



**Federal Ministry of Water Resources  
(FMWR)**



**Japan International Cooperation Agency  
(JICA)**

# **The Project for Review and Update of Nigeria National Water Resources Master Plan**

**Volume 1**

## **National Water Resources Master Plan 2013 Executive Summary**



Rural Water Supply



Shiroro Dam (Niger State)

**January 2014**



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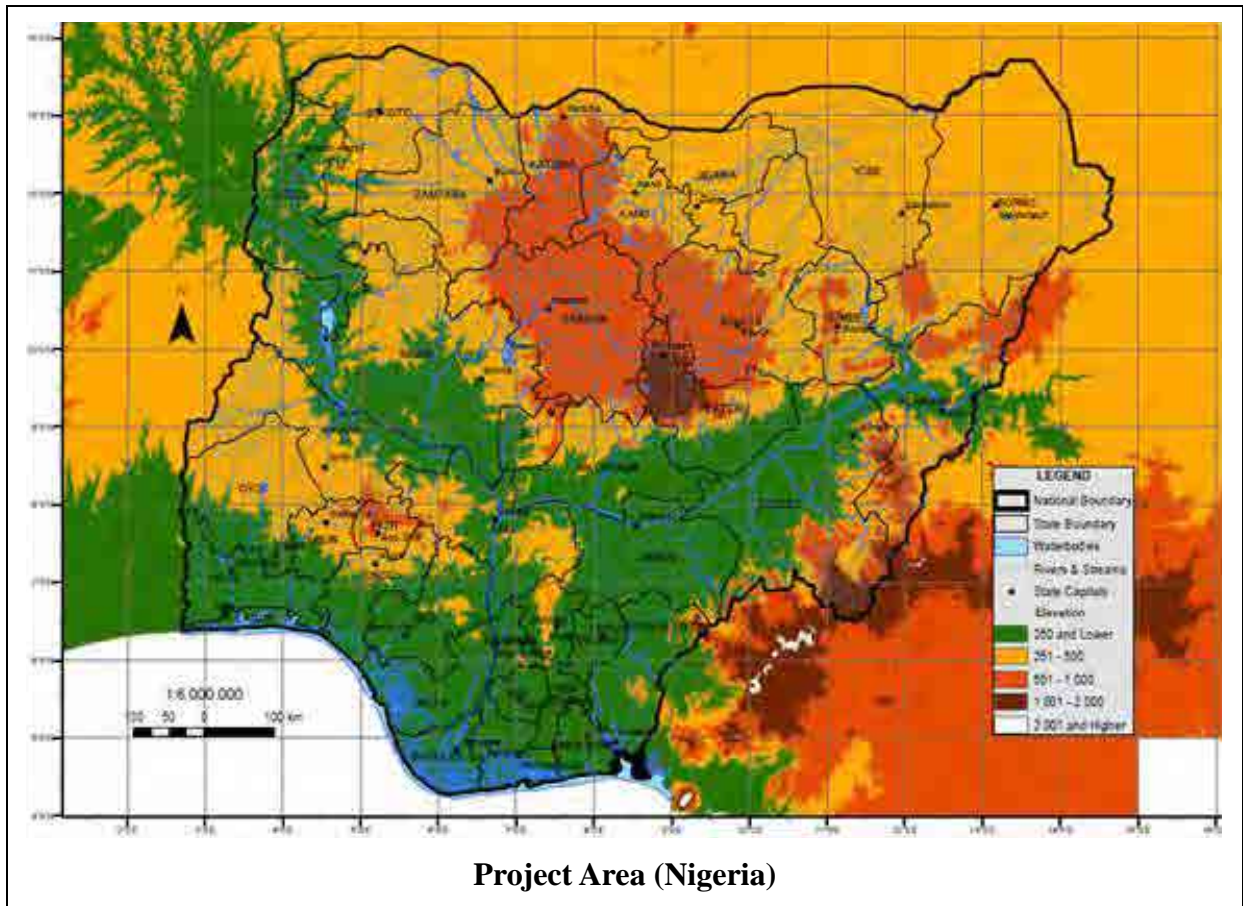
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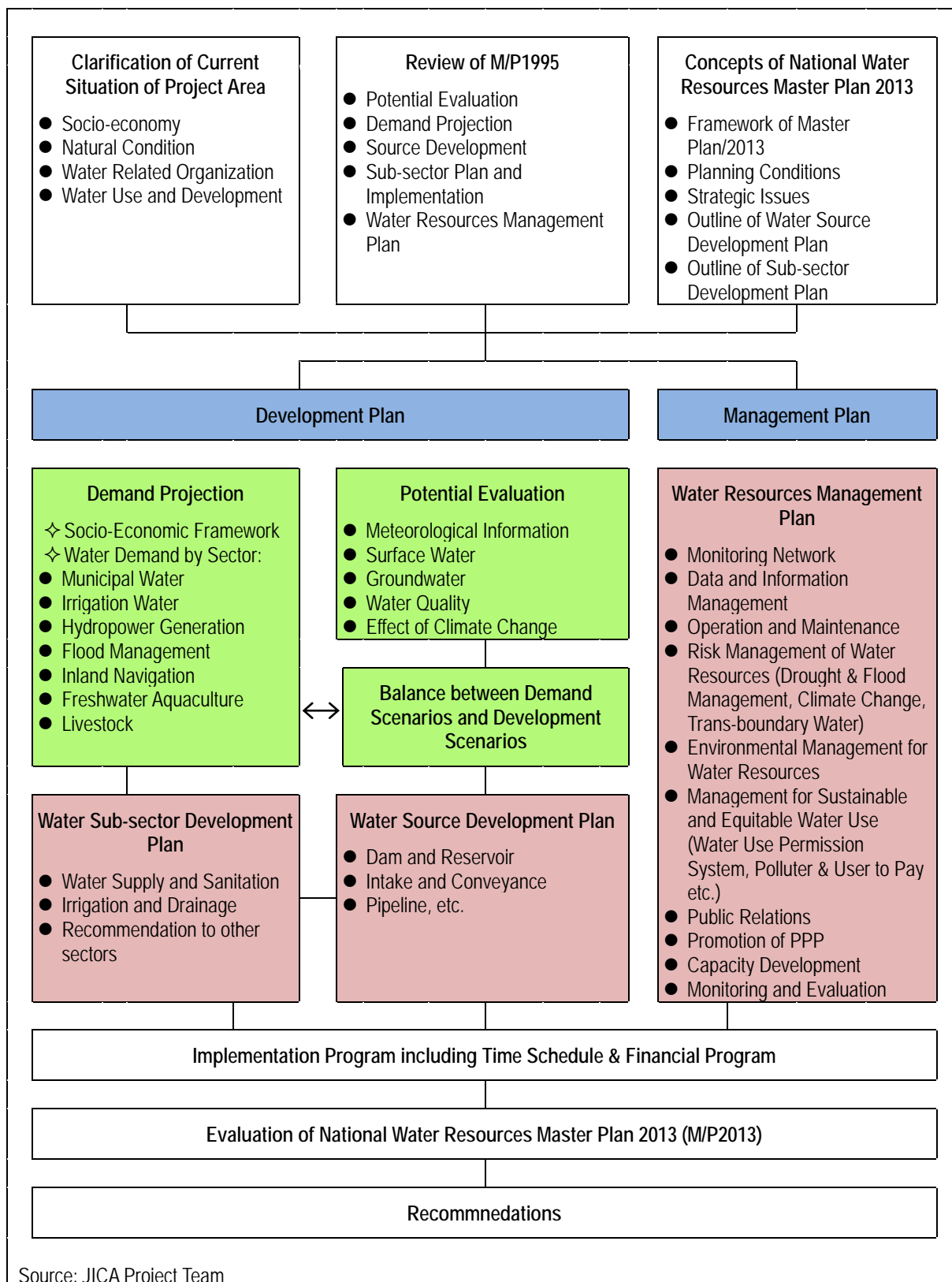
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**Foreign Exchange Rate**

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(31<sup>st</sup> Dec. 2012)





## Contents of National Water Resources Master Plan 2013



## 1. INTRODUCTION

This document is an executive summary of National Water Resources Master Plan 2013 described below.

### (1) Background of Revision of existing National Water Resources Master Plan 1995

In Nigeria, the water shortage is more serious than before mainly in the northern part of the country because the needs of water resources development is increasing for irrigation, water supply and energy generation and so on with population growth and economic development. Therefore, adequate management and development of water resources is an urgent problem, preventing environmental damage.

For promotion of appropriate administrative management of water resources, the Government of Nigeria requested the Government of Japan to review and update the existing National Water Resources Master Plan formulated in 1995 (hereinafter “M/P1995”). In response, Japan International Cooperation Agency (hereinafter “JICA”) dispatched a team of consultant to Nigeria in February 2011 to discuss the Scope of Works summarizing the framework of the master plan project, and then the Scope of Works was agreed and signed in March 2011. JICA formed the Project Team composed of consultants for “The Project for Review and Update of Nigeria National Water Resources Master Plan” (hereinafter “the Project”) and has implemented the Project since August 2011.

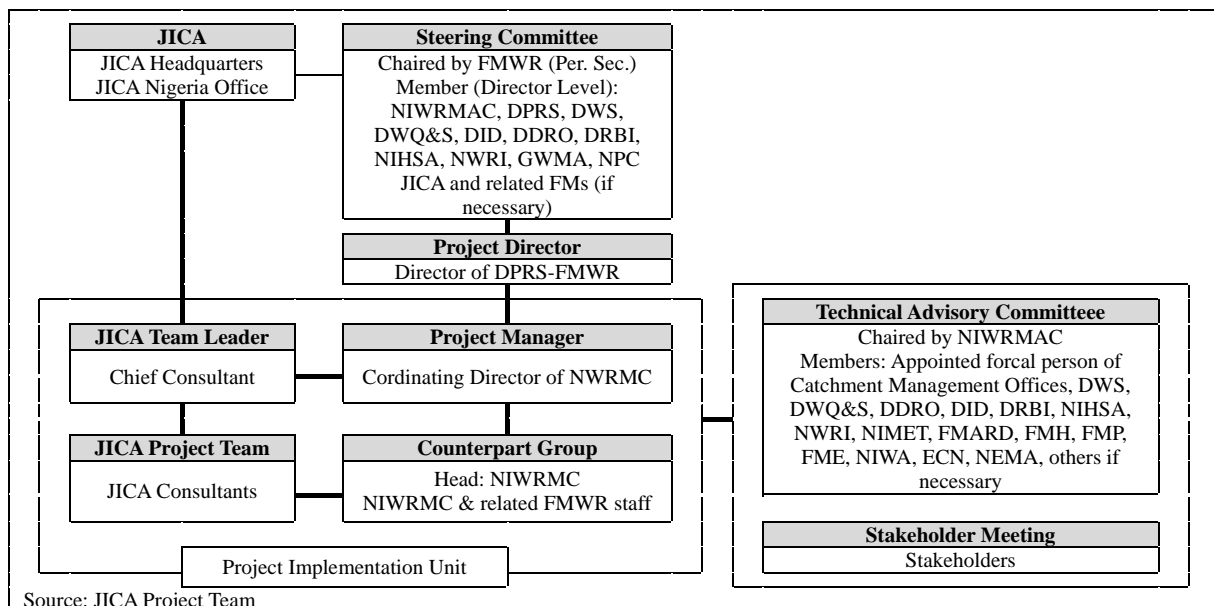
Objectives of the Project are as follows:

- 1) Formation of “Nigeria National Water Resources Master Plan 2013” (hereinafter “M/P2013”), through the process of review and updated of the M/P1995.
- 2) Formulation of Draft Catchment Management Plan (CMP) for the prioritized two areas; HA-1 (Niger-North) and Ogun-Oshun Basin in the eastern area of HA-6 (West Littoral)

The Project consists of the following three phases as a total of 30 months (see Table 1), and project organization is shown in Figure 1.

**Table 1 Schedule of Project**

Phase - 1 (Aug. 2011 - Aug. 2012) 13 months	Phase - 2 (Sep. 2012 – Apr. 2013), 8 months	Phase - 3 (May 2013 – Jan. 2014), 9 months
<p style="text-align: center;">Basic Study</p> <ul style="list-style-type: none"> <li>◆ Data Collection</li> <li>◆ Evaluation of Potential</li> <li>◆ Projection of Demand</li> <li>◆ Clarification of Issues</li> <li>◆ Discussion on Direction of Water Resources Management</li> </ul>	<p style="text-align: center;">M/P</p> <ul style="list-style-type: none"> <li>◆ Formulation of National Water Resources Master Plan (M/P2013)</li> </ul>	<p style="text-align: center;">CMP</p> <ul style="list-style-type: none"> <li>◆ Formulation of Draft Catchment Management Plan for 2 HAs:                             <ul style="list-style-type: none"> <li>- HA-1: Niger North</li> <li>- Ogun-Osun Basin in the eastern area of HA-6: West Littoral</li> </ul> </li> </ul>



**Figure 1 Project Organization**

## **(2) Results of Review of M/P1995**

Based on the projects proposed in the M/P1995 and overall performance of its implementation, the Project should consider the followings:

### **National Policies and Basic Strategies of Water Master Plan**

The M/P1995 take into account water policies shown in the “National Long Term Plan, 1992, NPC” such as 1) Expansion of irrigated agriculture to meet the growing food demand due to population growth, 2) Provision of facilities to supply safe and clean domestic water, and 3) Preservation of the quality of water environment. Strategies of the M/P1995 have been developed along with these basic policies. These policies, still important national water policies, should be retained by the Project in accordance with the latest national plans (Nigeria Vision 20: 2020, Water Sector Roadmap etc.).

