-	A-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-	-
	19	Hydrological situation (flow regime)	B-	-	-	-	-	-	B-	-	-
	20	Coastal zone	-	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	A-	-	-	A-	-	-	A-	A-	
	22	Meteorology	-	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	-	-
	26	Water pollution	A-	-	-	-	B-	B-	B-	A-	-
	27	Soil pollution	B-	-	-	-	-	-	-	B-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-	-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	-	-
	30	Ground subsidence	-	-	-	-	-	-	-	-	-
	31	Offensive odor	-	-	-	-	-	-	-	-	-
	32	Bottom sediment	B-	-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-	-

Potential conflitct impact is predicted among water users due to not enough water (Project Code: IG1)

Group 4: Irrigation shemes with area less than 5,000 has located in Protected Area

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Source: JICA Study Team

(5-4) Sector Sanitation

The identification of impacts and its significance were made for the following two (3) Groups as shown in the bellow tables.

Table S10.1-26 Matrix for Scoping (Sector Sanitation- Group 1)

				Planning		Construction Phase			Operation	
	Nº	Likely Impact Items	Overall Rating	Land Acquisition	Change of land use plan	Land Reclamation	Construction of treatment plant and sewers, etc.	Operation of Equipment for construction and vehicles	Operation of treatment plant	Operation of sewage pumping station
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	-	-
	3	Land use and utilization of local resources	B-	-	-	B-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	B-	B-	B-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-
	9	Local conflict of interests	A-	A-	A-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-	
	11	Sanitation (Sanitary Disposal of Sewage)	A+	-	-	-	-	-	A+	A+
	12	Vector of diseases	B-	-	-	-	-	-	B-	B-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-
	16	Protected Area	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+
	17	Ground water	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-	-		-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	-	-	-	B-	-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	B-
	26	Water pollution	B-	-	-	-	B-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	A-	-	-	-	-	-	A-	A-
	32	Bottom sediment	B-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-

Group 1: Construction of Sewerage

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulatio

• -: No impact is expected.

Source: JICA Study Team

Table S10.1-27 Matrix for Scoping (Sector Sanitation- Group 2)

	Nº	Likely Impact Items	Overall Rating	Planning: Land Acquisition	Planning: Change of land use plan	Construction Phase: Land Reclamation	Construction Phase: Construction of septage treatment plant	Construction Phase: Operation of Equipment for construction and vehicles	Operation: Operation of septage treatment plant	Operation: Operation of vacuum trucks
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	B+	-	-	B+	B+	B+	-	-
	3	Land use and utilization of local resources	B-	-	-	B-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	B-	-	-	B-	B-	B-	-	B-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-	-
	9	Local conflict of interests	A-	A-	A-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	-	
	11	Sanitation (Sanitary Disposal of Sewage)	A+	-	-	-	-	-	A+	A+
	12	Vector of diseases	B-	-	-	-	-	-	B-	
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	B-	-	-	B-	B-	B-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-	-
	16	Protected Area	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+	C-/C+
	17	Ground water	-	-	-	-	-	-	-	-
	18	Soil erosion	B-	-	-	B-	B-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-	-		-
	20	Coastal zone	-	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	B-	-	-	-	-	-	B-	-
	22	Meteorology	-	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-	-
Pollution	25	Air pollution	B-	-	-	-	-	B-	B-	B-
	26	Water pollution	B-	-	-	-	B-	B-	B-	-
	27	Soil pollution	-	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	B-	B-
	29	Noise and vibration	B-	-	-	B-	B-	B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-	-
	31	Offensive odor	A-	-	-	-	-	-	A-	A-
	32	Bottom sediment	B-	-	-	-	-	-	B-	-
	33	Accident	C-	-	-	C-	C-	C-	C-	C-

Group 2: Construction of Septage Treatment System

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulatio

・ -: No impact is expected.

Source: JICA Study Team

Table S10.1-28 Matrix for Scoping (Sector Sanitation- Group 3)

	Nº	Likely Impact Items	Overall Rating	Planning Phase: Land Acquisition	Planning Phase: Change of land use plan	Construction Phase: Land Reclamation	Construction Phase: Construction of Toilets	Operation Phase: Operation of Toilets	Operation Phase: Removal of Sludge from Toilets
Social Environment	1	Involuntary resettlement	-	-	-	-	-	-	-
	2	Local Economy such as Employment & Livelihood, etc.	-	-	-	-	-	-	-
	3	Land use and utilization of local resources	-	-	-	-	-	-	-
	4	Social institutions such as social infrastructure and local decision-making institutions	-	-	-	-	-	-	-
	5	Existing social infrastructure & Services such as Traffic/Public Facilities	-	-	-	-	-	-	-
	6	The poor, indigenous and ethnic people	-	-	-	-	-	-	-
	7	Inequality between beneficiaries and project-affected peoples	-	-	-	-	-	-	-
	8	Cultural heritage	-	-	-	-	-	-	-
	9	Local conflict of interests	-	-	-	-	-	-	-
	10	Water use right and common land use right	-	-	-	-	-	-	
	11	Sanitation (Sanitary Disposal of Sewage)	A+	-	-	-	-	A+	
	12	Vector of diseases	B-	-	-	-	-	B-	B-
	13	Disaster (natural risk) and infectious diseases such as HIV/AIDS	-	-	-		-	-	-
Natural Environment	14	Topography and geographical features	-	-	-	-	-	-	-
	15	Accumulation of sediment into Dams	-	-	-	-	-	-	-
	16	Protected Area	-	-	-	-	-	-	-
	17	Ground water	-	-	-	-	-	-	-
	18	Soil erosion	-	-	-	-	-	-	-
	19	Hydrological situation (flow regime)	-	-	-	-	-		-
	20	Coastal zone	-	-	-	-	-	-	-
	21	Flora, Fauna and Biodiversity	-	-	-	-	-	-	-
	22	Meteorology	-	-	-	-	-	-	-
	23	Landscape	-	-	-	-	-	-	
	24	Global warming	-	-	-	-	-	-	-
Pollution	25	Air pollution	-	-	-	-	-	-	-
	26	Water pollution	B-	-	-	-	B-	B-	B-
	27	Soil pollution	-	-	-	-	-	-	-
	28	Waste	B-	-	-	-	B-	B-	B-
	29	Noise and vibration	B-	-	-		B-	B-	B-
	30	Ground subsidence	-	-	-	-	-	-	-
	31	Offensive odor	A-	-	-	-	-	A-	A-
	32	Bottom sediment	-	-	-	-	-	-	-
	33	Accident	C-	-	-	-	C-	-	C-

Group 3: Construction of Public Toilets

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project for

・ -: No impact is expected.

Source: JICA Study Team

(6) Description of Mitigation Measures against Adverse Impacts

Based on the scoping activities as shown above, the following mitigation measures are recommended for adverse impacts in each Sector of both scenarios.

(6-1) Sector Dams

The bellow table summarizes the mitigation measures for adverse impacts expected in the sector of dams.

Table S10.1-29 Predictable Negative Impacts and Mitigation Measures (Sector Dam)

Predictable Impacts	Impact Stage	Mitigation Measure
Involuntary settlement	PL	• Conduct public consultation with Project affected person (PAPs) and local residents to explain the benefits of the project. For PAPs prepare detail analysis for compensation
Utilization of local resources	C	• Prepare utilization and post utilization plan for those areas from where materials will be extracted for construction of the dam
Traffic	C	• Control on the number of vehicles/equipment to avoid traffic congestion
Vector of diseases	O	• Implement medical check-up program
Infectious diseases such as HIV/AIDS	C	• Implement medical check-up program
Sediments	O	• The entrance of sediments into the dams will reduce its storage capacity as it already happen in many dams of Nigeria. The well management of the water basin including forest management is recommended to minimize this impact.
Soil erosion	C	• Provision of drains with sediment traps
Protected Area, Flora &Fauna	PL, C	• 19 Dams in total are expected to be located mainly in forest reserves. However, the list of forest reserves is old and some of them may not be in place presently. Therefore it is recommended to check these candidates' sites in the EIA stage to confirm the forest reserves. Anyway, many conflicts may arise if the project is to be located into a protected area. Some mitigation shall include the plantation of forest to be home of the biodiversity and to compensate deforestation due to the construction of the dams.
	O	• Minimum environmental flow shall be maintained downstream to support aquatic life.
Flow regime	O	• Minimum environmental flow shall be maintained downstream. Operation of Dam Manual must be prepared including this subject.
Air pollution (Dust, exhaust fumes from vehicles and equipment)	C, O	• Control on the number or speed of vehicles/ equipment • Watering of access road and operational places. Soil materials should be covered with sheet • Proper maintenance of vehicle and equipment
Water Pollution	C	• Provision of drains with sediment traps • Proper management of the construction • Proper management of waste oil from vehicle maintenance
	O	• Removal of vegetal before filling the dam
Waste	C	• Proper management of construction waste
Noise	C, O	• Trucks shall use exhaust mufflers to maintain the current noise levels • Control of number or speed of vehicles/ equipment • Adequate maintenance of equipment • Work schedule should be informed to the public and operation of heavy equipment should be limited to the day time only

Legend: PL: Planning Phase; C: Construction Phase, O: Operation Phase

(6-2) Sector Municipal Water Supply

The activities to be implemented in the projects of this sector depend on the type of water sources they use (surface or groundwater). Thus, mitigation measures are proposed for (a) projects using surface water as water source (Construction of Water Treatment Plant); and (b) projects using groundwater as water source (Construction of Boreholes). The bellow tables show the impacts and the mitigation measures for the two cases.

Table S10.1-30 Predictable Negative Impacts and Mitigation Measures for Projects using Surface Water as Water Source

Predictable Impacts	Impact Stage	Mitigation Measure
Utilization of local resources	C	• Prepare utilization and post utilization plan for those areas from where materials will be extracted for land reclamation of the facility site (water treatment Plant and intake)
Traffic	C	• Control on the number of vehicles/equipment to avoid traffic congestion
Infectious diseases such as HIV/AIDS	C	• Implement medical check-up program
Soil erosion	C	• Provision of drains with sediment traps
Flow regime	O	• Minimum environmental flow shall be maintained down stream
Flora&Fauna	O	• Minimum environmental flow shall be maintained down stream to support aquatic life.
Air pollution (Dust, exhaust fumes from vehicles and equipment)	C, O	• Control on the number or speed of vehicles/ equipment • Watering of access road and operational places. Soil materials should be covered with sheet • Proper maintenance of vehicle and equipment
Water Pollution	C	• Provision of drains with sediment traps • Proper management of waste oil from vehicle maintenance • Proper management of the construction
	O	• Proper management of chemicals and waste oil from equipment maintenance • Provision of treatment facility for wastewater and sludge originated from the water treatment plant
Waste	C,O	• Proper management of construction waste • Proper management of chemical waste
Noise	C, O	• Trucks shall use exhaust mufflers to maintain the current noise levels • Control of number or speed of vehicles/ equipment • Adequate maintenance of equipment • Work schedule should be informed to the public and operation of heavy equipment should be limited to the day time only
Botton sediment	O	• Provision of treatment facility for wastewater and sludge originated from the water treatment plant

Legend: C: Construction Phase, O: Operation Phase

Table S10.1-31 Predictable Negative Impacts and Mitigation Measures for Projects using Groundwater as Water Source

Predictable Impacts	Impact Stage	Mitigation Measure
Infectious diseases such as HIV/AIDS	C	• Implement medical check-up program
Air pollution (Dust, exhaust fumes from truck of drill rig and power generator)	C, O	• Proper maintenance of vehicle and equipment
Water Pollution	C	• Provision of drains with sediment traps • Proper management of the borehole construction
Waste	C	• Proper management of construction waste
Noise	C, O	• Truck of drill rig shall use exhaust mufflers to maintain the current noise levels • Adequate maintenance of equipment • Operation of equipment should be limited to the day time only

Legend: C: Construction Phase, O: Operation Phase

(6-3) Sector Irrigation and Drainage

The bellow table shows the impacts that can be expected in the sector of dams and summarize the mitigation measures.

Table S10.1-32 Predictable Negative Impacts and Mitigation Measures (Irrigation Sector)

Predictable Impacts	Impact Stage	Mitigation Measure
Utilization of local resources	C	• Prepare utilization and post utilization plan for those areas from where materials will be extracted for land reclamation of the irrigation site
Traffic	C	• Control on the number of vehicles/equipment to avoid traffic congestion
Conflicts among water users	O	• Five (5) Irrigation Projects will face conflicts among other water users (water supply) due to enough water at the project's sites. The changes of cropping patern or the reduction of irrigation area are alternative options to solve this conflict. It is recommended to conduct public consultation with project affected person to arrive to a beneficial agreement for the both side (irrigation users and water supply users).
Vector of diseases	O	• Implement medical check-up program
Infectious diseases such as HIV/AIDS	C	• Implement medical check-up program
Soil erosion	C	• Introduction of right agriculture practices • Provision of drains with sediment traps
Flow regime	O	• Minimum environmental flow shall be maintained down stream. Operation of Intake for Irrigation Manual must be prepared including this subject.
Protected Area, Flora&Fauna	C	• Twenty five (25) Irrigation projects are expected to be implemented in protected aera (mainly forest reserves). However, the list of forest reserves is old and some of them may not be in place presently. Therefore it is recommended to check these candidates' sites in the EIA stage to confirm the forest reserves. Anyway, many conflicts may arise if the project is to be located into a protected area. Some mitigation shall include the plantation of forest to be home of the biodiversity and to compensate deforestation due to the construction of irrigation projects
	O	• Minimum environmental flow shall be maintained downstream to support aquatic life. • Implement training and education of farmers on the kind of chemicals they can use rationally • Check that only authorized chemicals are used at the site
Air pollution (Dust, exhaust fumes from vehicles and equipment)	C, O	• Control on the number or speed of vehicles/ equipment • Watering of access road and operational places. Soil materials should be covered with sheet • Proper maintenance of vehicle and equipment
Water Pollution	C	• Provision of drains with sediment traps • Proper management of waste oil from vehicle maintenance • Proper management of the construction
	O	• Proper management of chemicals and waste oil from equipment maintenance • Implement training and education of farmers on the kind of chemicals they can use rationally • Check that only authorized chemicals are used at the site • Implement water quality monitoring for existing drinking wells. If affected, construct boreholes for affected people
		• Proper management of waste oil from equipment maintenance
Soil pollution	C, O	• Proper management of chemicals
Waste	C,O	• Proper management of construction waste • Proper management of chemical waste
Noise	C, O	• Trucks shall use exhaust mufflers to maintain the current noise levels • Control of number or speed of vehicles/ equipment • Adequate maintenance of equipment • Work schedule should be informed to the public and operation of heavy equipment should be limited to the day time only
Botton sediment	O	• Proper management of chemicals and waste oil from equipment maintenance

Legend: C: Construction Phase, O: Operation Phase

(6-4) Sector Sanitation

Mitigation measures are proposed for (a) the construction of sewerage and septage treatment system and (b) the construction of public toilets. The bellow tables show the impacts and the mitigation measures for the two cases.

Table S10.1-33 Predictable Negative Impacts and Mitigation Measures for Construction of Sewerage and Septage Treatment System

Predictable Impacts	Impact Stage	Mitigation Measure
Utilization of local resources	C	• Prepare utilization and post utilization plan for those areas from where materials will be extracted for land reclamation of the facility site (sewage treatment Plant)
Traffic	C	• Control on the number of vehicles/equipment to avoid traffic congestion
Social Conflicts	PL	• Conflicts to get approval from citizens for the location of the facility may arise. It is recommended to conduct public consultation with project affected person to arrive to a beneficial agreement. The Agency should make a compromise to manage properly the facility to obtain the consensus of the population on the Project implementation.
Vector of diseases	O	• Implement medical check-up program
Infectious diseases such as HIV/AIDS	C	• Implement medical check-up program
Soil erosion	C	• Provision of drains with sediment traps
Flora&Fauna	O	• Proper management of facility to avoid pollution of the aquatic environment
Air pollution (Dust, exhaust fumes from vehicles and equipment)	C, O	• Control on the number or speed of vehicles/ equipment • Watering of access road and operational places. Soil materials should be covered with sheet • Proper maintenance of vehicle and equipment
Water Pollution	C	• Provision of drains with sediment traps • Proper management of waste oil from vehicle maintenance • Proper management of the construction
	O	• Proper management of the facility to avoid water pollution • Proper management of waste oil from equipment maintenance
Waste	C,O	• Proper management of construction waste
Noise	C, O	• Trucks shall use exhaust mufflers to maintain the current noise levels • Control of number or speed of vehicles/ equipment • Adequate maintenance of equipment • Work schedule should be informed to the public and operation of heavy equipment should be limited to the day time only
Offensive Odor	O	• Proper management of the facility
Botton sediment	O	• Proper management of the facility

Legend: PL: Planning Phase, C: Construction Phase, O: Operation Phase

Table S10.1-34 Predictable Negative Impacts and Mitigation Measures for Construction of Public Toilets

Predictable Impacts	Impact Stage	Mitigation Measure
Vector of diseases	O	• Maintain the facility in good hygiene condition with adequate maintenance
Water Pollution	O	• Proper management of the facility to avoid water pollution
Waste	C,O	• Proper management of construction waste • Proper management of toilet paper waste
Offensive Odor	O	• Proper management of the facility

Legend: PL: Planning Phase, C: Construction Phase, O: Operation Phase

(7) Conclusions and Recommendations

In general, the projects proposed in the CMP for Ogun-Oshun Basin will benefit three main sectors namely water supply, irrigation and sanitation. As for water supply high positive impacts are expected through the project implementation on the current health level of the beneficiary population by consuming potable water which in turn will allow the exercise of better hygiene practices in the households. As for irrigation, the socio-economic status of the population will be highly upgraded through the increase of agricultural production and employment opportunities. In addition food security for the population will be improved.