### **Evaluation of Water Resources Potential**

In the M/P1995, the water resources potential has been evaluated by using the observed flow and rainfall observations of the 1970s and 1980s. It was the first time comprehensive evaluation of water resources across the country as a whole. However, it has several drawbacks from the viewpoint of appropriate water resources management. For example, regarding the evaluation of surface water potential, 1) Evaluation period using data is short. 2) Potential is evaluated only in average and drought is not evaluated. 3) There is no discussion on flood discharge. In the Project, using long-term observation data (long-term rainfall data is available) as long as possible, evaluation should clarify the flow regime, flood discharge and probability of flow. Regarding the evaluation of groundwater potential, evaluation shall take into account not only meteorological conditions but also hydrogeological conditions of the area.

### **Demand Projection and Implementation of Water Resources Development Plan**

The M/P1995 shows water demand to satisfy as target of the national plan, but the process to decide final amount of demand which is a base of development plan for water supply and irrigation is not clear. Demand options should be compared based on various development scenarios. As an evaluation of the present, the planned demand seems to be somewhat excessive. About this, it may be said that progress of various projects is late adversely. Water development project (for surface water and groundwater development), water supply project and irrigation project shows the delayed progress. The delay of the project extends to the rehabilitation project for existing facilities as well as a new project. Although it is pointed out that the project is delayed due to budget shortfall, there seems to be a problem with not only budget shortfall but also the project operation systems. Concerning sub-sectors other than water supply and irrigation, there is insufficient discussion in the M/P1995 due to the jurisdiction of other ministries.

In recent years, the demands for flood / erosion control and small scale hydropower generation are increasing. In the Project, discussion on these new demands should be deepened from the viewpoint of “Integrated Water Resources Management (IWRM)”.

### **Implementation of Water Resources Management Plan**

The M/P1995 has proposed the foundation of monitoring system to observe the quantity and quality of water resources elements (climate, surface water and groundwater) but its implementation is very late. Since monitoring of water resources is the cornerstone of water resources management, in the Project, the method of early realization of water resources monitoring system should be examined.

New organizations such as NIHSA and NIWRMC were established changing the form but taking over the functions of the organization proposed in the M/P1995. NIWRMC was established to be responsible for water resources management. The M/P1995 does not mention the contents of water resources management. The Project should discuss the contents of water resources management that NIWRMC should carry out. Also, these new organizations have important issues in addition to existing organizations. One of the challenges is Capacity Development (CD). In addition to CD mentioned above, the Project should discuss current and important challenges concerning water resources management such as information management, risk management (including drought, flood, cross boundary water), adjustment of water right, conservation of water environment, promotion of PPP, effective application of monitoring and evaluation (M&E) etc. The Project should also propose the practical measures to realize them.

## **Conclusion**

The M/P1995 outlined how to achieve the targets set in the national policy at the time (on water supply, and irrigation etc.). Implementation of the projects proposed in the M/P1995 does not proceed as scheduled after some 20 years have passed from the planning, and it is also difficult to achieve goals for the target year (2020). There are such reasons as

- 1) Is it correct demand projection? (water supply unit rate, irrigation scale, cropping pattern, combination with irrigation and rain-fed agriculture etc.),
- 2) Is it weak implementation structure? (deficient regulatory & operational system, lack of human capacity, insufficient participation of stakeholders etc.),
- 3) Is it lack of budget? (unsuitable project environment such as consensus building, poor project justification note, lack of lobbying for budget acquisition).

In the Project, measures to solve these issues, or measures to realize the plan should be carefully examined.

### **(3) Concepts of M/P2013**

The national plans such as “Nigeria Vision 20:2020”, “Water Sector Roadmap” which are the top plans of national water resources master plan set the goals to improve the current situation in the water sector:

- Low rate of access to safe and clean water and sanitation facilities
- Low contribution of irrigation to national food security, and
- Insufficient utilization of hydropower for renewable energy

The M/P2013 is a plan stimulating concrete actions to solve these problems. To break through this situation, it is necessary to formulate a plan integrating development, utilization and management of water resources through evaluation of water resources potential and demand projection on the basis of the philosophy of Integrated Water Resources Management (IWRM). This section introduces the framework of the updated/new master plan that was prepared to address these issues.

### **Planning Conditions of M/P2013**

In principle, the M/P2013 is formulated based in following planning conditions:

#### **Flow and Climate Condition**

- Future climate condition is still uncertain. Therefore, the planning will be based on the existing climate and runoff conditions.
- The existing climate condition (40 years: 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**

- 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.
- For the climate change scenario, the scenario based on the output of GCM would be applied.

#### **Trans-boundary Water**

- 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.
- 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**

- The following target safety level for surface water development will be basically applied. It is noted that municipal water supply includes domestic, industrial and commercial through water

supply system.

- 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.)

### **Priority of Water Usage**

- 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.
- 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.
  - 1<sup>st</sup> priority: Minimum stream flow requirement
  - 2<sup>nd</sup> priority: Municipal water supply
  - 3<sup>rd</sup> priority: Irrigation water supply
  - 4<sup>th</sup> priority: Other water supply including hydropower, if any
- 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**

- $Q_{97DS90\%Y}$  (90% yearly dependable 97 percentaile daily flow for a single year), which may represent the drought condition according to the flow regime in each area in Nigeria, will be applied as the minimum stream flow requirement.
- 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**

- Basically, the groundwater use that exceeds safe yield should not be planned.

### **Strategic Socio-Environmental Consideration**

In order to avoid significant negative socio-environmental impacts, the followings are strategically considered for formulating the M/P2013.

### **Water Sources 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 the 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 farmers in Fadama area could secure their current practical life style.
- Supplemental irrigation scheme which utilizes rain water efficiently would be promoted in such area where precipitation is high as HA-5 and -7, in order to minimize water source development.

### **Effective Utilization of M/P2013**

The M/P2013 deals with nationwide water resources development and management in Nigeria comprehensively, and is convenient for FMWR. However, many activities of water resources development and management should be carried out at the level of hydrological area or state, and some of the sub-sectors are under the jurisdiction of other federal ministries or agencies.

Therefore, the M/P2013 is formulated with respect to water usage as follows:

- Application to Catchment Management Plan (CMP) as a master plan for each hydrological area
- Application to sub-sector development plans except water supply, sanitation, irrigation and drainage

## **2. STRATEGIC ISSUES**

Through the Project, the strategic issues on water resources in Nigeria have been identified. The following strategic issues are taken into account in formulating the M/P2013.

### **Strategic Issue-1: Water Resources Management and Development in Consideration of Unevenly Distributed Water Resources and Demand**

The hydrological condition in Nigeria varies much from place to place, resulting in the uneven distribution of water resources. Although the average is 1,800m<sup>3</sup>/year/person in 2010 and 1,100m<sup>3</sup>/year/person in 2030, respectively, those in HA-1 and 8 are especially low. It is necessary to consider these unevenly distributed water resources for effective and sustainable water use. The water resources management and development plan would be formulated based upon the water balance between supply capacity of water source and water demand.

### **Strategic Issue-2: Addressing Increasing Municipal Water Demand on the Premise of Current Low Operation Rate of Water Supply Facilities**

The current (2010) population of 150 million in Nigeria is expected to reach to 250 million in 2030 that is the target year of the M/P2013. It is most fundamental and important in the water sector to secure the adequate volume of domestic water to meet the increasing population.

Water supply coverage is presently about 50%. When the target of municipal water supply is set at 100% coverage in 2030, the municipal water demand of 3.1BCM/year in 2010 would increase to 9.0BCM/year in 2030. In other words, almost three times volume of water would be required in 2030. Meanwhile, the existing water supply facilities are not fully utilized; the average operation rates of water purification plant and production wells are 45.2% and 63% of those design capacity, respectively. This could be one of the major reasons for current low coverage (about 50% in average) of municipal water supply. 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.

### **Strategic Issue-3: Promotion of Sound and Self-reliant Irrigation Development**

The developed irrigation area and the actually irrigated area are 130,000ha and 70,000ha, respectively, although the planned irrigation area is 440,000ha. The low operation rate of the developed irrigation area could be mainly caused by high operation and maintenance cost as well as deterioration of facilities, especially for the schemes that require external energy such as pumps. It is necessary to develop new schemes that are more economically efficient and self-reliant, instead of further developing existing schemes with low efficiency; in order to increase the irrigation area effectively. For example, gravity schemes without pump and integrated scheme with hydropower component that can supply energy for internal use within a project would be considered for the new schemes.

### **Strategic Issue-4: Effective Utilization of Existing Water Source Facilities in View of Contemporary Needs**

It is an important issue to identify how the excess volume of water is effectively utilized to meet contemporary needs, when it is expected that the existing dams have excess volume even if water demand in 2030 is considered. For example, part of excess volume can be converted for flood control purpose if there is problem of flooding downstream, or part of the excess volume may be converted to increase hydropower generation and enhance river and flood plain environment. Reliable supply of energy is a major issue of development in Nigeria; therefore, the conversion of the excess surface water volume for hydropower generation could be the solutions. As a result, the optimum utilization of excess volume of water in existing dams would be promoted.

**Strategic Issue-5: Enhancement of Water-related Data/Information and Its Uniform Management**

Currently, water-related data/information such as dams, water purification plants, irrigation schemes and production wells are not uniformly managed. Furthermore, meteorological, hydrological data as well as water use data are also not managed uniformly. This also poses an impediment to daily operation of water resources facilities. The strategy would be to enhance the capacity of FMWR and relevant agencies for periodical collection and uniform management of water-related data/information as well as promote awareness on importance of water-related data/information.

**Strategic Issue-6: Consideration of Increasing Risk on Water Resources**

From the view point of risk management, the identification of the risk as well as the coping strategy is important. In order to identify the risk correctly, the enhancement of fundamental data/information including proper communication with neighboring countries should be promoted. As for coping with the risk, the following should be considered; i) establishment of flexible implementation structure which can adapt future changes, and ii) enhancement of emergency response for flood and drought conditions. It should be noted that both rely on the availability of fundamental water-related data/information.

**Strategic Issue-7: Active Involvement of Water Resources Administrator in Management of Important Rivers and Flood Plains**

There were devastating damages in such rivers and flood plains during the large scale flood along the Niger and Benue Rivers in 2012. Due to the importance of proper management of rivers and flood plains, as the place where water is used and flood often disturb human activity with been increasing frequency, it is necessary for the water resources administrator to be involved actively in the management of the rivers and flood plains. The strategy is that the main rivers such as rivers where large scale dams are located are first identified and designated as important rivers, on which active management such as grasp and prediction of flood situation, information dissemination, as well as control of low flow condition are then be conducted through intensive monitoring of the rivers. It is necessary to establish the monitoring system and enhance its capacity.

**Strategic Issue-8: Water Quality Monitoring to Secure Clean and Safe Water**

It is important to secure clean and safe water by proper water environmental management, in addition to adequate water quantity conservation and development. However, because the current water quality condition for both surface and groundwater is not well grasped, it is difficult to assess the water quality for existing and future conditions and to consequently undertake decision making. In order to conduct proper water environment management, the condition of water quality in terms of water use should be studied by FMWR as water resources administrator. The capacity of FMWR on the water quality monitoring should therefore be enhanced.

**Strategic Issue-9: Institutional Development & Strengthening of Water Resources Management**

FMWR have the powers and functions mainly in such water sub-sectors as water resources development (surface water and groundwater), water supply and sanitation, irrigation and drainage. Other sub-sectors such as hydro-electric power generation, flood control, inland transportation, fisheries/aquaculture/livestock etc. are undertaken by Federal Ministry of Powers, Federal Ministry of Environment and etc. Even in a single sub-sector, roles and responsibilities are further compartmentalized in some institutions. The current water resources management is a multi-sectorial management. A lack of adequate coordination and cooperation is considered the challenge to be addressed. In addition, inconsistency of policies and strategies in some ministries and agencies causes

fragmentation in the management. Taking the current situation and issues with regard to water resources management into account, development and strengthening of institutional framework shall be established. Hence, we suggest the basic policies for the purpose of addressing this challenge; “Cooperative Institutional Arrangement”, “Participatory Management Administration”, “Fair Regulatory Framework”, and “Decentralization and Coordination”

### 3. PROJECTION OF FUTURE WATER DEMAND

#### 3.1 Population

The projected population up to 2030 was carried out based on two data; Census Population of 1991 and 2006 and Estimated Population of 2010 by the United Nations. “The 2010 Revision of World Population Prospects” of the United Nations projected the three different cases of future national population of Nigeria as presented. Based on the median case, the JICA Project Team projected the state-wise and HA-wise future population up to 2030 as shown in Table 2.

**Table 2 Census and Projected Population (People in thousands)**

Region	Census <sup>1)</sup>		Estimate <sup>2)</sup>	Projection <sup>3)</sup>				
	1991	2006	2010	2015	2020	2025	2030	
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%	
HA-wise <sup>3)</sup>								
1	Niger North	-	15,252	17,142	19,361	21,829	24,448	27,231
2	Niger Central	-	14,802	17,018	19,779	23,064	26,828	31,171
3	Upper Benue	-	10,866	12,220	13,807	15,565	17,427	19,398
4	Lower Benue	-	7,299	8,301	9,513	10,909	12,454	14,173
5	Niger South	-	17,504	19,644	22,161	24,959	27,924	31,078
6	Western Littoral	-	31,864	35,910	40,690	46,036	51,735	57,821
7	Eastern Littoral	-	18,578	20,803	23,410	26,302	29,359	32,593
8	Lake Chad	-	24,267	27,385	31,070	35,205	39,621	44,350

Source: 1) NPC - Census, 2) & 3) United Nations - estimate and projection on Nigeria, and 3) JICA Project Team - State-wise and HA-wise projection on the basis of the projection on Nigeria by the United Nations

#### 3.2 Municipal Water

##### (1) Basic Conditions of Water Demand Projection

##### Domestic Water

Domestic water demand is projected based on the conditions shown in the following tables:

**Table 3 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: household using flush toilet)
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	Ruralized water usage (referenced indicator: household using handpump)

Source: JICA Project Team

**Table 4 National Water Supply Coverage by Settlement Category in Target Years**

Target Year	National Water Supply Coverage			
	Nationwide	Urban	Semi-Urban, Small Town	Rural
2010 (Current) Estimated by the Project	56%	72%	51%	40%
2015	71%	81%	68%	60%
2020	85%	91%	84%	80%
2025	100%	100%	100%	100%
2030	100%	100%	100%	100%

Source: JICA Project Team

**Table 5 Population Served by State**

	Population Served (1,000 persons)				
	2010	2015	2020	2025	2030
Nationwide	79,848	120,287	170,100	229,796	257,815

Source: JICA Project Team

**Table 6 Per Capita Consumption of Domestic Water**

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

Source: Federal Ministry of Water Resources (FMWR)

### **Commercial Water**

Daily average commercial water consumption is calculated at the ratio of 10% of daily average domestic water consumption across the board at the State level; and at 20% for Kano, Lagos States and FCT Abuja.

### **Industrial Water**

Daily average industrial water consumption in 2010 is calculated at the ratio of 1.25% of daily average domestic water consumption in the Northern area, 2.5% in the Southern area and 5.0% in Kano and Lagos States. It is estimated that daily average industrial water consumption increases at an annual ratio of 8.5% (GDP growth rate).

### **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 with unaccounted for water (UFW). But, most State Water Agencies can not figure out water loss ratio accurately because flat rate tariff is much more common in water supplies in Nigeria, which means there is almost no water meter installation. Furthermore, poor data management of existing facilities causes difficulty of status analysis. In view of these facts, 30% of water loss ratio is applied across the board except for rural water supply.

## **(2) Result of Water Demand Projection**

Table 7 shows result of nationwide water demand projection, and it will nearly triple between 2010 and 2030.

**Table 7 Water Demand Projection by State**

	Water Demand (Million Liter per Day : MLD)					2030/2010 Ratio
	2010	2015	2020	2025	2030	
Nationwide	8,254	11,666	15,890	20,994	23,876	2.9

Source: JICA Project Team

## **3.3 Irrigation Water**

### **(1) Development of Agricultural and Irrigation**

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 it is still heavily dependent on import of processed agricultural products, particularly rice, wheat, sugar, livestock products and fish. Rice and cassava are specially identified as significant crops in the nation. Potential irrigable area of 3.14 million hectares spread across Nigeria but irrigated paddy is at about 48,000 hectares. It is necessary to expand irrigable farmland and rain-fed paddy for food security, and also to enhance rehabilitation and expansion of existing public irrigation schemes and development of new irrigated farmlands.

Keys to Nigerian agricultural and irrigation policies are 1) enhanced agricultural productivity, 2) expanded irrigated farmland, and 3) internal reform of irrigated farming. In order to achieve these, the followings should be promoted.

- Completion of ongoing schemes for irrigation development and rehabilitation,
- Development of new irrigated farmland,
- Increased rice production,
- Expansion of rain-fed farmland and growth of crop production, and
- Creation of employment opportunity

### **Planted area and yield of rain-fed rice cultivation**

Rain-fed upland rice and lowland rice is predominant in Nigeria and irrigated paddy field is less

common. In 2008, the farmland areas of these three types of rice cultivation are 510,050ha, 1,243,151ha, 47,799ha, respectively.

According to statistical data of National Bureau of Statistics and Regional Office, the rates of annual increase of rice cultivation in the past 16 years are 0.83% and 3.98% in the last 5 years. On the other hand, annual rate of yield in the past 16 years is 0.92%.

### **Required rice production for accomplishing 100% self-sufficiency**

To achieve 100% self-sufficiency in rice production for the population in 2030, 11.9 million tons of rice production is required, according to National Rice Development Strategy.

- Polished rice consumption : 30 kg/capita/yr (Source: NRDS)
- Projected polished rice : 30 (kg/capita/yr) × 257,800,000 (people) ×  
consumption in 2030 : 1.0 (self-sufficiency ratio) = 7,700,000 (t/yr: milled)
- Rice grain yield necessary in : 7,700,000 (tons) / 0.65 = 11,900,000 (tons)  
2030 (before polishing)

### **Rice production by rain-fed upland and lowland rice**

Production of rain-fed upland and lowland rice as of 2030 are in Table 8, calculated based on acreage under cultivation and annual rate of increase in yield mentioned above.

**Table 8 Production of Rain-fed Rice as of 2030**

	Area Growth Rate	Cropping area (ha)	Yield growth 1.0%		Yield growth 1.5%		Yield growth 2.0%		Yield growth 2.5%	
			Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)
R. upland	1.0%	634,950	2.0	1,270	2.2	1,397	2.5	1,587	2.8	1,778
R. lowland		1,547,535	2.5	3,869	2.8	4,333	3.1	4,797	3.4	5,262
Total		2,182,485		5,139		5,730		6,384		7,040
R. upland	2.0%	788,460	2.0	1,577	2.2	1,735	2.5	1,971	2.8	2,208
R. lowland		1,921,678	2.5	4,804	2.8	5,381	3.1	5,957	3.4	6,534
Total		2,710,138		6,381		7,116		7,928		8,742
R. upland	3.0%	977,160	2.0	1,954	2.2	2,150	2.5	2,443	2.8	2,736
R. lowland		2,381,588	2.5	5,954	2.8	6,668	3.1	7,383	3.4	8,097
Total		3,358,748		7,908		8,818		9,826		10,833
R. upland	4.0%	1,208,700	2.0	2,417	2.2	2,659	2.5	3,022	2.8	3,384
R. lowland		2,945,910	2.5	7,365	2.8	8,249	3.1	9,132	3.4	10,016
Total		4,154,610		9,782		10,908		12,154		13,400
R. upland	5.0%	1,491,750	2.0	2,984	2.2	3,282	2.5	3,729	2.8	4,177
R. lowland		3,635,775	2.5	9,089	2.8	10,180	3.1	11,271	3.4	12,362
Total		5,127,525		12,073		13,462		15,000		16,539

R. upland, R. lowland: Rain-fed upland rice, Rain-fed lowland rice; Growth rate of area and yield indicate per year.  
Source: JICA Project Team

### **Development area and rice production due to public irrigation scheme**

According to irrigation development plan mentioned below, planned irrigation areas of public irrigation scheme is 468,752ha by 2030 and rice cultivated areas 385,711ha depending on planned cultivation pattern. On the other hand, farmland areas of private small scale irrigation farming are 335,000ha by 2030 in which rice cultivation areas are 39,319ha. Rice production is estimated based on annual yield and shown in Table 9. It is possible to produce rice of about 1.9-2.6 million tons comprising public irrigation scheme and private small scale irrigation farming. The amount of rice production becomes about 11.7-12.4 million tons with adding 9.8 million tons by the rain-fed rice production. It is also possible to secure almost or more than 100% of rice self-sufficient, when the irrigation area for rice production will be developed as planned by 2030.

**Table 9 Production of Irrigated Rice as of 2030**

Type of Irrigation	Rice cropping are (ha)	Yield growth 1.0%		Yield growth 1.5%		Yield growth 2.0%		Yield growth 2.5%	
		Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)	Yield (t/ha)	Production (,000ton)
Public scheme	385,711	4.4	1,697	4.9	1,890	5.4	2,083	6.0	2,314
Private small scale	39,319	4.4	173	4.9	193	5.4	212	6.0	236
Total	425,030		1,870		2,083		2,295		2,550

Source: JICA Project Team

## (2) Proposed Cropping Pattern

### Cropping Calendar

Figure 2 shows cropping seasons in the three large hydrological basins of Nigeria, which are obtained from various materials and interview surveys.

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

Source: JICA Project Team

**Figure 2 Cropping Calendar**

### Current and Proposed Cropping Patterns

Table 10 shows the current and proposed cropping rates.

**Table 10 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
1	Current	40	25	5	60	20	50	0	70
	Proposed	40	50	0	50	20	70	0	80
2	Current	10	60	10	30	10	60	0	70
	Proposed	60	30	20	60	10	80	0	80
3	Current	10	60	10	30	10	60	0	70
	Proposed	60	30	20	60	10	80	0	80
4	Current	10	60	10	30	10	60	0	70
	Proposed	60	30	20	60	10	80	0	80
5	Current	70	5	0	0	30	40	0	70
	Proposed	80	10	60	20	30	60	0	80
6	Current	35	25	0	35	20	50	0	70
	Proposed	60	30	40	40	20	70	0	80
7	Current	70	30	5	15	30	40	0	70
	Proposed	80	10	60	20	30	60	0	80
8	Current	80	15	0	25	30	40	0	70
	Proposed	80	10	0	50	30	60	0	80

Source : JICA Project Team

## (3) Projection of Future Water Demand

Table 11 shows current water demand 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 872MCM in the wet season and 1,054MCM in the dry season, and the total amount is 1,926MCM year-round. The total amount corresponds approximately to 0.7% of Nigeria's total water abundance of 286,600MCM (internal generation only). The overall proposed water demand is 2,052MCM in the wet season and 4,193MCM in the dry season, and the total amount is 6,245MCM year-round. The total amount corresponds approximately to 2.2% of Nigeria's total water abundance of 286,600MCM (internal generation only).

**Table 11 Current Irrigation Water Demand**

Water Source	Type		Area (ha)	Wet Season (MCM)	Dry Season (MCM)	Total (MCM)
Surface Water	Irrigation scheme	Current	142,106	741	345	1,086
		Proposed	494,252	1,720	2,712	4,432
Sub-surface Flow	Fadama, partial Small-scale private irrigation	Current	93,000	0	361	361
		Proposed	139,000	0	617	617
Groundwater	Small-scale private irrigation	Current	90,000	131	348	479
		Proposed	196,000	332	864	1,196
Total		Current	325,106	872	1,054	1,926
		Proposed	829,252	2,052	4,193	6,245

Source: JICA Project Team



### **3.4 Other Sub-Sectors**

#### **(1) Livestock**

Dependence of livestock on surface water is greater in southern part of Nigeria than in northern part where by far large livestock herds rely on groundwater and remaining water in Fadama. As to method of estimating, annual water demand for livestock was calculated from the text of FAO livestock guideline in African region. The projected water demand for livestock in 2030 amounts to 320.8 MCM, as against 232.8 MCM in 2010, which means 38% increase in 20 years.

#### **(2) Freshwater Aquaculture**

This sub-sector has recently been growing faster than ever supported by policy generated towards the application of subsidy for private facility development, and by rapid growth of domestic demand for fish. Southern states in HA-5 and HA-6 are center of this activity because many feed mills and fingerling hatcheries are available for fish farming. The method for projecting future water demand for this subsector is based on the data in "Inventory of private and Government Fish Farms". Water area in fish farms, summarized by fishery department of MFARD in 2007 was 6,126 ha, identified as the total area of fresh inland water. Fish yield per ha will grow from 1.4 t/ha in 2007 to 8.6 t/ha in 2030, then water surface area required for meeting future annual demand as projected for 2030 is estimated at 38,880ha, assuming this future yield. Water demand for inland fish farming will increase from 727.8 MCM in 2007 to 1,166.1 MCM in 2030.

#### **(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, 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.

#### **(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.

#### **(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.

#### **(6) Minimum Stream Flow Requirement**

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 Project is to formulate the national water resources master plan, the hydrological method to discuss the minimum stream flow would be applied. There are many criteria for determining the minimum stream flow using the hydrological method. In

the M/P2013,  $Q_{97DS90\%Y}$  (90% yearly dependable 97percentaile 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,  $Q_{95D}$  (95percentaile flow for long-term multi-year) is usually used for the minimum stream flow requirement.

It should be noted that the minimum stream flow discussed in the M/P2013 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.

### 3.5 Water Demand Structure

The existing total water demand is estimated at 5.93 BCM/year. It is expected to increase to 16.58 BCM/year in 2030.

Figure 3 shows the share of water demand by each sector. The share of municipal water demand in 2010 and 2030 is about 50%. The share of irrigation water demand will increase from about 30% in 2010 to about 40% in 2030.

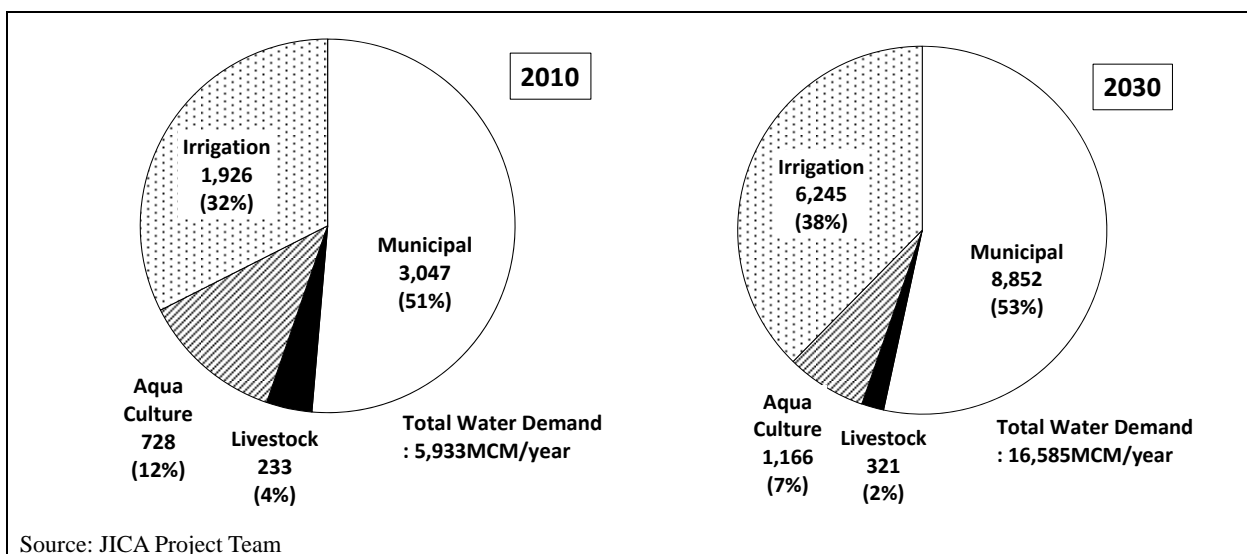


Figure 3 Change in Share of Water Demand by Sectors

Figure 4 shows the water demand by each sector for each HA. From the figure, the followings are noted.