As for sanitation, a high positive impact is expected on the public health of the population through the safe disposal of sewage and excreta.

Some adverse impacts on the environment are also expected from the project implementation which shall be diminished through the proposed mitigation measures. In this sense, especial attention must be given to the the dam sectors since it involve huge physical intervention and may need the resettlement of people living around the candidate site.

ANNEX S10.1-1

TERMS OF REFERENCE FOR INITIAL ENVIRONMENTAL EXAMINATION

TECHNICAL SPECIFICATIONS

1. General

The Initial Environmental Examination (IEE) is the first field recognizance of the environment where a project is planned to be executed.

2. Targeted Projects for IEE

The CMP in this JICA Survey involves the study for the execution of projects in Ogun-Oshun Basin on water resources development and sanitation sectors such as (1) Construction of Dams; (2) Construction of Water Supply System; (3) Construction of Irrigation System; and (4) Construction of Sanitation System. In this sense, the IEE in this stage will be realized on all on-going and proposed projects that relates to water resources development and sanitation.

3. Items to be study into the IEE

The following points shall be checked utilizing existing information in Nigeria

3.1 Legal and Institutional Aspects on Environment and Social Considerations

3.2 Natural Environmental Condition of the Study Area

The Study Area is composed of Lagos, Ogun, Osun and Oyo States that falls under Ogun-Oshun Basin in HA-6. The state of the environment in the Study Area shall be checked from the point of view of the followings components.

(1) Water

The actual condition of surface and groundwater shall be checked.

(2) Fauna and Flora

Existing species of flora and fauna shall be checked.

(3) Protected Areas

The protected areas shall be identified including national parks, games reserves, forest reserves and wetlands.

3.3 Social Environment

The social environmental condition shall be checked from the point of view of the followings components.

(1) Socio-economy

The socioeconomic condition of the population shall be checked.

(2) Health condition

The number of people affected by waterborne or other communicable disease shall be checked

3.4 List of Projects and Brief Description

Projects will be listed by location with a brief description of the major activities

3.5 Categorization of Projects (Screening)

Projects will be categorized through the following steps:

- Classification and grouping into same type of projects by Sector i.e. Sector Dams; Sector Irrigation and so on.
- Screening by list of projects for which EIA is mandatory (Category I)
- Screening by list of projects for which a partial EIA will be required (Category II)
- Screening by list of projects for which EIA is not required (Category III), specifically those which only involve preparation of studies, environmental awareness programs, institutional development, etc.
- Checking the status of projects (e.g. ongoing project)

The screening of projects will be made based on the Categories List (see Annexes) stipulated in the Procedural Guidelines on Environmental Impact Assessment, Decree 86, 1992 (Federal Environmental Protection Agency).

3.6 Identification of Impacts and Its Significance

For all projects that need IEE/EIA, the identification of impacts and its significance shall be made based on scoping matrix.

3.7 Description of Mitigation Measures against Adverse Impacts

Mitigation measures shall be proposed based on the identified impacts in the scoping process.

3.8 Conclusion and Recommendations

4. Methodology

4.1 Data Collection and Analysis Methods

The IEE will start with the collection of existing data and information on natural and social environment in the Study Area. These data, so called primary data, may be available in relevant institutions or agencies and will be used for further analysis work on environmental components of the Study.

For analysis of the IEE shall be used the following documents:

(1) Nigerian Environmental Guidelines and Standards and International standards

(2) JICA Guidelines for Environmental and Social Considerations

4.2 Methods for Identification of Impacts and Determination of Significant Impacts

The impacts, its significance and its sources shall be identified in preliminary form during the IEE.

(1) Identification of Impacts and Impact Sources

Environmental impacts and impact sources shall be predicted for each phase of project implementation, i.e., planning, construction and operation.

(2) Significant impacts

The relevant environmental impacts will be ranked depending on its environmental and social significance in accordance with rating criteria listed below.

Rating Criteria

A+/-: Significant positive/negative impact is expected.

B+/-: Some positive/negative impact is expected.

C+/-: Extent of positive/negative impact is unknown. (A further examination is required in the further project formulation)

・-: No impact is expected.

Significant impact shall be determined on the basis of non-negligible environmental changes induced by project implementation.

Annex S10.1-2 List of Dams Projects in the CMP (Ogun-Oshun Basin, Scenario-A)

SN	Sector	Status	Type	Code	Name of Project	Implementing Agency	HA	State	Outline/Scope of the Project	Group 1	Group 2	Group 3	Group 4	Protected Area	Category for EIA	Scoping for IEE
1	D	G	1	DG1	Owiwi dam project	FMWR	6	Ogun	New dam construction(SN=1001): H=20m, GS=30MCM, SA=3.84km2, Purpose: IR, MW	1					1	1
2	D	G	1	DG2	Ile-Ife dam project	FMWR	6	Osun	New dam construction(SN=1002): H=19.7m, GS=14MCM, SA=1.67km2, Purpose: MW		1				2	1
3	D	G	1	DG3	Ilesha dam project	FMWR	6	Osun	New dam construction(SN=1003): H=20m, GS=25MCM, SA=3.12km2, Purpose: IR, MW, FI	1					1	1
4	D	G	1	DG32	Igbojaye dam project	FMWR	6	Oyo	New dam construction(SN=1033): H=18m, GS=5.6MCM, SA=0.66km2, Purpose: IR, WS		1				2	1
5	D	P	1A	DP16	Ibu dam project	FMWR	6	Ogun	New dam construction(SN=2205): H=19m, GS=20.6MCM, SA=4.61km2, Purpose: To ensure stable water source for the existing Otta Ikosi/Ogere/Shagamu Water Supply Scheme	1					1	1
6	D	P	1A	DP19	Ota dam project	FMWR	6	Ogun	New dam construction(SN=4014): H=16m, GS=6.4MCM, SA=1.5km2, Purpose: To ensure stable water source for the existing Ota Water Supply Scheme		1				2	1
7	D	P	1A	DP20	Araromi Ake/ Ijebu-Ode-Yemoji dam project	FMWR	6	Ogun	New dam construction(SN=4018): H=12m, GS=3.3MCM, SA=1.5km2, Purpose: To ensure stable water source for the existing Ijebu-Ode/Yemoji Water Supply Scheme		1				2	1
8	D	P	1A	DP23	Odedele dam project	FMWR	6	Oyo	New dam construction(SN=3501): H=30m, GS=182.6MCM, SA=21.9km2, Purpose: To ensure stable water source for the proposed Odedele/Ibadan Water Supply Scheme	1					1	1
										4	4	0	0			8

G: on-going project =4; P: proposed project by JICA Project Team=4

Group of projects for For IEE Study: Group 1: Dams with SA more than 200 has; Group 2: Dams with SA less than 200 has; Group 3: Dams with SA more than 200 has located in protected area;

Group 4: Dams with SA less than 200 has located in protected area

Type: 1=Small to Medium scale dam; 1A=Small to medium scale dam for municipal water supply; 1B=Small to medium scale dam for irrigation develoment; 2: Large scale dam for irrigation development

3=Integrated project (Irrigation&Hydropower); 4=Rehabilitation project; 5=Capacity development project

Purpose: FC= Flood control; IR= Irrigation; MW=Municipal water supply; HP= Hydropower; FI= Fishery, OT= Others

Summary

Categorization		Projects for EIA/IEE	
Category 1	4		4
Category 2	4		4
Cagegory 3	0		
Total	8	Total	8

Annex S10.1-3 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (1/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
1	WS	P	R	WSP259	Lagos/Adiyan Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	110,782	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
2	WS	P	R	WSP260	Lagos/Iju Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	71,217	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
3	WS	P	R	WSP261	Lagos/Isashi Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ojo	U	S	6,330	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
4	WS	P	R	WSP262	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	Lagos	-	R	G	3,344	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
5	WS	P	R	WSP263	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	Lagos	-	R	G	1,605	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
6	WS	P	N	WSP264	Lagos/Yewa-1 Water Supply Project (Desalination)	Lagos Water Corporation	Lagos	Badagry	U	S	214,224	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
7	WS	P	N	WSP265	Lagos/Odomola-1 Water Supply Project	Lagos Water Corporation	Lagos	Epe	U	S	107,112	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
8	WS	P	N	WSP266	Lagos/Odomola-2 Water Supply Project	Lagos Water Corporation	Lagos	Epe	U	S	385,604	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
9	WS	P	N	WSP267	Lagos/Adiyan-2 Water Supply Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	299,914	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
10	WS	P	N	WSP268	Lagos/Adiyan-3 Water Supply Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	299,914	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
11	WS	P	N	WSP269	Lagos/Ibesha Water Supply Project (Desalination)	Lagos Water Corporation	Lagos	Ikorodu	U	S	214,224	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
12	WS	P	N	WSP270	Lagos/Isashi Expansion-1 Water Supply Project	Lagos Water Corporation	Lagos	Ojo	U	S	34,276	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
13	WS	P	N	WSP271	Lagos/Isashi Expansion-2 Water Supply Project	Lagos Water Corporation	Lagos	Ojo	U	S	98,543	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
14	WS	P	N	WSP272	Rural Water Supply Projects (Point-Source, Handpumps)	Lagos Min. of Rural Develop't	Lagos	-	R	G	2,863	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
15	WS	P	N	WSP273	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	Lagos Min. of Rural Develop't	Lagos	-	R	G	4,295	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
16	WS	P	R	WSP304	Abeokuta Main Water Supply Scheme / Old Rehabilitation Project	State Water Corporation	Ogun	Abeokuta South	U	S	5,222	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
17	WS	P	R	WSP305	Abeokuta Main Water Supply Scheme / New Rehabilitation Project	State Water Corporation	Ogun	Abeokuta South	U	S	28,547	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
18	WS	P	R	WSP306	Ota Old Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	853	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
19	WS	P	R	WSP307	Ota New Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	2,350	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
20	WS	P	R	WSP308	Ilaro Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Egbado South	U	S	84	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
21	WS	P	R	WSP309	Ifo Akinsede/Papalanto Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ifo	U	S	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
22	WS	P	R	WSP310	Itele Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu East	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
23	WS	P	R	WSP311	Ijebu-Igbo/Apoje Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu North	U	S	6,440	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
24	WS	P	R	WSP312	Ijebu-Ode/Yemoji Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu Ode	U	S	6,266	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
25	WS	P	R	WSP313	Ogere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ikenne	U	S	2,332	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
26	WS	P	R	WSP314	Imeko Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Imeko-Afon	U	S	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
27	WS	P	R	WSP315	Abigi Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ogun Waterside	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
28	WS	P	R	WSP316	Shagamu Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Shagamu	U	S	2,263	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
29	WS	P	R	WSP317	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Ogun	-	R	G	764	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
30	WS	P	R	WSP318	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Ogun	-	R	G	10,356	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
31	WS	P	N	WSP319	Ota Old (Doubling) Water Supply Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	2,450	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
32	WS	P	N	WSP320	Apoje Regional Water Supply Project 1	State Water Corporation	Ogun	Ijebu North	U	S	87,627	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
33	WS	P	N	WSP321	Mokoloki Regional Water Supply Project 1	State Water Corporation	Ogun	Obafemi-Owode	U	S	250,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1

Annex S10.1-3 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (2/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
34	WS	P	N	WSP322	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Ogun	-	R	G	19,249	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
35	WS	P	N	WSP323	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Ogun	-	R	G	28,873	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
36	WS	P	R	WSP339	Orile-Owu Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedade	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
37	WS	P	R	WSP340	Odeyinka Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
38	WS	P	R	WSP341	Ile-Ogbo/Kuta Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedire	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
39	WS	P	R	WSP342	Oluponna Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedire	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
40	WS	P	R	WSP343	Iperindo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa East	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
41	WS	P	R	WSP344	Ifewara Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	146	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
42	WS	P	R	WSP345	Ifewara/Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
43	WS	P	R	WSP346	Osu/Ilesha Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
44	WS	P	R	WSP347	Igbajo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
45	WS	P	R	WSP348	Otan/Iresi Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
46	WS	P	R	WSP349	Igbajo/Oke-Irun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
47	WS	P	R	WSP350	Iree/Eripa Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boripe	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
48	WS	P	R	WSP351	Ada Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boripe	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
49	WS	P	R	WSP352	Ede/Old Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ede North	U	S	3,133	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
50	WS	P	R	WSP353	Ede/New Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ede North	U	S	62,664	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
51	WS	P	R	WSP354	Ejigbo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ejigbo	U	S	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
52	WS	P	R	WSP355	Ife-Odan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ejigbo	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
53	WS	P	R	WSP356	Mokuro Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife East	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
54	WS	P	R	WSP357	Famia/Oyere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife North	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
55	WS	P	R	WSP358	Alajue Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife North	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
56	WS	P	R	WSP359	Ifetedo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	1,288	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
57	WS	P	R	WSP360	Aye-Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
58	WS	P	R	WSP361	Omifunfun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
59	WS	P	R	WSP362	Mefoworade Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
60	WS	P	R	WSP363	Ora Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
61	WS	P	R	WSP364	Eko-Ende Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
62	WS	P	R	WSP365	Dagbolu Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
63	WS	P	R	WSP366	Iba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	52	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
64	WS	P	R	WSP367	Ila/Orangun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ila	U	S	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
65	WS	P	R	WSP368	Ibodi/Oscoed Water Scheme	State Water Corporation	Osun	Ilesha East	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
66	WS	P	R	WSP369	Asejire Water Scheme	State Water Corporation	Osun	Irewole	U	S	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1

Annex S10.1-3 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (3/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
67	WS	P	R	WSP370	Iwo/Ayiba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Iwo	U	S	3,161	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
68	WS	P	R	WSP371	Esa-Odo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Obokun	U	S	1,741	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
69	WS	P	R	WSP372	Oyan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	80	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
70	WS	P	R	WSP373	Okuku Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
71	WS	P	R	WSP374	Igbaye Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
72	WS	P	R	WSP375	Inisa Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
73	WS	P	R	WSP376	Tootoo/Igere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ola Oluwa	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
74	WS	P	R	WSP377	Ajagunlase Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ola Oluwa	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
75	WS	P	R	WSP378	Ikeji-Ile Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
76	WS	P	R	WSP379	Esa-Oke Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
77	WS	P	R	WSP380	Iwara/Igangan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
78	WS	P	R	WSP381	Ikeji-Arakeji Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
79	WS	P	R	WSP382	Oke-Osun/Abere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Osogbo	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
80	WS	P	R	WSP383	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	Osun	-	U/S	G	39,417	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
81	WS	P	R	WSP384	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Osun	-	R	G	2,079	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
82	WS	P	R	WSP385	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Osun	-	R	G	21,927	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
83	WS	P	N	WSP386	Ilesha Water Supply Project	State Water Corporation	Osun	Atakumosa West	U/S	S	60,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
84	WS	P	N	WSP387	Ife Water Supply Project	State Water Corporation	Osun	Ife Central	U/S	S	30,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
85	WS	P	N	WSP388	Urban/Small-Town Water Supply Projects	State Water Corporation	Osun	-	U/S	G	49,271	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps,			1						1	1
86	WS	P	N	WSP389	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Osun	-	R	G	12,002	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
87	WS	P	N	WSP390	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Osun	-	R	G	18,003	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
88	WS	P	R	WSP391	Ibadan/Asejire Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Egbeda	U	S	64,753	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
89	WS	P	R	WSP392	Ibadan/Osegere Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Egbeda	U	S	4,700	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
90	WS	P	R	WSP393	Ibadan/Eleyele Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ibadan North West	U	S	9,483	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
91	WS	P	R	WSP394	Igboora-Eruwa-Lanlate/Eruwa Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ibarapa East	U	S	1,149	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
92	WS	P	R	WSP395	Owode Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ido	U	S	313	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
93	WS	P	R	WSP396	Kishi Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Irepo	U	S	251	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
94	WS	P	R	WSP397	Iseyin Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Iseyin	U	S	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
95	WS	P	R	WSP398	Lalupon Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Lagelu	U	S	152	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
96	WS	P	R	WSP399	Ogbomoso-Ikoyi Ile/Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ogbomosho North	U	S	2,228	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
97	WS	P	R	WSP400	Igbetti /Afowose Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Olorunsogo	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
98	WS	P	R	WSP401	Igboho/Sanya Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Orelope	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
99	WS	P	R	WSP402	Oyo//Erelu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Oyo East	U	S	2,611	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1