- Present municipal water demand is highest in HA-6, followed by HA-8. This will be maintained in the future (2030).
- Present total water demand is highest in HA-6, followed by HA-8. This will be maintained in the future (2030).
- The increasing rate of irrigation water demand in HA-3 is much larger than that in other HAs.

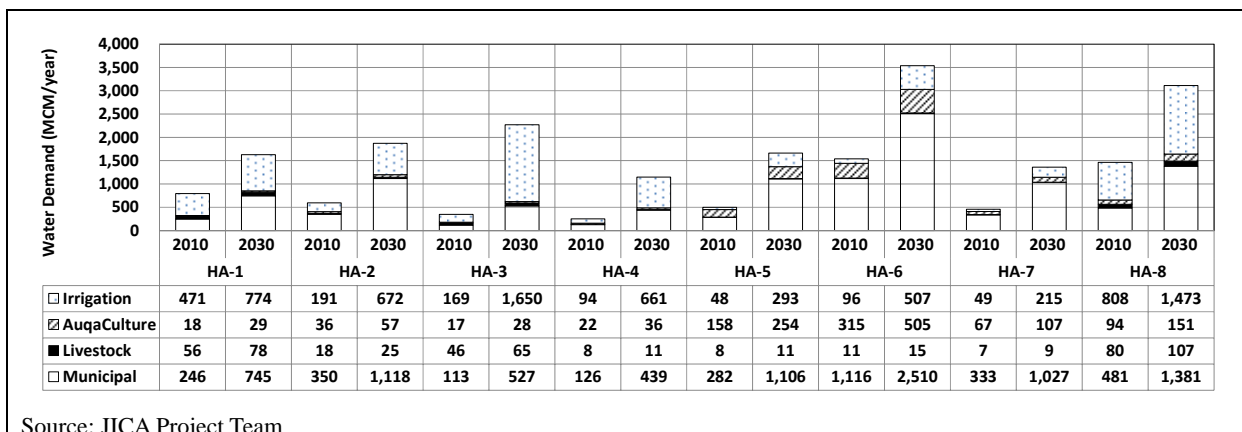


Figure 4 Water Demand by Sectors and by HAs

#### 4 EVALUATION OF WATER RESOURCES POTENTIAL

The basis of estimation of water resources potential is as follows.

- 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 set up 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.

The estimated water resources potential is summarized in Table 12 (refer to Figure 5).

The average precipitation over the country is about 1,150mm. Only 24% of the precipitation becomes runoff and the rest are lost as evapotranspiration and/or others. Total internal generation of the runoff is 244BCM/year and the surface water resources potential is estimated at about 333BCM/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 287BCM/year and the total water resources potential with inflow from neighboring countries is estimated at 375BCM/year. 88BCM/year of water comes from neighboring countries, which roughly indicates that almost 24% of surface water resources in Nigeria relies on neighboring countries. The total groundwater resources potential is estimated at 156BCM/year as a renewable source on the basis of the estimated groundwater recharge.

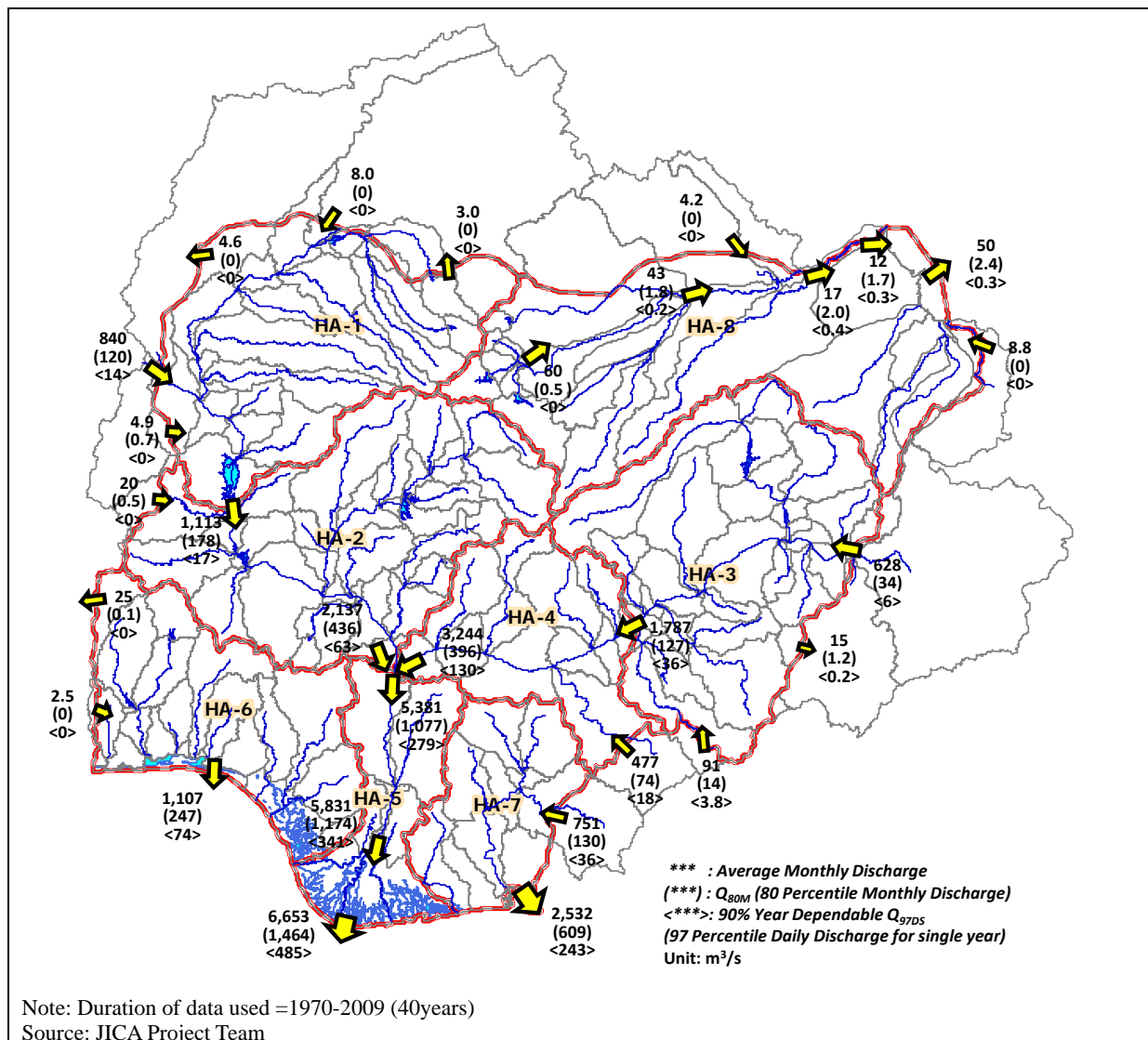


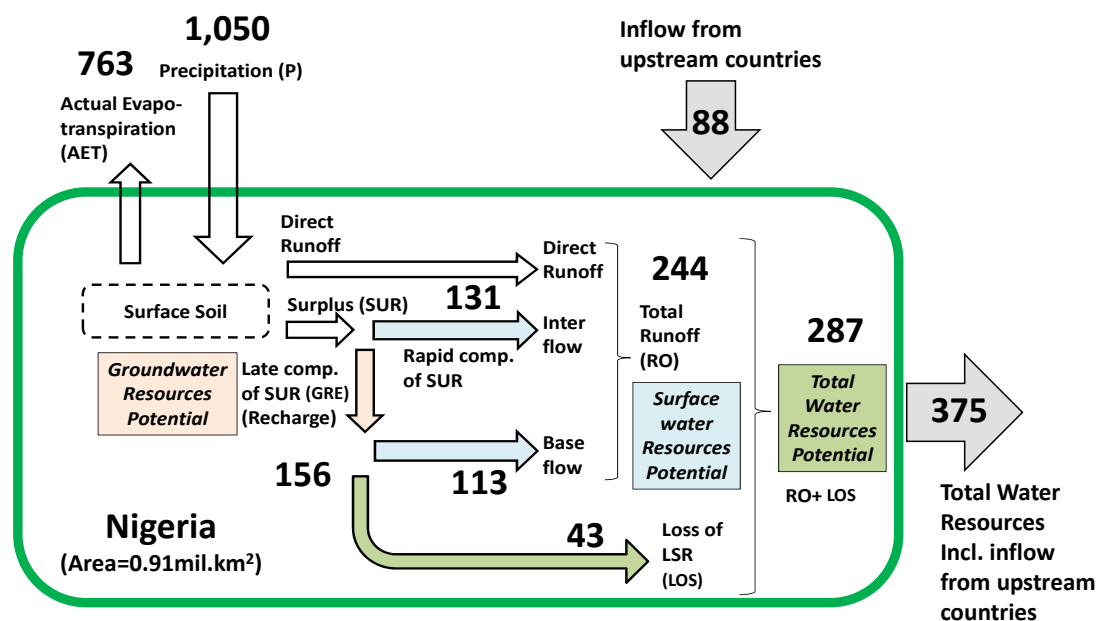
Figure 5 Average Discharge,  $Q_{80M}$  and  $Q_{97DS}90\%Y$

**Table 12 Estimated Water Resources Potential**

		HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
<b>Water Resources Potential</b>										
<b>Total Water Resources Potential <sup>1)</sup></b>										
Including inflow from outside Nigeria	(BCM /year)	37.4	40.9	60.2	47.9	50.7	43.7	84.0	10.3	375.1
Only internal generation in Nigeria	(BCM /year)	10.7	40.3	37.9	32.8	50.7	43.6	60.3	10.3	286.6
<b>Surface Water Resources Potential</b>										
Including inflow from outside Nigeria	(BCM /year)	35.1	32.3	56.4	46.0	40.1	35.7	79.9	7.2	332.7
Only internal generation in Nigeria	(BCM /year)	8.4	31.7	34.1	30.9	40.1	35.6	56.2	7.2	244.2
<b>Groundwater Resources Potential</b>										
Groundwater Recharge	(BCM /year)	5.0	20.5	19.3	18.6	31.9	23.4	32.8	4.3	155.8
<b>Runoff Condition (Only internal generation in Nigeria)</b>										
Precipitation (P)	(mm/year)	767	1,170	1,055	1,341	2,132	1,540	2,106	609	1,148
Total Runoff (RO)	(mm/year)	62	205	218	415	744	359	978	40	268
Groundwater Recharge (GRE)	(mm/year)	37	132	123	250	592	236	570	24	171
Loss of Recharge (LOS)	(mm/year)	18	56	24	25	197	80	72	17	47
Runoff Rate (RO/P)	(%)	8.1	17.5	20.7	30.9	34.9	23.3	46.4	6.6	23.4
Recharge Rate (GRE/P)	(%)	4.8	11.3	11.7	18.7	27.7	15.3	27.1	3.9	14.9
Loss Rate (LOS/P)	(%)	2.3	4.8	2.3	1.9	9.2	5.2	3.4	2.9	4.1
Total Water Res. Rate ((RO+LOS)/P)	(%)	10.4	22.3	22.9	32.8	44.1	28.5	49.8	9.5	27.4

Note:

- Total Water Resources Potential**  
= Surface Water Resource Potential + Groundwater Recharge – Base Flow Runoff  
= Surface Water Resource Potential + Loss of Groundwater Recharge
- Water Resources Potential in HA-5, 6 include the runoff in the delta area.
- Water Resources Potential in HA-8 shows the total runoff generation without the loss in the large wet land area.



Unit: BCM/year (Billion m<sup>3</sup>/year)

Source: JICA Project Team

## 5. WATER BALANCE BETWEEN DEMAND AND SUPPLY

### (1) Overall Water Balance between Total Water Demand and Water Resources Potential

Table 13 shows the total water demand and water resources potential by HA. The existing total water demand is estimated at 5.93BCM/year. It is expected to increase to 16.58BCM/year. 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 just 1.6%. In 2030, the ratio will become 4.4%, however.

The total water demand in 2030 is still much less than the total water resources potential. However, it should be noted that the currently usable water with stable supply for the demand is also much smaller than the surface water resources potential. Furthermore, because the water demand and water resources are unevenly distributed, the necessity of water resources development should be examined through the water balance between supply and demand at local level.

**Table 13 Overall Water Balance between Total Water Demand and Water Resources Potential**

			HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
<b>Total Water Resources Potential</b>											
Including inflow from outside Nigeria	(BCM /year)	(1)	37.4	40.9	60.2	47.9	50.7	43.7	84.0	10.3	375.1
Only Internal Generation	(BCM /year)	(2)	10.7	40.3	37.9	32.8	50.7	43.6	60.3	10.3	286.6
Groundwater Resources Potential	(BCM /year)	(3)	5.0	20.5	19.3	18.6	31.9	23.4	32.8	4.3	155.8
<b>Total Water Demand</b>											
<b>Existing (2010)</b>	(BCM /year)	(4)	<b>0.79</b>	<b>0.59</b>	<b>0.35</b>	<b>0.25</b>	<b>0.50</b>	<b>1.54</b>	<b>0.46</b>	<b>1.46</b>	<b>5.93</b>
	(%)	(4)/(1)	2.1	1.5	0.6	0.5	1.0	3.5	0.5	14.2	1.6
	(%)	(4)/(2)	7.4	1.5	0.9	0.8	1.0	3.5	0.8	14.2	2.1
<b>Future (2030)</b>	(BCM /year)	(5)	<b>1.63</b>	<b>1.87</b>	<b>2.27</b>	<b>1.15</b>	<b>1.66</b>	<b>3.54</b>	<b>1.36</b>	<b>3.11</b>	<b>16.58</b>
	(%)	(5)/(1)	4.3	4.6	3.8	2.4	3.3	8.1	1.6	30.2	4.4
	(%)	(5)/(2)	15.2	4.6	6.0	3.5	3.3	8.1	2.3	30.2	5.8

Remarks:

- 1) Water Resources Potential in HA-5, 6 include the runoff in the delta area.
- 2) Water Resources Potential in HA-8 shows the total runoff generation without the loss in the large wet land area.