Annex S10.1-3 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (4/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
100	WS	P	R	WSP403	Ago Amodu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Saki East	U	S	174	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
101	WS	P	R	WSP404	Saki/Fofo Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Saki West	U	S	464	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
102	WS	P	R	WSP405	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Oyo	-	R	G	5,096	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
103	WS	P	R	WSP406	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Oyo	-	R	G	25,069	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
104	WS	P	N	WSP407	Afijio Water Supply Project	State Water Corporation	Oyo	Afijio	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
105	WS	P	N	WSP408	Akinyele Water Supply Project	State Water Corporation	Oyo	Akinyele	U	S	6,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
106	WS	P	N	WSP409	Ago-Are/Tede Water Supply Project	State Water Corporation	Oyo	Atigbo	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
107	WS	P	N	WSP410	Ido Water Supply Project	State Water Corporation	Oyo	Ido	U	S	5,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
108	WS	P	N	WSP411	Iganna Water Supply Project	State Water Corporation	Oyo	Iwajowa	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
109	WS	P	N	WSP412	Okeho Water Supply Project	State Water Corporation	Oyo	Kajola	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
110	WS	P	N	WSP413	Lagelu Water Supply Project	State Water Corporation	Oyo	Lagelu	U	S	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
111	WS	P	N	WSP414	Ogo Oluwa Water Supply Project	State Water Corporation	Oyo	Ogo Oluwa	U	S	2,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
112	WS	P	N	WSP415	Oluyole Water Supply Project	State Water Corporation	Oyo	Oluyole	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
113	WS	P	N	WSP416	Ona-Ara Water Supply Project	State Water Corporation	Oyo	Ona-Ara	U	S	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
114	WS	P	N	WSP417	Ibadan/Odedele Water Supply Project 1	State Water Corporation	Oyo	Ona-Ara	U	S	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
115	WS	P	N	WSP418	Ibadan/Odedele Water Supply Project 2	State Water Corporation	Oyo	Ona-Ara	U	S	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
116	WS	P	N	WSP419	Ibadan/Odedele Water Supply Project 3	State Water Corporation	Oyo	Ona-Ara	U	S	118,460	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
117	WS	P	N	WSP420	Oriowo-Owode Water Supply Project	State Water Corporation	Oyo	Oyo West	U	S	7,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
118	WS	P	N	WSP421	Surulere Water Supply Project	State Water Corporation	Oyo	Surulere	U	S	4,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
119	WS	P	N	WSP422	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Oyo	-	R	G	23,863	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
120	WS	P	N	WSP423	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Oyo	-	R	G	35,794	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
P: proposed project by JICA Project Team=120													20	8	1	4	4	12	67	4		116

Group of projects for For IEE Study: Group 1: Water Treatment Plant with capacity more than 4,500 m3/d; Group 2: Water Treatment Plant with capacity less than 4,500 m3/d; Group 3: Well Field with capacity more than 4,500 m3/d; Group 4: Single Borehole Equipped with Electrical-mechanical Pump
Group 5: Single Borehole Equipped with Hand pump; Group R1: Rehabilitation of water system (big scale activities including important civil works); Group R2: Rehabilitation of water system (small scale activities including minor civil works); Group R3: Replacement of handpumps, etc.

Summary

Categorization		Projects for EIA/IEE	
Category 1	33		33
Category 2	83		83
Cagegory 3	4		-
Total	120	Total	116

Annex S10.1-4 List of Irrigation and Drainage Projects in the CMP (Ogun-Oshun Basin, Scenario-A)

SN	Sector	Status	Type	Code	Name of Project	Implementing Agency	HA	State	Outline/Scope of the Project	Group 1	Group 2	Group 3	Group 4	Protected Area	Category for EIA	Scoping for IEE	Remarks
1	I	G	1	IG17	Middle Ogun (I.G)	OORBDA	6	Oyo	Future Irrigation area 12000ha, Pump				1	Odo Ogun Forest Reserve	1	1	
2	I	G	1	IG18	Lower Ogun	OORBDA	6	Ogun	Future Irrigation area 12000ha, Dam, maize, cucumber	1					1	1	
3	I	G	1	IG19	Itoikin	OORBDA	6	Lagos	Future Irrigation area 315ha, Intake, rice		1				2	1	
4	I	G	1	IG31	Owiwi	OORBDA	6	Ogun	Future Irrigation area 302ha, Dam		1				2	1	
5	I	P	2	IP29	Esa Odo Dam	MANR	6	Osun	Future Irrigation area 800ha, Dam		1				2	1	
6	I	P	2	IP30	New Erinle	MANR	6	Osun	Future Irrigation area 500ha, Dam		1				2	1	
7	I	P	2	IP73	Orile Owu	MANR	6	Osun	Future Irrigation area 100ha, unknown		1				2	1	
8	I	P	2	IP74	Old Erinle Dam	MANR	6	Osun	Future Irrigation area 150ha, unknown		1				2	1	
9	I	P	2	IP109	Iwo	OORBDA	6	Osun	Future Irrigation area 0ha, Weir					Ikeji forest reserve, Ikeji-Ipetu, Ileji Native Area			Not available water for this project
10	I	P	2	IP110	Ilero	OORBDA	6	Oyo	Future Irrigation area 70ha, Dam		1				2	1	
11	I	P	2	IP111	Asa	OORBDA	6	Oyo	Future Irrigation area 500ha, Dam		1				2	1	
12	I	P	2	IP112	Okuku	OORBDA	6	Osun	Future Irrigation area 30ha, Dam				1	Oba Hills Forest Reserve, Oba Hills	1	1	
13	I	P	2	IP113	Oogi	OORBDA	6	Osun	Future Irrigation area 400ha, Intake		1				2	1	
14	I	P	2	IP114	Ipetu-Ijesha	OORBDA	6	Osun	Future Irrigation area 250ha, Intake		1				2	1	
										1	10	0	2			13	

G: on-going project=4; P: proposed project by JICA Project Team=10

Group of projects for For IEE Study: Group 1: Irrigation shemes with area more than 5,000 has; Group 2: Irrigation shemes with area less than 5,000 has; Group 3: Irrigation shemes with area more than 5,000 ha located in Protected Area

Group 4: Irrigation shemes with area less than 5,000 ha located in Protected Area

Existing Irrigation Scheme: Type=1 : On-going Scheme; Type=2 : Proposed Extension of Existing Scheme

New Irrigation Scheme: Type=3 : Proposed Supplementary Irrigation Scheme; Type=4 : Proposed Dam Irrigation Scheme; Type=5 : Proposed Integrated Scheme

Summary			
Categorization		Projects for EIA/IEE	
Category 1	3		3
Category 2	10		10
Cagegory 3	0		
Total	13	Total	13
Disregarded project			1
Total			14

Annex S10.1-5 List of Sanitation Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (1/2)

SN	Sector	Status	Code	Name of Project	Implementing Agency (I.M)	State	Settlement Category (U/S/R)	Qty (m3/day) (no.)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Category for EIA	Scoping for IEE
1	SA	P	SP163	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Lagos	U	239,273	Construction of sewerage treatment plant, sewer, etc.	1				1	1
2	SA	P	SP164	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Lagos	U	1,425,821	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
3	SA	P	SP165	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Lagos	U	1,688	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
4	SA	P	SP166	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Lagos	S	763	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
5	SA	P	SP167	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Lagos	S	1,437,537	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
6	SA	P	SP168	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Lagos	R	102,557	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
7	SA	P	SP169	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Lagos	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
8	SA	P	SP170	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Lagos	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
9	SA	P	SP185	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Ogun	U	374,326	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
10	SA	P	SP186	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Ogun	U	311	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
11	SA	P	SP187	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Ogun	S	324	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
12	SA	P	SP188	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Ogun	S	766,513	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
13	SA	P	SP189	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Ogun	R	515,919	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
14	SA	P	SP190	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Ogun	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
15	SA	P	SP191	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Ogun	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
16	SA	P	SP199	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Osun	U	11,042	Construction of sewerage treatment plant, sewer, etc.	1				1	1
17	SA	P	SP200	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Osun	U	182,391	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
18	SA	P	SP201	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Osun	U	197	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1

Annex S10.1-5 List of Sanitation Projects in the CMP (Ogun-Oshun Basin, Scenario-A) (2/2)

SN	Sector	Status	Code	Name of Project	Implementing Agency (I.M)	State	Settlement Category (U/S/R)	Qty (m3/day) (no.)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Category for EIA	Scoping for IEE
19	SA	P	SP202	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Osun	S	253	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
20	SA	P	SP203	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Osun	S	488,501	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
21	SA	P	SP204	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Osun	R	525,804	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
22	SA	P	SP205	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Osun	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
23	SA	P	SP206	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Osun	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
24	SA	P	SP207	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Oyo	U	34,109	Construction of sewerage treatment plant, sewer, etc.	1				1	1
25	SA	P	SP208	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Oyo	U	358,968	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
26	SA	P	SP209	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Oyo	U	374	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
27	SA	P	SP210	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Oyo	S	446	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
28	SA	P	SP211	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Oyo	S	870,682	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
29	SA	P	SP212	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Oyo	R	824,239	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
30	SA	P	SP213	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Oyo	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
31	SA	P	SP214	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Oyo	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
P: proposed project by JICA Project Team=31										3	4	8	16		15

Group of projects for For IEE Study: Group 1: Construction of Sewerage; Group 2: Construction of Septage Treatment System; Group 3: Construction of Public Toilets; Group 4: Promotion & Education Activities

Summary			
Categorization			Projects for EIA/IEE
Category 1	7		7
Category 2	8		8
Cagegory 3	16		-
Total	31	Total	15

Annex S10.1-6 List of Dams Projects in the CMP (Ogun-Oshun Basin, Scenario-B)

SN	Sector	Status	Type	Code	Name of Project	Implementing Agency	HA	State	Outline/Scope of the Project	Group 1	Group 2	Group 3	Group 4	Protected Area	Category for EIA	Scoping for IEE
1	D	G	1	DG1	Owiwi dam project	FMWR	6	Ogun	New dam construction(SN=1001): H=20m, GS=30MCM, SA=3.84km2, Purpose: IR, MW	1					1	1
2	D	G	1	DG2	Ile-Ife dam project	FMWR	6	Osun	New dam construction(SN=1002): H=19.7m, GS=14MCM, SA=1.67km2, Purpose: MW		1				2	1
3	D	G	1	DG3	Ilesha dam project	FMWR	6	Osun	New dam construction(SN=1003): H=20m, GS=25MCM, SA=3.12km2, Purpose: IR, MW, FI	1					1	1
4	D	G	1	DG32	Igbojaye dam project	FMWR	6	Oyo	New dam construction(SN=1033): H=18m, GS=5.6MCM, SA=0.66km2, Purpose: IR, WS		1				2	1
5	D	P	1A	DP16	Ibu dam project	FMWR	6	Ogun	New dam construction(SN=2205): H=19m, GS=20.6MCM, SA=4.61km2, Purpose: To ensure stable water source for the existing Otta Ikosi/Ogere/Shagamu Water Supply Scheme	1					1	1
6	D	P	1A	DP19	Ota dam project	FMWR	6	Ogun	New dam construction(SN=4014): H=16m, GS=6.4MCM, SA=1.5km2, Purpose: To ensure stable water source for the existing Ota Water Supply Scheme		1				2	1
7	D	P	1A	DP20	Araromi Ake/ Ijebu-Ode-Yemoji dam project	FMWR	6	Ogun	New dam construction(SN=4018): H=12m, GS=3.3MCM, SA=1.5km2, Purpose: To ensure stable water source for the existing Ijebu-Ode/Yemoji Water Supply Scheme		1				2	1
8	D	P	2	DP23	Odedele dam project	FMWR	6	Oyo	New dam construction(SN=3501): H=30m, GS=182.6MCM, SA=21.9km2, Purpose: To ensure stable water source for the proposed Odedele/Ibadan Water Supply Scheme	1					1	1
9	D	P	2		Aiete dam project	FMWR	6	Oyo	New dam construction(SN=3502): H=53m, GS=543MCM, SA=50.7km2, Purpose: To ensure stable water source for Lagos			1		Igangan Forest Reserve	1	1
10	D	P	2		Oba dam project	FMWR	6	Osun	New dam construction(SN=3593): H=22m, GS=197MCM, SA=32km2, Purpose: To ensure stable water source for Lagos	1					1	1
										5	4	1	0			10

G: on-going project =4; P: proposed project by JICA Project Team=6

Group of projects for For IEE Study: Group 1: Dams with SA more than 200 has; Group 2: Dams with SA less than 200 has; Group 3: Dams with SA more than 200 has located in protected area;

Group 4: Dams with SA less than 200 has located in protected area

Type: 1=Small to Medium scale dam; 1A=Small to medium scale dam for municipal water supply; 1B=Small to medium scale dam for irrigation develoment; 2: Large scale dam for irrigation development

3=Integrated project (Irrigation&Hydropower); 4=Rehabilitation project; 5=Capacity development project

Purpose: FC= Flood control; IR= Irrigation; MW=Municipal water supply; HP= Hydropower; FI= Fishery, OT= Others

Summary			
Categorization		Projects for EIA/IEE	
Category 1	6		6
Category 2	4		4
Cagegory 3	0		
Total	10	Total	10

Annex S10.1-7 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-B) (1/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
1	WS	P	R	WSP259	Lagos/Adiyan Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	110,782	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
2	WS	P	R	WSP260	Lagos/Iju Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	71,217	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
3	WS	P	R	WSP261	Lagos/Isashi Water Supply Scheme Rehabilitation Project	Lagos Water Corporation	Lagos	Ojo	U	S	6,330	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
4	WS	P	N	WSP264	Lagos/Yewa-1 Water Supply Project (Desalination)	Lagos Water Corporation	Lagos	Badagry	U	S	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
5	WS	P	N	WSP264-1	Lagos/Yewa-2 Water Supply Project (Desalination)	Lagos Water Corporation	Lagos	Badagry	U	S	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
6	WS	P	N	WSP265	Lagos/Odomola-1 Water Supply Project	Lagos Water Corporation	Lagos	Epe	U	S	113,650	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
7	WS	P	N	WSP266	Lagos/Odomola-2 Water Supply Project	Lagos Water Corporation	Lagos	Epe	U	S	409,140	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
8	WS	P	N	WSP266-1	Lagos/Odomola-3 Water Supply Project	Lagos Water Corporation	Lagos	Epe	U	S	431,870	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
9	WS	P	N	WSP267	Lagos/Adiyan-2 Water Supply Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	318,220	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
10	WS	P	N	WSP268	Lagos/Adiyan-3 Water Supply Project	Lagos Water Corporation	Lagos	Ifako-Ijaye	U	S	318,220	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
11	WS	P	N	WSP269	Lagos/Ibesha Water Supply Project (Desalination)	Lagos Water Corporation	Lagos	Ikorodu	U	S	227,300	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
12	WS	P	N	WSP270	Lagos/Isashi Expansion-1 Water Supply Project	Lagos Water Corporation	Lagos	Ojo	U	S	36,368	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
13	WS	P	N	WSP271	Lagos/Isashi Expansion-2 Water Supply Project	Lagos Water Corporation	Lagos	Ojo	U	S	104,558	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
14	WS	P	N	WSPA1	Addiotnal Water Works 1	Lagos Water Corporation	Lagos		U	S	1,102,093	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
15	WS	P	N	WSPA2	Addiotnal Water Works 2	Lagos Water Corporation	Lagos		U	S	1,102,093	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
16	WS	P	R	WSP304	Abeokuta Main Water Supply Scheme / Old Rehabilitation Project	State Water Corporation	Ogun	Abeokuta South	U	S	5,222	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
17	WS	P	R	WSP305	Abeokuta Main Water Supply Scheme / New Rehabilitation Project	State Water Corporation	Ogun	Abeokuta South	U	S	28,547	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
18	WS	P	R	WSP306	Ota Old Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	853	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
19	WS	P	R	WSP307	Ota New Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	2,350	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
20	WS	P	R	WSP308	Ilaro Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Egbado South	U	S	84	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
21	WS	P	R	WSP309	Ifo Akinsede/Papalanto Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ifo	U	S	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
22	WS	P	R	WSP310	Itele Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu East	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
23	WS	P	R	WSP311	Ijebu-Igbo/Apoje Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu North	U	S	6,440	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
24	WS	P	R	WSP312	Ijebu-Ode/Yemoji Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ijebu Ode	U	S	6,266	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
25	WS	P	R	WSP313	Ogere Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ikenne	U	S	2,332	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
26	WS	P	R	WSP314	Imeko Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Imeko-Afon	U	S	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
27	WS	P	R	WSP315	Abigi Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Ogun Waterside	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
28	WS	P	R	WSP316	Shagamu Water Supply Scheme Rehabilitation Project	State Water Corporation	Ogun	Shagamu	U	S	2,263	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
29	WS	P	R	WSP317	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Ogun	-	R	G	764	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
30	WS	P	R	WSP318	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Ogun	-	R	G	10,356	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
31	WS	P	N	WSP319	Ota Old (Doubling) Water Supply Project	State Water Corporation	Ogun	Ado-Odo/Ota	U	S	2,450	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
32	WS	P	N	WSP320	Apoje Regional Water Supply Project 1	State Water Corporation	Ogun	Ijebu North	U	S	87,627	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
33	WS	P	N	WSP321	Mokoloki Regional Water Supply Project 1	State Water Corporation	Ogun	Obafemi-Owode	U	S	250,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1