Source: JICA Project Team

### (2) Water Balance by Sector

#### Water Sources 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 measures to secure the stable water supply with 90% yearly dependability by state are necessary. The municipal water supply plan as well as surface water development plan is proposed by referring the results of water balance study.

#### Water Sources 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 irrigation development plan is proposed by referring the results of water balance study.

#### 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 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 in each of hydrological area. It would be one of important topics during formulation of the Catchment Management Plan (CMP).

## 6. WATER SOURCES DEVELOPMENT PLAN

### 6.1 Groundwater Development Plan

New groundwater development will be implemented for water supply in 2030 by newly drilled boreholes and borehole rehabilitation as shown in Table-14. The amount of groundwater to be developed is 9.9MCM/day (urban/semi-urban/small-town water supply: 7.7MCM/day, rural water supply: 2.2MCM/day). To meet this demand, 7.2MCM/day will be developed by newly drilled boreholes, and 2.7MCM/day will be by rehabilitation of the existing boreholes.

To meet the water supply in 2030, number of newly drilled boreholes with motorized pump is 15,361 for urban/semi-urban/town water supply and 9,105 for rural water supply. On the other hand, number of boreholes with hand pumps is 82,538 for rural water supply.

**Table 14 Amount of Groundwater by Newly Drilled Boreholes and 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/ Semi-urban/ town	Rural	Urban/ Semi-urban/ town	Rural	Urban/ Semi-urban/ town	Rural		
					Motorized pump	Motorized pump	Hand pump	
	m <sup>3</sup> /day	m <sup>3</sup> /day	m <sup>3</sup> /day	m <sup>3</sup> /day	m <sup>3</sup> /day	m <sup>3</sup> /day	m <sup>3</sup> /day	
1	Abia	234,836	30,910	73,485	6,576	161,351	14,600	9,734
2	Adamawa	176,499	64,336	3,435	2,007	173,064	37,397	24,931
3	Akwa Ibom	311,393	69,628	155,697	24,797	155,697	26,899	17,933
4	Anambra	134,954	49,824	56,736	4,496	78,218	27,197	18,131
5	Bauchi	300,186	109,555	112,291	16,326	187,895	55,937	37,291
6	Bayelsa	246,612	19,464	4,540	8,622	242,072	6,506	4,337
7	Benue	146,595	86,034	73,298	24,723	73,298	36,786	24,524
8	Borno	290,589	82,243	37,792	4,037	252,797	46,924	31,283
9	Cross River	121,148	63,719	60,574	31,859	60,574	19,116	12,744
10	Delta	465,063	59,466	232,531	27,234	232,531	19,339	12,893
11	Ebonyi	0	41,270	0	3,930	0	22,404	14,936
12	Edo	212,275	43,604	0	2,036	212,275	24,941	16,628
13	Ekiti	65,945	31,420	32,973	15,587	32,973	9,500	6,333
14	Enugu	377,139	48,300	22,150	6,552	354,988	25,049	16,699
15	Gombe	134,299	49,695	44,113	9,475	90,186	24,132	16,088
16	Imo	356,887	69,027	37,369	8,743	319,519	36,171	24,114
17	Jigawa	251,869	57,835	26,778	16,964	225,091	24,523	16,348
18	Kaduna	110,091	91,901	55,045	45,951	55,045	27,570	18,380
19	Kano	323,421	153,056	161,710	16,974	161,710	81,649	54,433
20	Katsina	416,521	103,700	39,013	17,140	377,509	51,936	34,624
21	Kebbi	201,880	68,542	64,437	22,203	137,443	27,803	18,535
22	Kogi	257,044	55,443	78,468	13,752	178,576	25,014	16,676
23	Kwara	129,600	28,500	54,045	13,321	75,555	9,107	6,071
24	Lagos	0	10,676	0	4,949	0	3,436	2,291
25	Nasarawa	94,527	31,785	47,263	13,051	47,263	11,241	7,494
26	Niger	191,784	65,360	88,748	19,926	103,036	27,260	18,174
27	Ogun	0	49,617	0	11,120	0	23,098	15,399
28	Ondo	154,922	61,726	77,461	24,341	77,461	22,431	14,954
29	Osun	78,834	48,011	39,417	24,006	39,417	14,403	9,602
30	Oyo	0	77,890	0	30,165	0	28,635	19,090
31	Plateau	173,722	67,490	54,851	8,978	118,870	35,107	23,405
32	Rivers	583,030	76,512	219,073	17,400	363,957	35,468	23,645
33	Sokoto	181,504	62,983	90,752	31,491	90,752	18,895	12,597
34	Taraba	143,180	51,001	5,609	1,599	137,571	29,641	19,761
35	Yobe	192,148	48,067	65,190	11,913	126,958	21,692	14,462
36	Zamfara	133,053	63,761	55,893	10,930	77,160	31,699	21,132
37	FCT Abuja	551,877	19,035	22,598	2,948	529,279	9,653	6,435
	Total	7,743,426	2,211,389	2,193,335	556,123	5,550,091	993,159	662,106

Source: JICA Project Team



## **6.2 Surface Water Development Plan**

### **(1) Strategy on Surface Water Development**

#### **Strategy-1: 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

#### **Strategy-2: 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 the 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.

### **(2) Proposed Projects**

The proposed projects are described below, in consideration of the strategy.

#### **Project 1-1: Capacity Development of Dam Management**

The direction of improvement of dam management is discussed 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. The activities such as preparation of dam management manual, inspection of dams, Installation of simple monitoring equipment, if necessary are performed in selected pilot areas. The duration of the project is proposed to be three years

#### **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 mentoring, 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.

#### **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. In case of earthfill or rockfill dam, it is important to check if there is water leakage or not. Furthermore, the condition of cracks on dam body, erosion, caving should be carefully checked. All of these could cause the failure of dam. The detail conditions should be studied for individual dam and accordingly the countermeasure would be implemented.

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

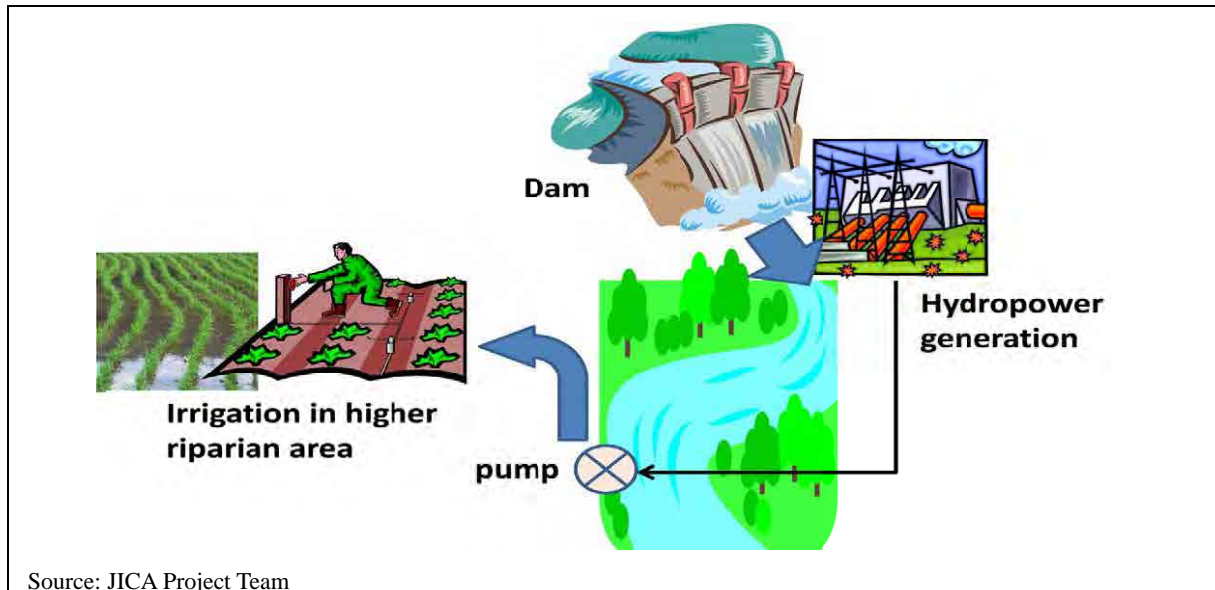
This project is to prepare stable water source for municipal water supply against the water source where the safety level is expected to be lower than 90% yearly dependability in 2030. On the basis of the results of water balance study, the surface water source development projects with 23 sites are proposed. The total storage capacity of the proposed dams is 381MCM.

### **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. On the basis of the results of water balance study, the surface water source development projects with 21 sites are proposed. The total storage capacity of the proposed dams is 969MCM.

### **Project 2-3: Integrated Surface Water Development**

This is an integrated project to combine hydropower generation and irrigation development. Necessary energy for pumping for supplying irrigation water is provided internally by the generated energy in the project so as to secure self-reliance and sustainability of the project (refer to Figure 6). Three project sites along the Benue River are proposed (refer to Table 15). The total storage volume of the proposed dams is 960MCM.



Source: JICA Project Team

**Figure 6 Schematic Drawing on Integrated Surface Water Development**

**Table 15 Integrated Surface Water Development**

No	Project	HA	State	Irrigation/Hydropower scheme	Dam SN	Dam Name	H (m)	GS (MCM)
1	Nasarawa Integrated Project	4	Nasarawa	New Irrigation scheme: 19,000ha Hydropower 4MW; Total generate energy 29GWh/year, Required energy for irrigation 2GWh/year, Excess energy 27GWh/year	3011	Ragwa	24	30
2	Taraba integrated project	3	Taraba	New Irrigation scheme: 45,000ha Hydropower 7MW; Total generate energy 52GWh/year, Required energy for irrigation 12GWh/year, Excess energy 40GWh/year	3001	Baudeu	37	240
				Hydropower 2MW; Total generate energy 15GWh/year, Required energy for irrigation 10GWh/year, Excess energy 5GWh/year	3004	Kogin Baba	39	290
3	Donga-Suntai Integrated project	3	Taraba	New Irrigation scheme: 35,000ha Hydropower 9MW; Total generate energy 60GWh/year, Required energy for irrigation 37GWh/year, Excess energy 23GWh/year	3005	Kwossa	78	400

Remarks:

- 1) The size of dam is set so as to provide necessary water for hydropower generation for pumping as well as irrigation water supply with 1/5 safety level.
- 2) The capacity of hydropower equipment is set so as to maximize the net benefit (benefit-cost) under the following assumptions with keeping the necessary capacity for pumping of irrigation water.

Assumptions: a) Overall efficiency of hydropower generation=0.7, b) project cost of installation of hydropower equipment=2.53mil.US\$/MW, c) Project duration=50year, d) Replacement of equipment=every 20year, e) O&M cost=0.5% of project cost /year, f) Discount rate=10%, and g) Selling price of electricity=0.05US\$/kWh.

SN=Serial number of dam, H=Height of dam, GS=Gross storage

Source: JICA Project Team

## 7. WATER RESOURCES SUB-SECTOR DEVELOPMENT PLAN

### 7.1 Water Supply and Sanitation Development Plans

#### (1) Water Supply Development Plan

To meet the future water demand, the Project calculates nationwide water supply development for both hydrological balance and facility planning in the target year 2030, as shown in Table 16. 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 M/P2013 from 2011 to 2014, water supply development by both rehabilitation and new construction projects proposed in the M/P2013 is 12,620 million liter per day (MLD) in hydrological balance and 14,880 MLD in facility planning.

**Table 16 Water Supply Development Plan**

Scheme	Category	Existing Cap. (2010)	Pre-M/P Period (2011-2014)	M/P Period (2015-2030)	Grand Total (2030)
Rehabilitation	Urban, SU/ST (SW)	1,870 (1,870)	- (-)	1,388 (1,388)	3,257 (3,257)
	Urban, SU/ST (GW)	5,667 (5,667)	425 (425)	1,761 (1,761)	7,852 (7,852)
	Rural (GW)	718 (718)	126 (126)	430 (430)	1,274 (1,274)
	<b>Sub-Total</b>	<b>8,254</b> <b>(8,254)</b>	<b>551</b> <b>(551)</b>	<b>3,578</b> <b>(3,578)</b>	<b>12,383</b> <b>(12,383)</b>
New Construction	Urban, SU/ST (SW)	-	964 (1,204)	3,317 (4,146)	4,280 (5,350)
	Urban, SU/ST (GW)	-	1,109 (1,386)	4,449 (5,561)	4,280 (6,947)
	Rural (GW)	-	379 (474)	1,276 (1,595)	1,655 (2,069)
	<b>Sub-Total</b>	-	<b>2,452</b> <b>(3,065)</b>	<b>9,041</b> <b>(11,302)</b>	<b>11,493</b> <b>(14,367)</b>
<b>Total</b>	Unit: MLD	<b>8,254</b> <b>(8,254)</b>	<b>3,003</b> <b>(3,616)</b>	<b>12,620</b> <b>(14,880)</b>	<b>23,876</b> <b>(26,750)</b>

Remarks: Upper for Hydrological balance, Lower (\*\*) for Facility Planning  
Source: JICA Project Team

#### (2) Sanitation Development Plan

Based on current sanitation coverage as of baseline year 2010, 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 M/P2013 from 2011 to 2014, sanitation development by the projects proposed in the M/P2013 are shown in Table 17.

**Table 17 Sanitation Development Plan**

Project	Settlement Category	Required Development
Public toilet	Urban	8,564 places
	Semi Urban / Small Town	11,762 places
Final septage disposal facility/site	Urban	For 9,325,745 households
Sewerage system	Urban	For 876,758 households (Treatment : 473,266m <sup>3</sup> /day)
Hygiene Promotion	Semi Urban / Small Town	For 16,650,716 households
	Rural	For 13,406,807 households

Source: JICA Project Team

Sanitation development plan includes projects for septage disposal and sewerage, but formulation of the following master plans is necessary to promote realization of the projects.