Annex S10.1-7 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-B) (2/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
34	WS	P	N	WSP322	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Ogun	-	R	G	19,249	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
35	WS	P	N	WSP323	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Ogun	-	R	G	28,873	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
36	WS	P	R	WSP339	Orile-Owu Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedade	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
37	WS	P	R	WSP340	Odeyinka Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
38	WS	P	R	WSP341	Ile-Ogbo/Kuta Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedire	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
39	WS	P	R	WSP342	Oluponna Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Aiyedire	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
40	WS	P	R	WSP343	Iperindo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa East	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
41	WS	P	R	WSP344	Ifewara Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	146	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
42	WS	P	R	WSP345	Ifewara/Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
43	WS	P	R	WSP346	Osu/Ilesha Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Atakumosa West	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
44	WS	P	R	WSP347	Igbajo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	627	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
45	WS	P	R	WSP348	Otan/Iresi Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
46	WS	P	R	WSP349	Igbajo/Oke-Irun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boluwaduro	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
47	WS	P	R	WSP350	Iree/Eripa Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boripe	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
48	WS	P	R	WSP351	Ada Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Boripe	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
49	WS	P	R	WSP352	Ede/Old Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ede North	U	S	3,133	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
50	WS	P	R	WSP353	Ede/New Regional Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ede North	U	S	62,664	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
51	WS	P	R	WSP354	Ejigbo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ejigbo	U	S	836	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
52	WS	P	R	WSP355	Ife-Odan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ejigbo	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
53	WS	P	R	WSP356	Mokuro Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife East	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
54	WS	P	R	WSP357	Famia/Oyere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife North	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
55	WS	P	R	WSP358	Alajue Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife North	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
56	WS	P	R	WSP359	Ifetedo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	1,288	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
57	WS	P	R	WSP360	Aye-Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
58	WS	P	R	WSP361	Omifunfun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
59	WS	P	R	WSP362	Mefoworade Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
60	WS	P	R	WSP363	Ora Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ife South	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
61	WS	P	R	WSP364	Eko-Ende Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	4,178	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
62	WS	P	R	WSP365	Dagbolu Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
63	WS	P	R	WSP366	Iba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ifelodun	U	S	52	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
64	WS	P	R	WSP367	Ila/Orangun Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ila	U	S	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
65	WS	P	R	WSP368	Ibodi/Oscoed Water Scheme	State Water Corporation	Osun	Ilesha East	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
66	WS	P	R	WSP369	Asejire Water Scheme	State Water Corporation	Osun	Irewole	U	S	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
67	WS	P	R	WSP370	Iwo/Ayiba Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Iwo	U	S	3,161	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
68	WS	P	R	WSP371	Esa-Odo Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Obokun	U	S	1,741	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
69	WS	P	R	WSP372	Oyan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	80	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
70	WS	P	R	WSP373	Okuku Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
71	WS	P	R	WSP374	Igbaye Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
72	WS	P	R	WSP375	Inisa Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Odo-Otin	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
73	WS	P	R	WSP376	Tootoo/Igere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ola Oluwa	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
74	WS	P	R	WSP377	Ajagunlase Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Ola Oluwa	U	S	209	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
75	WS	P	R	WSP378	Ikeji-Ile Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	766	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
76	WS	P	R	WSP379	Esa-Oke Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
77	WS	P	R	WSP380	Iwara/Igangan Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
78	WS	P	R	WSP381	Ikeji-Arakeji Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Oriade	U	S	104	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
79	WS	P	R	WSP382	Oke-Osun/Abere Water Supply Scheme Rehabilitation Project	State Water Corporation	Osun	Osogbo	U	S	70	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
80	WS	P	R	WSP383	Urban/Small-Town Water Supply Schemes Rehabilitation Project	State Water Corporation	Osun	-	U/S	G	39,417	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
81	WS	P	R	WSP384	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Osun	-	R	G	2,079	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
82	WS	P	R	WSP385	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Osun	-	R	G	21,927	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
83	WS	P	N	WSP386	Ilesha Water Supply Project	State Water Corporation	Osun	Atakumosa West	U/S	S	60,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
84	WS	P	N	WSP387	Ife Water Supply Project	State Water Corporation	Osun	Ife Central	U/S	S	30,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
85	WS	P	N	WSP388	Urban/Small-Town Water Supply Projects	State Water Corporation	Osun	-	U/S	G	49,271	Boreholes, motorized pumps, rizer pipes and accessories, generators, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps,			1						1	1
86	WS	P	N	WSP389	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Osun	-	R	G	12,002	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
87	WS	P	N	WSP390	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Osun	-	R	G	18,003	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
88	WS	P	R	WSP391	Ibadan/Asejire Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Egbeda	U	S	64,753	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
89	WS	P	R	WSP392	Ibadan/Osegere Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Egbeda	U	S	4,700	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
90	WS	P	R	WSP393	Ibadan/Eleyele Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ibadan North West	U	S	9,483	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc						1			1	1
91	WS	P	R	WSP394	Igboora-Eruwa-Lanlate/Eruwa Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ibarapa East	U	S	1,149	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
92	WS	P	R	WSP395	Owode Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ido	U	S	313	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
93	WS	P	R	WSP396	Kishi Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Irepo	U	S	251	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
94	WS	P	R	WSP397	Iseyin Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Iseyin	U	S	418	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
95	WS	P	R	WSP398	Lalupon Mini Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Lagelu	U	S	152	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
96	WS	P	R	WSP399	Ogbomoso-Ikoyi Ile/Oba Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Ogbomosho North	U	S	2,228	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
97	WS	P	R	WSP400	Igbetti /Afowose Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Olorunsogo	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
98	WS	P	R	WSP401	Igboho/Sanya Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Orelope	U	S	348	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
99	WS	P	R	WSP402	Oyo//Erelu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Oyo East	U	S	2,611	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1

Annex S10.1-7 List of Municipal Water Supply Projects in the CMP (Ogun-Oshun Basin, Scenario-B) (4/4)

S/N	Sector	Status	Devel. Type N/R	Code	Name of Project	Implementing Agency (I.M)	State	LGA	Settement Category (U/S/R)	Water Source (S/G)	Develop't Water Supply (m3/day)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Group 5	Rehabilitation Type R1	R2	R3	Category for EIA	Scoping for IEE
100	WS	P	R	WSP403	Ago Amodu Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Saki East	U	S	174	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
101	WS	P	R	WSP404	Saki/Fofo Water Supply Scheme Rehabilitation Project	State Water Corporation	Oyo	Saki West	U	S	464	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
102	WS	P	R	WSP405	Rural Water Supply Facilities Rehabilitation Project (Point-Source, Handpumps)	State RUWASSA	Oyo	-	R	G	5,096	Replacement of handpump, rizer pipes, accessories, repair of platform, etc								1	3	0
103	WS	P	R	WSP406	Rural Water Supply Facilities Rehabilitation Project (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Oyo	-	R	G	25,069	Replacement of motorized pump(s), generator(s), accessories, repair of structure(s) and pipes, etc							1		2	1
104	WS	P	N	WSP407	Afijio Water Supply Project	State Water Corporation	Oyo	Afijio	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
105	WS	P	N	WSP408	Akinyele Water Supply Project	State Water Corporation	Oyo	Akinyele	U	S	6,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
106	WS	P	N	WSP409	Ago-Are/Tede Water Supply Project	State Water Corporation	Oyo	Atigbo	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
107	WS	P	N	WSP410	Ido Water Supply Project	State Water Corporation	Oyo	Ido	U	S	5,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
108	WS	P	N	WSP411	Iganna Water Supply Project	State Water Corporation	Oyo	Iwajowa	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
109	WS	P	N	WSP412	Okeho Water Supply Project	State Water Corporation	Oyo	Kajola	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
110	WS	P	N	WSP413	Lagelu Water Supply Project	State Water Corporation	Oyo	Lagelu	U	S	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
111	WS	P	N	WSP414	Ogo Oluwa Water Supply Project	State Water Corporation	Oyo	Ogo Oluwa	U	S	2,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
112	WS	P	N	WSP415	Oluyole Water Supply Project	State Water Corporation	Oyo	Oluyole	U	S	3,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
113	WS	P	N	WSP416	Ona-Ara Water Supply Project	State Water Corporation	Oyo	Ona-Ara	U	S	8,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
114	WS	P	N	WSP417	Ibadan/Odedele Water Supply Project 1	State Water Corporation	Oyo	Ona-Ara	U	S	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
115	WS	P	N	WSP418	Ibadan/Odedele Water Supply Project 2	State Water Corporation	Oyo	Ona-Ara	U	S	120,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
116	WS	P	N	WSP419	Ibadan/Odedele Water Supply Project 3	State Water Corporation	Oyo	Ona-Ara	U	S	118,460	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
117	WS	P	N	WSP420	Oriowo-Owode Water Supply Project	State Water Corporation	Oyo	Oyo West	U	S	7,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc	1								1	1
118	WS	P	N	WSP421	Surulere Water Supply Project	State Water Corporation	Oyo	Surulere	U	S	4,000	Intake, water treatment works, pumping main, reservoirs and/or overhead tanks, distribution networks and public taps, etc		1							2	1
119	WS	P	N	WSP422	Rural Water Supply Projects (Point-Source, Handpumps)	State RUWASSA	Oyo	-	R	G	23,863	Boreholes, handpumps, rizer pipes and accessories, etc					1				2	1
120	WS	P	N	WSP423	Rural Water Supply Projects (Mini/Point-Source, Motorized Pumps)	State RUWASSA	Oyo	-	R	G	35,794	Boreholes, motorized pumps, rizer pipes, accessories, generator, overhead tanks, pipes and public taps, etc				1					2	1
P: proposed project by JICA Project Team=120													24	8	1	3	3	12	66	3		117

Group of projects for For IEE Study: Group 1: Water Treatment Plant with capacity more than 4,500 m3/d; Group 2: Water Treatment Plant with capacity less than 4,500 m3/d; Group 3: Well Field with capacity more than 4,500 m3/d; Group 4: Single Borehole Equipped with Electrical-mechanical Pump

Group 5: Single Borehole Equipped with Hand pump; Group R1: Rehabilitation of water system (big scale activities including important civil works); Group R2: Rehabilitation of water system (small scale activities including minor civil works); Group R3: Replacement of handpumps, etc.

Summary			
Categorization		Projects for EIA/IEE	
Category 1	37		37
Category 2	80		80
Cagegory 3	3		-
Total	120	Total	117

Annex S10.1-8 List of Irrigation and Drainage Projects in the CMP (Ogun-Oshun Basin, Scenario-B)

SN	Sector	Status	Type	Code	Name of Project	Implementing Agency	HA	State	Outline/Scope of the Project	Group 1	Group 2	Group 3	Group 4	Protected Area	Category for EIA	Scoping for IEE	Remarks
1	I	G	1	IG17	Middle Ogun (I.G)	OORBDA	6	Oyo	Future Irrigation area 12000ha, Pump				1	Odo Ogun Forest Reserve	1	1	
2	I	G	1	IG18	Lower Ogun	OORBDA	6	Ogun	Future Irrigation area 12000ha, Dam, maize, cucumber	1					1	1	
3	I	G	1	IG19	Itoikin	OORBDA	6	Lagos	Future Irrigation area 315ha, Intake, rice		1				2	1	
4	I	G	1	IG31	Owiwi	OORBDA	6	Ogun	Future Irrigation area 302ha, Dam		1				2	1	
5	I	P	2	IP29	Esa Odo Dam	MANR	6	Osun	Future Irrigation area 800ha, Dam		1				2	1	
6	I	P	2	IP30	New Erinle	MANR	6	Osun	Future Irrigation area 500ha, Dam		1				2	1	
7	I	P	2	IP73	Orile Owu	MANR	6	Osun	Future Irrigation area 100ha, unknown		1				2	1	
8	I	P	2	IP74	Old Erinle Dam	MANR	6	Osun	Future Irrigation area 150ha, unknown		1				2	1	
9	I	P	2	IP109	Iwo	OORBDA	6	Osun	Future Irrigation area 0ha, Weir					Ikeji forest reserve, Ikeji-Ipetu, Ileji Native Area			Not available water for this project
10	I	P	2	IP110	Ilero	OORBDA	6	Oyo	Future Irrigation area 70ha, Dam		1				2	1	
11	I	P	2	IP111	Asa	OORBDA	6	Oyo	Future Irrigation area 500ha, Dam		1				2	1	
12	I	P	2	IP112	Okuku	OORBDA	6	Osun	Future Irrigation area 30ha, Dam				1	Oba Hills Forest Reserve, Oba Hills	1	1	
13	I	P	2	IP113	Oogi	OORBDA	6	Osun	Future Irrigation area 400ha, Intake		1				2	1	
14	I	P	2	IP114	Ipetu-Ijesha	OORBDA	6	Osun	Future Irrigation area 250ha, Intake		1				2	1	
										1	10	0	2			13	

G: on-going project=4; P: proposed project by JICA Project Team=10

Group of projects for For IEE Study: Group 1: Irrigation shemes with area more than 5,000 has; Group 2: Irrigation shemes with area less than 5,000 has; Group 3: Irrigation shemes with area more than 5,000 ha located in Protected Area

Group 4: Irrigation shemes with area less than 5,000 ha located in Protected Area

Existing Irrigation Scheme: Type=1 : On-going Scheme; Type=2 : Proposed Extension of Existing Scheme

New Irrigation Scheme: Type=3 : Proposed Supplementary Irrigation Scheme; Type=4 : Proposed Dam Irrigation Scheme; Type=5 : Proposed Integrated Scheme

Summary			
Categorization		Projects for EIA/IEE	
Category 1	3		3
Category 2	10		10
Cagegory 3	0		
Total	13	Total	13
Disregarded project			1
Total			14

Annex S10.1-9 List of Sanitation Projects in the CMP (Ogun-Oshun Basin, Scenario-B) (1/2)

SN	Sector	Status	Code	Name of Project	Implementing Agency (I.M)	State	Settlement Category (U/S/R)	Qty (m3/day) (no.)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Category for EIA	Scoping for IEE
1	SA	P	SP163	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Lagos	U	564,908	Construction of sewerage treatment plant, sewer, etc.	1				1	1
2	SA	P	SP164	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Lagos	U	2,073,752	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
3	SA	P	SP165	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Lagos	U	3,985	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
4	SA	P	SP166	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Lagos	S	1,949	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
5	SA	P	SP167	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Lagos	S	3,952,549	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
6	SA	P	SP168	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Lagos	R	-	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
7	SA	P	SP169	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Lagos	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
8	SA	P	SP170	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Lagos	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
9	SA	P	SP185	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Ogun	U	374,326	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
10	SA	P	SP186	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Ogun	U	311	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
11	SA	P	SP187	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Ogun	S	324	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
12	SA	P	SP188	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Ogun	S	766,513	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
13	SA	P	SP189	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Ogun	R	515,919	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
14	SA	P	SP190	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Ogun	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
15	SA	P	SP191	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Ogun	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
16	SA	P	SP199	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Osun	U	11,042	Construction of sewerage treatment plant, sewer, etc.	1				1	1
17	SA	P	SP200	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Osun	U	182,391	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
18	SA	P	SP201	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Osun	U	197	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1

Annex S10.1-9 List of Sanitation Projects in the CMP (Ogun-Oshun Basin, Scenario-B) (2/2)

SN	Sector	Status	Code	Name of Project	Implementing Agency (I.M)	State	Settlement Category (U/S/R)	Qty (m3/day) (no.)	Outline / Scope of the Project(s)	Group 1	Group 2	Group 3	Group 4	Category for EIA	Scoping for IEE
19	SA	P	SP202	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Osun	S	253	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
20	SA	P	SP203	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Osun	S	488,501	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
21	SA	P	SP204	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Osun	R	525,804	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
22	SA	P	SP205	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Osun	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
23	SA	P	SP206	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Osun	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
24	SA	P	SP207	Construction of Sewarage System (Urban)	FMWR, FME, FEPA or/and SEPA	Oyo	U	34,109	Construction of sewerage treatment plant, sewer, etc.	1				1	1
25	SA	P	SP208	Construction of Septage Treatment System (Urban)	FMWR, FME, FEPA or/and SEPA	Oyo	U	358,968	Construction of septage treatment facilities, final disposal site, etc.		1			1	1
26	SA	P	SP209	Construction of Public Toilets (Urban)	FMWR or/and StateAgencies	Oyo	U	374	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 4 public toilets per 20,000 urban population.			1		2	1
27	SA	P	SP210	Construction of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Oyo	S	446	Construction of a unit of 3 compartment toilet, urinals and hand washing facilities. 2 public toilets per 20,000 semi-urban/small-towns population.			1		2	1
28	SA	P	SP211	Social Intervention (Semi-Urban/Small-Towns)	StateAgencies or/and LGA	Oyo	S	870,682	Social intervention activities to promote appropriate choice of sanitary latrine.				1	3	
29	SA	P	SP212	Social Intervention (Rural) / Community-Led Total Sanitation	StateAgencies or/and LGA	Oyo	R	824,239	Social intervention activities to promote appropriate choice of sanitary latrine with Community-Led Total Sanitation Approach.				1	3	
30	SA	P	SP213	Promotion of Public Toilets (Urban)	FMWR or/and StateAgencies	Oyo	U		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
31	SA	P	SP214	Promotion of Public Toilets (Semi-Urban/Small-Towns)	FMWR or/and StateAgencies	Oyo	S		Promotion and education of use of public toilets for upgrading sanitation level and public health of people. 30% of construction cost.				1	3	
P: proposed project by JICA Project Team=31										3	4	8	16		15

Group of projects for For IEE Study: Group 1: Construction of Sewerage; Group 2: Construction of Septage Treatment System; Group 3: Construction of Public Toilets; Group 4: Promotion & Education Activities

Summary			
Categorization		Projects for EIA/IEE	
Category 1	7		7
Category 2	8		8
Cagegory 3	16		-
Total	31	Total	15

JICA