- National Master Plan on Sanitation (including septage management)
- National Master Plan on Sewerage Development (for major urban areas)

## **7.2 Irrigation and Drainage Development Plan**

### **(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. 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.

### **(2) Irrigation and Drainage Development Plan**

#### **Ongoing Scheme**

There are 32 sites of on-going irrigation scheme implemented by FMWR in the country, and those schemes should be completed early. According to evaluation based on surface water potential, number of irrigation scheme become 9 sites of which future irrigation area evaluated fall below planned irrigation area.

#### **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 37 sites and 45 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 37 schemes not only that rehabilitation but the planned irrigation areas. Meanwhile some existing schemes were abandoned or were not expanded up to planned irrigation area, although existing dam has actually abundant water. On these schemes it is possible to realize economical development due to needless new dam construction. Therefore in the point of view of utilization of existing dam, it is recommended to expand the system development area up to the planned irrigation areas at the additional five schemes such Swashi Valley, Kontagora, Bagoma, Tubo, and Sendam (1).

#### **Supplementary Irrigation Scheme**

Economical irrigation development is possible utilizing regional characteristics of HA-5 and HA-7. The southern regions locate at tropical rainforest climate zone and then rain-fed rice cultivation has been active. However, it is necessary enough water in the initial stage of rice cultivation and then it is desire to keep the supplemental water resources for unstable rainfall condition in this season. Accordingly, land reclamation and supplementary irrigation facilities are planned utilizing farm ponds and groundwater. In this case, irrigation water is for only rainy season because of small scale of water resources. However, it is convinced to increase rice yield due to irrigation effectively. The cost of development method minimizes comparing with other development menu, also this method is applied as small scale irrigation scheme by local government. Possible available farmlands in HA-5 and HA-7 are vast. In case terrain is flat and soil is suitable to rice cultivation in the area, this development method is easily applied to all over the place. New development areas are 19,000 ha for HA-5 and 29,000 ha for HA-7 corresponding to the irrigation areas omitted at the dam selection stage mentioned below.

#### **Dam Irrigation Scheme**

Nigerian agriculture depend on rain-fed cultivation nationwide, however it is imperative to enhance irrigated agriculture emphatically for national food security. Possible merit expected from irrigation in the case of converting rain-fed cultivation into irrigated one include 1) yield improvement by avoiding drought damages, 2) extension of cropping period from only wet season to throughout the

year. New proposed irrigation scheme development is planned possible to irrigate through a whole year at the downstream of dam, which water resources to be groups of dam projected in the M/P1995 and dams newly proposed. Location of dam will be selected considering economy, possibility of suitable irrigation area at downstream of dam, dam efficiency, avoidance of competition among water supply and the existing irrigation scheme, and possibility of resettlement. The sites of new proposed irrigation schemes owing to dam are 17 sites.

### **Integrated Development Scheme**

The long term target of irrigation sector in Nigeria is to convert irrigable potential area of 3.14 million hectares lying in this country to irrigated farmland. Herein it is a plan developing large scale irrigation scheme including pump operation which utilize electricity created by the hydraulic power generation in the multi-purpose medium and large scale dams constructed in the branch river of Benue River. This development system takes long implementation period to complete the dam construction. Therefore, considering easiness and cheapness of management and maintenance and immediate effectively, private small scale irrigated farming should be preceded as a group in the irrigation development area. At the time keeping water resources after completion of late dam construction the public irrigation scheme is transferred.

### **(3) 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 in Table 18.

**Table 18 Planned Irrigation Area as of 2030**

	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-8	Total
<b>Existing Irrigation Scheme</b>	<b>41,041</b>	<b>26,946</b>	<b>20,265</b>	<b>12,494</b>	<b>17,700</b>	<b>29,398</b>	<b>8,410</b>	<b>84,598</b>	<b>240,852</b>
● Completion with No Extension	24,441	3,048	905	877	630	1,449	2,250	4,418	38,018
● Ongoing	9,750	5,200	11,110	1,100	11,490	24,617	1,000	34,630	98,897
● Extension	6,850	18,698	8,250	10,517	5,580	3,332	5,160	45,550	103,937
<b>New Irrigation Scheme</b>	<b>1,500</b>	<b>7,400</b>	<b>111,700</b>	<b>48,000</b>	<b>23,100</b>	<b>1,500</b>	<b>34,700</b>	<b>0</b>	<b>227,900</b>
● Supplementary Irrigation	0	0	0	0	19,000	0	29,000	0	48,000
● Dam Irrigation	1,500	7,400	39,200	21,500	4,100	1,500	5,700	0	80,900
● Integrated Development	0	0	72,500	26,500	0	0	0	0	99,000
<b>Total</b>	<b>42,541</b>	<b>34,346</b>	<b>131,965</b>	<b>60,494</b>	<b>40,800</b>	<b>30,898</b>	<b>43,110</b>	<b>84,598</b>	<b>468,752</b>

Source: JICA Project Team

## **7.3 Recommendation to Other Sub-Sectors**

### **(1) Hydropower Generation**

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.

### **Evaluation of Hydroelectric Potential (of Irrigation Waterways)**

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 such as 1,200 GWh of annual output. HA-2 and HA-3 have large potentials, as these areas are blessed with good stream flows and topographical advantages.

### **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.

### **Necessity of Trial Installation**

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.

### **(2) Flood and Erosion Control**

The flood control sector in Nigeria has been materialized in three tiers such as Federal, State and Local governments with frameworks on environmental management and disaster management. FMWR has nation-wide hydrological monitoring network and jurisdiction of a lot of dams. In this sense, FMWR should be involved in management of floodplain along the major rivers, especially for the downstream reaches of her multipurpose dams. At the same time, the hydrological monitoring system of FMWR should be improved to monitor more short term phenomenon such as floods. Moreover, FMWR should extensively do flood risk evaluation for the area of floodplain along the major rivers in which irrigation project is/will be implemented or urbanization has been/will be progressed.

Regarding the erosion control in Nigeria, some State governments as implementing body express their desires on proper budget allocation from the Federal Government and technical support from Federal agencies in terms of hydrological analysis. NIWSA of FMWR can contribute to this aspect through hydrological monitoring.

### **(3) Inland Navigation**

The inland waterways of Nigeria comprise of the main river system (Rivers Niger and Benue which form a confluence at Lokoja), creeks, lagoons, lakes and intra-coastal waters. They are declared by the 1997 decree as Federal navigable waterways. Basically all navigable waterways shall be under the exclusive management, direction and control of National Inland Waterways Authority (NIWA).

FMWR owns and manages dams which may affect flow regimes along navigable river sections in the country. Furthermore, FMWR has to provide necessary information for disaster management in cities along rivers as well as for management of large scale irrigation area in the floodplain which is under jurisdiction of NIWA. It is necessary to consider effects of floodplain management on inland navigation.

### **(4) 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.

### **(5) Livestock**

The policies on promotion of livestock industry in "National Agriculture and Food Security Strategy 2010-2020" 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.



## 8. WATER RESOURCES MANAGEMENT PLAN

### 8.1 General

#### (1) Objective and Strategy 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

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. The M/P2013 proposes action plans according to four (4) policies for improvement and strengthening of organization and institution; 1) Cooperative Institutional Arrangement, 2) Participatory Management Administration, 3) Fair Regulatory Institutional Framework, and 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 M/P2013 proposes proper operation and maintenance regarding water resources development facilities such as dam, well, water supply facility and irrigation facility.

- **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. Based on analysis of current situation and framework related to water allocation and regulation, the M/P2013 proposes four (4) projects; 1) CMP Formulation Project, 2) Capacity Development Project for Water License and Regulation, 3) Catchment Management Promotion Project and 4) Project for Preparation of Water Pricing Guideline.

- **Strategy-4: Facilitation and Improvement for Water Resources Management**

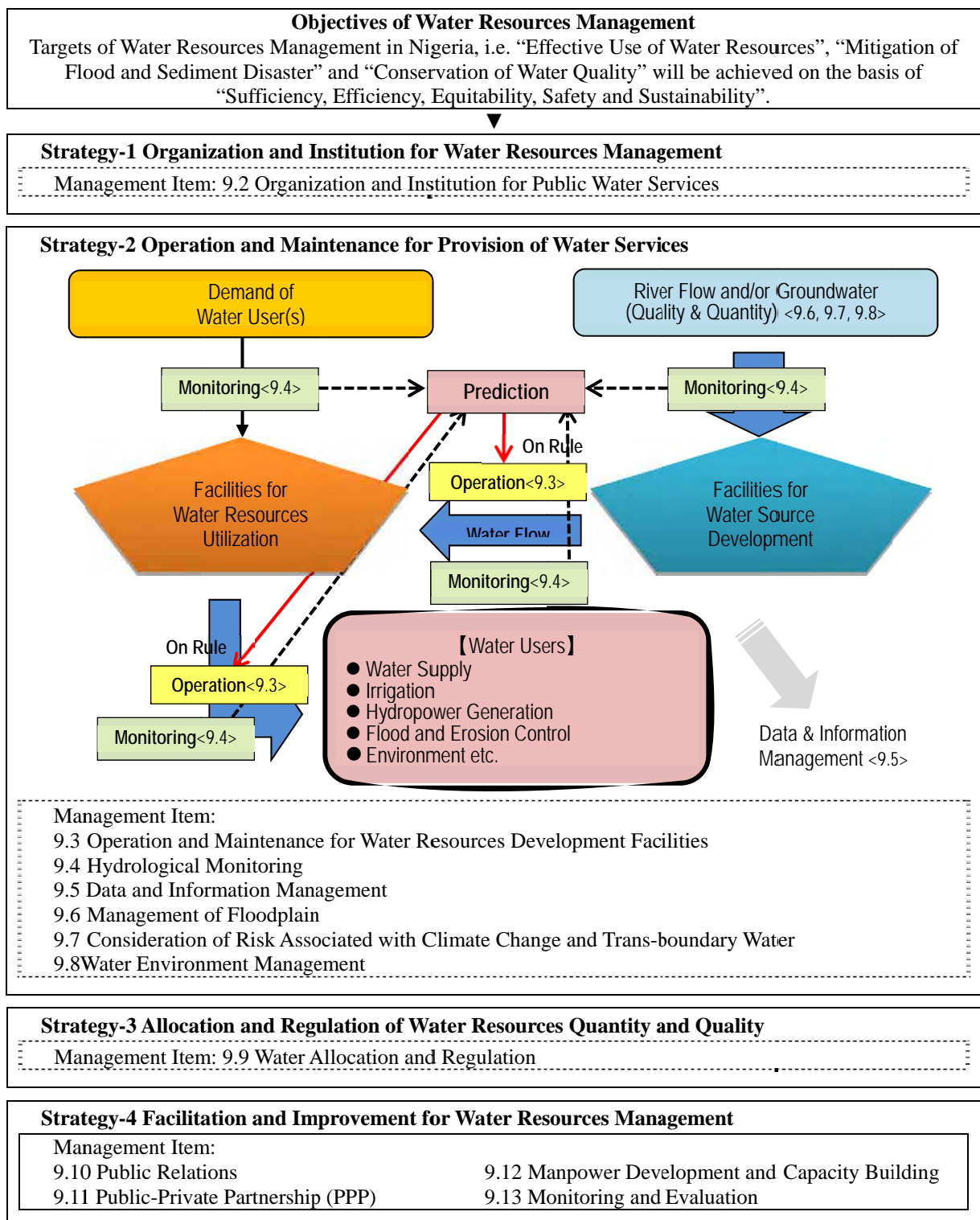
This plan includes action plans to support and improve human resources and technology for water resources development / utilization / management, and also to promote effectively water projects.

In order to achieve proper water resources management, in the M/P2013, it is proposed to consider the improvement plan and method analyzing the current issues relating to management items shown in Figure 7.

#### (2) Framework of Water Resources Monitoring

The water resources monitoring is one of fundamental elements for water resources management. The water resources monitoring is not limited to the hydrological monitoring, but covers other important aspects for proper management of water resources. The water resources monitoring includes the following four major components, and these components are related and support each other.

- Hydrological Monitoring for Water Resources Assessment and Information Dissemination
- Water Quality Monitoring for Water Use
- Monitoring for Daily Activities for Management of Water Resources Facilitie
- Control Monitoring for Enforcement of Water Regulation



Source: JICA Project Team

**Figure 7 Targets of Water Resources Management**

## 8.2 Organization and Institution for Public Water Services

### (1) Basic Policy

To implement the projects and programs proposed in the M/P2013, the Project strongly suggests the following basic policies for institutional development and strengthening.

- Basic Policy-1: Cooperative Institutional Arrangement
- Basic Policy-2: Participatory Management Administration
- Basic Policy-3: Fair Regulatory Institutional Framework
- Basic Policy-4: Decentralization and Coordination

## (2) Action Plan

Based on the basic policies mentioned above, the Project suggests the action plans as shown in Table 19. It must be noted that no distinguished differences among the action plans in terms of priority for implementation are identified. It implies that it is believed to be ideal to take up all action plans at the same time as earlier as possible in the course of the M/P2013. However, in reality, taking into consideration disparity or different constraints that for each institution, it is advisable as a realistic approach to launch available activities according to plan. It must be also noted that the prioritized target group for the action plan is mostly FMWR including its parastatals and agencies.

**Table 19 Action Plan for Institutional Development and Strengthening**

No.	Activities	Leading Institutions
<b>[BASIC POLICY – 1] COOPERATIVE INSTITUTIONAL ARRANGEMENT</b>		
1.1	[Challenge/Problem] Incompletion of National Water Policy [Activity] ● Completion, Approval, Publication and Dissemination of National Water Policy to replace Water Decree No.101 of 1993 [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDAs	
1.2	[Challenge/Problem] Incompletion of National Water Resources Act [Activity] ● Completion, Approval and Promulgation of National Water Resources Act ● Based on National Water Resources Act, review and revision of relevant laws and regulations to manage the nation's water resources [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDA	
1.3	[Challenge/Problem] Lack of Collaboration among Institutions among Relevant Institutions [Activity] ● Enlargement and evolvement of collaborative arrangement among relevant institutions in water sector through promotion of periodic meeting among key stakeholders to address common issues for water resources management [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDAs	
1.4	[Challenge/Problem] Improvement of Data and Information Management System on Water Resources [Activity] ● Establishment of institutional framework to share hydrological data etc. among relevant institutions ● Development and Improvement of institutional framework for Integrated Monitoring and Evaluation System [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDAs/NIHSA/FMEvn/NIMET/State MDAs	
1.5	[Challenge/Problem] Development of Institutional Framework for Implementation of Comprehensive Projects and Works which call for Integration of Various Sectors [Activity] ● Creation of task forces under FMWR for specific national comprehensive projects and programs [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDAs/NWRI/NIHSA/Federal Ministries Concerned	
<b>[BASIC POLICY - 2] PARTICIPATORY MANAGEMENT ADMINISTRATION</b>		
2.1	[Challenge/Problem] Promotion of Public Awareness and Social Mobilization for Participatory Management of Water Resources [Activity] ● Organization of nationwide survey on public opinion and reaction on water issues, and formulation of data-base on survey results for preparing better awareness programs, etc. ● Organization of workshops and seminars to incorporate people's awareness for water conservation and management [Leading Institutions] NIWRMC/COMs/RBDAs/NIHSA/State MDAs/CBOs	
2.2	[Challenge/Problem] Inadequate Catchment Management [Activity] ● Creation of comprehensive institutional framework involving all stakeholders for implementation of adequate Catchment Management Plan ● Promotion of Collaboration among partner government and other organizations through closer dialogue and greater interaction of CMOs with other basin organizations (CMCC, etc.) [Leading Institutions] NIWRMC/COMs/RBDAs/NIHSA/State MDAs/CBOs	
2.3	[Challenge/Problem] Mainstreaming of Water Related Issues such as Health, Gender, Poverty, Human Rights, etc. [Activity] ● Assistance and support for educative campaign and other tools and policies on water, sanitation, gender, empowerment, etc. in collaboration with relevant institutions (Federal Ministries of Health, Women Affairs, etc.) [Leading Institutions] PR Unit/Gender and Human Rights Unit/Dept. of PRS/NIWRMC/NWRI/State MDAs	
<b>[BASIC POLICY - 3] FAIR REGULATORY INSTITUTIONAL FRAMEWORK</b>		
3.1	[Challenge/Problem] Weak Legal Regulatory Framework (Legal Backing) [Activity] ● Completion of legislative process and enactment of NIWRMC Bill as a primary basis of legal regulatory framework ● Review and revision of relevant laws and regulations including powers to grant licenses for water abstractions and allocation (RBDA Act, NIWA Act, Mineral Act, etc.) [Leading Institutions] NCWR/Dept. of PRS/NIWRMC/RBDAs/FMT/FMM&SD	

3.2	[Challenge/Problem] Weak Regulatory Framework (Powers and Functions of NIWRMC) [Activity] <ul style="list-style-type: none"> <li>● Establishment of operational procedures for effective regulatory framework of NIWRMC and CMOs considering Catchment Management Plan in collaboration with other relevant basin institutions such as NIHSA, RBDAs, NWRI, etc.</li> </ul> [Leading Institutions] NIWRMC/ CMOs/RBDAs/NIHSA/NWRI/Dept. of PRS/State MDAs
3.3	[Challenge/Problem] Weak Regulatory Framework (Institutional and Human Resources Capacity Building and Enhancement) [Activity] <ul style="list-style-type: none"> <li>● Strengthening of institutional capacity of NIWRMC and CMOs based on needs assessment and development for capacity building</li> <li>● Undertaking of recruitment, education and training for the staff (leader, technical and managerial staff, etc.) for IWRM in the basin</li> </ul> [Leading Institutions] NIWRMC/CMOs/Dept. of HR/Dept. of PRS/NIHSA/RBDAs/NWRI
<b>[BASIC POLICY - 4] DECENTRALIZATION AND COORDINATION</b>	
4.1	[Challenge/Problem] Improvement of Sustainability and Performance in Water Supply and Sanitation Sector considering Decentralization to State Agencies and LGAs [Activity] <ul style="list-style-type: none"> <li>● Encouragement of State Agencies (Water Boards, STWSSA, RUWASSA, etc.) and LGAs to boost efficiency of projects and programs through provision of technical assistance and support from federal institutions</li> <li>● Preparation and dissemination of national technical guidelines and manuals etc. to ensure good quality standards in water supply and sanitation undertakings by states and LGAs</li> <li>● Assistance and support for development of institutional arrangement at state level on PPP promotion in the Sector in consultation with concerned federal institutions</li> </ul> [Leading Institutions] NCWRI/Dept. of PRS/ PPP Unit/NWRI/RBDAs/NIWRMC/State MDAs/ICRC/NESREA
4.2	[Challenge/Problem] Optimization of Function of RBDAs in Irrigation and Drainage Sector [Activity] <ul style="list-style-type: none"> <li>● Improvement in operation and management of RBDAs (budget, water charges system, auditing on operation, etc.)</li> <li>● Promotion of collaboration between RBDAs and the stakeholders such as farmers, Water User Association, etc. with respect to water resources for irrigation and agriculture development</li> <li>● Updating of RBDAs functions in consistence with national policy documents such as National Water Policy</li> </ul> [Leading Institutions] NCWR/RBDAs/NIWRMC/Dept. of PRS/PPP Unit/ICRC
4.3	[Challenge/Problem] Inadequate Skilled and Experienced Technical Staff [Activity] <ul style="list-style-type: none"> <li>● Establishment of National Water Resources Capacity Building Network (NWRCBNet) in various states of the country under the coordination of NWRI</li> <li>● Capacity development for PPP capacity at various level of government to cope with inadequate funding of the water sector due to lack of private sector participation</li> </ul> [Leading Institutions] NWRI/Dept. of HR/Dept. PRS/PPP Unit/State MDAs/ICRC

Source: JICA Project Team

[Note]

NCWR: National Council on Water Resources/Dept. of PRS: Department of Planning, Research and Statistics of FMWR/NIWRMC: Nigeria Integrated Water Resources Management Commission of FMWR/RBDAs: River Basin Development Authorities of FMWR/NIHSA: Nigeria Hydrological Services Agency of FMWR/FMEvn: Federal Ministry of Environment/NIMET: Nigeria Meteorological Agency of FMEvn/State MDAs: State Ministries and Agencies /CMOs: Catchment Management Offices of NIWRMC/CBOs: Community-Based Organizations/PR Unit: Press and Public Relations Unit of FMWR/Gender and Human Rights Unit: Gender and Human Rights Unit of FMWR/NWRI: National Water Resources Institute of FMWR/ICRC: Infrastructure Concessionaire Regulatory Commission/PPP Unit: Water Sector Reform and PPP Unit of FMWR/CMCC: Catchment Management Coordinating Committee/LGA: Local Government Authorities or Areas/NESREA: National Environmental Standards and Regulations Enforcement Agency of FMEvn/NIWA: National Inland Waterways Authority of FMT/STWSSA: Small Town Water Supply and Sanitation Agencies/RUWASSA: Rural Water Supply and Sanitation Agencies

## 8.4 Proposed Projects on Water Resources Management

According to current situation on water resources development and management, the Project proposes the projects shown in Table 20.

**Table 20 Proposed Projects for Water Resources Management**

Category	No	Project Title	Content	Objective
Hydrological Monitoring	1	Improvement of Surface Water Monitoring Network	Installation of equipment of surface water monitoring, observation, maintenance, etc.	Assessment of surface water resources
	2	Improvement of Groundwater Monitoring Network	Installation of monitoring well, observation, operation and maintenance, etc.	Evaluation of groundwater level, groundwater environment (excessive pumping, land subsidence, seawater intrusion)
	3	Enhancement of Data Management Capacity in NIHSA	Preparation of hydrological data management manual, formulation and update of database, etc.	Improvement of hydrological data management
	4	Establishment of Hydrological Modeling Center within NIHSA	Flood modeling, Support for early warning system, Runoff analysis	Promotion of adequate utilization of hydrological information and its publishing, etc.
	5	Enhancement of Awareness on Importance of Hydrological Monitoring	Seminars, workshops, etc.	Awareness raising of importance of hydrological information
Water Allocation and Regulation	6	Formulation of CMPs	Formulation of CMP in 8 HAs	Preparation of framework of water allocation and regulation
	7	Enhancement of Capacity on Water Use Permitting and Regulation	Preparation of manual, practices, inventory survey, database formulation, etc.	Strengthening capacity of NIWRMC and CMOs
	8	Promotion of Catchment Management	Strengthening of manpower, update of CMP, stakeholder meetings, etc.	Promotion of Appropriate practices of catchment management
	9	Preparation of Guideline for Water Pricing	Evaluation of raw water price, preparation of guideline	Appropriate water pricing for license fee and water charge
Water Environment Management	10	National Drinking Water Quality Monitoring Improvement Plan	Formulation of National Drinking Water Quality Monitoring Improvement Plan, equipment, human resources development	Monitoring of quality of water sources and drinking water
	11	Water Quality Monitoring Plan for Important Rivers	Formulation of Water Quality Monitoring Plan for Important Rivers, practices	Monitoring of water quality of important rivers
Floodplain Management	12	Flood Risk Evaluation in Floodplain	Human resources development, Flood modeling	Management of floodplain for flood disaster mitigation as well as promotion of appropriate land use
	13	Flood control for proposed irrigation project in the Benue river floodplain	Human resources development for planning, designing and implementation	Enhancement of capacity on flood control project related to irrigation development, especially for planning, design and implementation
Financial Strengthening	14	CD of RBDA's Accounting	Preparation of accounting guideline	Standardization of RBDA's accounting system
Project Management	15	CD of Project Management on WR	CD on M&E and data & information management	CD of FMWR on management of water sector projects
	16	CD of WR Development and Management	Human resources development, workshops, training, etc.	CD of FMWR on planning and designing of water resources development and management
Operation & Maintenance	17	Optimization Project of Irrigation Water Pricing of RBDA	Setting of appropriate charge for irrigation water delivery service, Enhancement of water users association	Strengthening of cost recovery of RBDA's
	18	Human Resources Develop't in Dam Operation	Human resources development on dam management, preparation of dam operation manual, workshops, trainings, etc.	Appropriate safety control of dams

Source: JICA Project Team

## **9. IMPLEMENTATION PROGRAM**

### **9.1 Implementation Schedule**

The schedule is decided based on strategies of each sector explained below:

#### **(1) Water Sources Development**

##### **Surface Water Development**

###### **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. The water source development for irrigation development would be implemented according to the irrigation development plan. As for the integrated project, relatively small scale project would be implemented as a pilot case, and then the remaining large projects would be implemented by 2030.

##### **Groundwater Development**

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) Water Resources Sub-sector Development**

##### **Water Supply and Sanitation**

Water supply facilities using surface water; the M/P2013 proposes rehabilitation of existing facilities and newly construction of the facilities in the process of concrete designing as priorities in the 1<sup>st</sup> state, and then continuing newly construction of facilities according to progress of water sources development in the 2<sup>nd</sup> and 3<sup>rd</sup> stages. Water supply facilities using groundwater; the M/P2013 proposes rehabilitation of existing facilities and newly construction of facilities in the entire period from 1<sup>st</sup> to 3<sup>rd</sup> stage.

As for sanitation, the M/P2013 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 2<sup>nd</sup> and 3<sup>rd</sup> stages.

##### **Irrigation and Drainage**

It is proposed that the Ongoing Scheme should be achieved by 2025 considering their high priority. Supplementary Irrigation Scheme, which is expected earlier effective benefit due to comparatively small and economical scale development, would be achieved by 2025. Extension Scheme and Integrated Development Scheme would be prepared on 1<sup>st</sup> Stage and implemented by 2025 considering their own large scale development. Dam Irrigation Scheme would be implemented by 2030 in accordance with those irrigation dams construction period. Integrated Development Scheme also would be implemented by 2030.

#### **(3) Water Resources Management**

The M/P 2013 proposes the 18 projects, which should be launched immediately because of their urgent



needs. Particularly, the projects related to project management is quite important from the viewpoint of human resources development and capacity development so as to implement the projects proposed in the M/P2013. Continuous observation should be carried out after formulation of network system in hydrological monitoring and water quality monitoring activities.

## 9.2 Financial Program for Project Implementation

In water sources development sector (surface water and groundwater), 30% of the total investment is for the 1<sup>st</sup> Stage, 31% for the 2<sup>nd</sup> Stage and 39% for the 3<sup>rd</sup> Stage. Investment is almost the same at every stage though it is a little higher in the 3<sup>rd</sup> stage.

In water supply and sanitation sector, 45% of the total investment is for the 1<sup>st</sup> Stage, 34% for the 2<sup>nd</sup> Stage and 22% for the 3<sup>rd</sup> Stage. Investment for the 1<sup>st</sup> Stage is the largest of all the stage. Then investment will gradually reduce afterward.

In irrigation and drainage sector, 23% of the total investment is for the 1<sup>st</sup> Stage, 50% for the 2<sup>nd</sup> Stage and 27% for the 3<sup>rd</sup> Stage. Investment for the 2<sup>nd</sup> stage is the largest of all the stage.

**Table 21 Financial Program of Investment for Water Sources Development Schemes**

Project	Investment for each Stage (Billion Naira)			Total (Billion Naira)
	1 <sup>st</sup> Stage 2014-2020	2 <sup>nd</sup> Stage 2021-2025	3 <sup>rd</sup> Stage 2026-2030	
<b>A. Water Source Development</b>	<b>144.0</b>	<b>146.8</b>	<b>184.8</b>	<b>475.7</b>
A.1 Surface Water Development	98.4	108.8	168.4	375.6
A.1.1 On-going Project	98.4	0	0	98.4
A.1.2 New Water Source Development	0	108.8	168.4	277.2
A.2 Groundwater development	45.6	38.0	16.4	100.1
A.2.1 Rehabilitation of existing boreholes	1.4	1.2	1.0	3.6
A.2.2 New drilling boreholes	44.2	36.8	15.4	96.5
<b>B. Water Supply and Sanitation</b>	<b>1,836.9</b>	<b>1,393.5</b>	<b>886.9</b>	<b>4,117.3</b>
B.1 Water Supply Rehabilitation Scheme	142.5	49.8	43.3	235.6
B.2 Water Supply Newly Construction Scheme	1,489.4	994.6	564.3	3,048.3
B.3 Sanitation Scheme	205.0	349.1	279.3	833.3
<b>C. Irrigation and Drainage</b>	<b>353.8</b>	<b>757.6</b>	<b>420.0</b>	<b>1,531.4</b>
C.1 Rehabilitation of Existing scheme	14.7	33.8	2.4	50.9
C.2 New Irrigation scheme	339.1	723.8	417.6	1,480.5
<b>Total</b>	<b>2,334.7</b>	<b>2,297.9</b>	<b>1,491.7</b>	<b>6,124.4</b>

Source: JICA Project Team

## 10. EVALUATION OF NATIONAL WATER RESOURCES MASTER PLAN 2013

### 10.1 Economic Evaluation

#### (1) Water Supply Projects

Results vary from state to state. However, from the national viewpoint, the EIRR exceeds the 10 % of opportunity cost of capital (OCC) or slightly below it. Accordingly, the water supply projects of the M/P2013 as a whole are judged to be economically feasible.

#### (2) Irrigation and Drainage Projects

Results vary from HA to HA. However, from the national viewpoint, the EIRR exceeds the 10 % of OCC. Accordingly, the irrigation and drainage projects of the M/P2013 as a whole are judged to be economically feasible.

### 10.2 Financial Consideration

The budget of the both governments to water supply development and irrigation & drainage development amounted to 148billion Naira and 35billion Naira respectively. Assuming that the like budget continues hereafter in the future, the allocations to the project costs of the M/P2013 from the governments are presumed as follows; 1<sup>st</sup> Stage (year 2014-2020): 50% out of the year budget allocation to the projects of the M/P2013 in consideration of priority and antecedent allocation to the existing and implementing projects for its acceleration and completion, and both 2<sup>nd</sup> Stage (year 2021-2025) and 3<sup>rd</sup> Stage (year 2026-2030): 100%.

## (1) Water Supply Projects

Firstly, the allocated budget to the M/P2013 would be disbursed to the projects that could achieve the highest economical effectiveness, namely the rehabilitation projects. Secondary, the remaining budget would be spent to the new development projects. However, it is mathematically obvious that the project cost of these new development projects could not be financed entirely with this remaining government budget. Meanwhile, FGN strongly envisages the 100% nationwide coverage with water supply. To attain this national goal, it is earnestly suggested that the government would aggressively finance with an additional budgeting to enable the said uncovered part of the new development project costs to be fulfilled. Particularly, the state governments play the crucial role for the development of water supply sector in Nigeria, currently bearing more than 80% of the water supply development costs of Nigeria. The M/P2013 requires a year average amount of 224billion Naira in 1<sup>st</sup> Stage, 186billion Naira in 2<sup>nd</sup> Stage and 100billion Naira in 3<sup>rd</sup> Stage from the state governments (Project Cost X 80%). Accordingly, a substantial amount of additional budget especially for the respective stage is estimated at 165billion Naira, 68billion Naira and 5billion Naira. As a result, the state governments have to collaborate closely with FGN and also discuss the financial support from FGN on the implementation of the M/P2013.

**Table 22 Financing to Water Supply Projects (Naira in billion)**

Items	1 <sup>st</sup> Stage 2014-2020		2 <sup>nd</sup> Stage 2021-2025		3 <sup>rd</sup> Stage 2026-2030		Total 2014-2030	
	Entire Stage	Year Average	Entire Stage	Year Average	Entire Stage	Year Average	Entire Stage	Year Average
1. Current FGR & State Gov. Budget Allocation (Year ave. of 2009/11)	445	74 100%	741	148 100%	593	119 100%	1,779	105 100%
2. Way of Financing for Project Costs	1,679	280 379%	1,163	233 191%	625	125 105%	3,467	204 194%
1) Rehabilitation (FGR & State Gov. Budget)	145	24	112	22	45	9	302	18
2) New Development (FGR & State Gov. Budget)	300	50	629	126	548	110	1,477	87
3) New Development (Additional Budget)	1,234	206	422	85	32	6	1,688	99

Source: JICA Project Team

## (2) Irrigation and Drainage Projects

Firstly, the allocated budget to the M/P2013 would be disbursed to the projects that could achieve the highest economical effectiveness, namely the rehabilitation projects and the supplementary irrigation projects. Secondary, the remaining budget would be spent to the new projects. However, obviously, the project cost of these new development projects could not be financed entirely with this remaining budget. Meanwhile, FGN has been challenging the 100% self-supply of rice. To accomplish this national plan, it is strongly proposed that the government would aggressively finance with an additional budget to enable the said uncovered part of the new project costs to be disbursed.

**Table 23 Financing to Irrigation Projects (Naira in billion)**

Items	1 <sup>st</sup> Stage 2014-2020		2 <sup>nd</sup> Stage 2021-2025		3 <sup>rd</sup> Stage 2026-2030		Total 2014-2030	
	Entire Stage	Year Average	Entire Stage	Year Average	Entire Stage	Year Average <sup>3)</sup>	Entire Stage	Year Average <sup>4)</sup>
1. Current FGR Budget Allocation (Year average of 2009/11)	121	17 100%	173	35 100%	138	35 100%	432	27 100%
2. Way of Financing for Project Costs	353	50 294%	776	155 442%	578	144 411%	1,707	107 396%
1) Rehabilitation (FGN Budget)	15	2	33	7	2	0.5	50	3
2) Supplementary (FGN Budget)	94	13	94	19	-	-	188	12
3) Other New Development (FGN Budget)	12	2	46	9	136	34	194	12
4) Other New Development (Additional Budget)	232	33	603	120	440	109	1,275	80

Note : New Development means these 4 schemes: Irrigation Extension of Ongoing Schemes, Extension Schemes, Dam Irrigation Schemes and Integration Schemes

Source: JICA Project Team

### **10.3 Evaluation from Social and Environmental Aspects**

In general, the projects proposed in the M/P2013 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.

## **11. RECOMMENDATIONS**

### **(1) Practical Use and Periodic Review of National Water Resources Master Plan 2013 (M/P2013)**

#### **Practical Use of M/P2013**

The M/P2013 shows the road map of water resources development and management up to 2030 and handles a comprehensive development and management of water resources in Nigeria as a whole country. Therefore, for the Federal Ministry of Water Resources (FMWR) responsible for the main trunk water resources development and management, it has become a convenient plan. However, the matters of water resources development and management should be conducted at the state level and hydrological basin level in many cases. In addition, in the water sector, there are many water sub-sectors under the jurisdiction of the other federal ministries other than the FMWR. Therefore, the M/P2013 has been compiled to practically use such matters as follows:

- Catchment Management Plan (CMP) as a master plan by Hydrological Area
- Water Sub-sector Development Plan other than "water supply and sanitation" and "irrigation and drainage"

The M/P2013 has been prepared in the collaboration for about two and a half years with the consultant team dispatched by JICA with the technical cooperation of Japan (JICA Project Team) and "Steering Committee", "Technical Advisory Committee" and "Counterpart Team" formulated by the members from the 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, the FMWR is recommended to elaborate and maintain this work (M/P2013) for better utilization of it.

#### **Periodic Review of M/P2013**

The M/P2013 has been formulated on the basis of evidence of water resource potential based on a scientific approach and water demand forecast based on economic growth and population projections up to 2030. Future, it is necessary to check the water demand forecast and look 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 trans-boundary water. About 1/4 (88BCM/Year) amount of water resources of Nigeria (374BCM/Year) are flowing in from outside the country through the Benue and Niger rivers. Reduction of inflow will take place by water resources development in the basins on both rivers. The other reason is the problem of global climate change. Increase in drought frequency and occurrence of large floods have been foreseen. Some situations, water resource potential also may change.

In view of the above, the FMWR is recommended to carry out periodic reviews (for example, every five years) of the M/P2013.

### **(2) Implementation of Water Resources Development Plan**

As water resources development plan, the M/P2013 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).

### **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 (100 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 the FMWR (2011), the water supply rate in 2025 is planned to achieve 100% of each.

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.

### **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 investment efficiency "Supplementary Irrigation Scheme" proposed in the basins of HA5 HA7 with high rainfall amount is particularly high.

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. The "Integrated Irrigation Scheme" newly planned at three locations propose multipurpose dam (for irrigation and hydropower generation) and irrigation land reclamation at each location. For the potential of hydroelectric power plant installation at existing dams, 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 for 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. The FMWR is recommended to steadily implement the irrigation scheme proposed in the M/P2013.

### **Involvement in Other Sub-sectors**

Also in water resource-related schemes under the jurisdiction different, involvement of the FMWR becomes more and more important in future. For example, flood management and hydroelectric power generation are important areas.

As noted above, the promotion of sound and self-reliant irrigation with hydroelectric power generation using the dam for water resources development is recommendable. Although the proposed plan covers small scale of hydropower generation only for pump irrigation, multi-purpose dam project with large-scale hydropower generation and irrigation is the subject of future investigation. Future cooperation with the Federal Ministry of Power having jurisdiction over the power becomes necessary.

In the wake of the flood damage in 2012, occurred in the Benue and Niger rivers, involvement in flood management of the FMWR has become important. If the FMWR increases the ability of flood management, the FMWR will be able to contribute to the flood forecasting and warning evacuation or flood management of the floodplain along large rivers. Future cooperation with the Federal Ministry of Environment having jurisdiction over the flood becomes necessary.

Against this background, for water related project which other ministries are under the jurisdiction, the FMWR is recommended to strengthen cooperation with other ministry in order to participate actively.

### **(3) Implementation of Water Resource Management Plan**

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.

The FMWR is recommended to implement steadily the projects and action plans which are indicated by Water Resources Management Plan proposed in the M/P2013. Water Resources Management Plan is aiming at the state shown below.

- 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.

#### **(4) Steady and Sound Investment**

##### **Direct Capital Investment of Federal Government of Nigeria (FGN)**

The year 2012 planned expenditure budget of FGN totaled 4.9 trillion Naira, out of which the allocation to capital expenditures amounted to 1.5trillion Naira equal to 28.5% of total budget. On the other hand, the anticipated revenues of FGN excluding the debts such as the government bonds were estimated at 3.6trillion Naira that largely depended on the oil; meanwhile the revenues from the income taxes and the value added taxes contributed 14% only. The nation revenues cannot be expected to grow largely in the future; under these circumstances FGN is facing a difficult fiscal policy in the midst of increasing population.

The M/P2013 presents investment plans to attain the goal of 100% water supply coverage and 100% self-supply of rice. Water supply projects recommended in the M/P2013 require yearly amount of 200billion Naira which is double (194%) of average investment amount spent to this sector by Government in the last three (3) years. Particularly, the 1<sup>st</sup> phase (2014-2020) requires yearly 280billion Naira, almost four (4) times (380%) more than Government investment in the last three (3) years. Meanwhile, irrigation and drainage projects require yearly amount of 107 billion Naira which is four (4) times (390%) more than investment of Government in the last three (3) years. The 1<sup>st</sup> phase (2014-2020) requires yearly amount of 50billion Naira, almost triple (290%) of Government investment in the last three (3) years.

Obviously, to achieve national goal of these, the government financial support is indispensable; so that FGN is strongly recommended, despite a severe financial status, to allocate the necessary budget amount preferentially to these two (2) sectors.

On the other hand, the FMWR, as a ministry to supervise and manage directly “Water Supply Projects” and “Irrigation and Drainage Projects”, is recommended to take following actions.

- To design the medium-term implementation and financial plan over the period of the 1st stage of the M/P2013 until the year 2020 in line with the Medium-term Sector Strategy (MTSS) and propose it definitely in order to secure the medium-term budgetary framework.
- To put it in action to take the steps of “M&E System for preparatory stage of Project Implementation”, in order to secure the budget for implementation of the projects.

##### **Other Sources of Financing**

The M/P2013 envisages that the governments will make an intensive capital investment up until 2030: 2 to 4 times of 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**

The 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.

The FGN, aiming to realize steadily the M/P2013, is recommend to actualize the above three (3) actions which contribute toward decreasing the government direct capital investment.

### **(5) Establishment of Project Promotion Function/Body**

“A beginning of big job is critical. (The first step is always the hardest)”

The FMWR is recommended to establish immediately project promotion function/body, e.g. “Project Promotion Mission Unit (PMU)” in the FMWR, so that the FMWR utilizes the M/P2013 effectively under her ownership, strength implementation system and responds flexibly to future problems and issues.

Missions of the PMU are as follow:

- **Follow-up of Authorization of the M/P2013**

To coordinate and take procedures in and out of the FMWR, in order to put the seal on the M/P2013 as an official document.

- **Implementation of Water Resources Development Plan**

To promote and accelerate immediately the various action plans and projects proposed in Water Resources Development Plan of the M/P2013, such as water source (surface water and groundwater) development plan, sub-sector (water supply and irrigation) development plans and involvement in other sub-sectors.

- **Implementation of Water Resources Management Plan**

To promote and accelerate immediately the various action plans and projects proposed in Water Resources Management Plan of the M/P2013, in order to adequate provision of water services.

- **Coordination with Related Ministries and Agencies**

To be liaison for active coordination with the related ministries and agencies in charge of other sectors such as hydropower generation and flood control.

The PMU works under the direct control of the Permanent Secretary of FMWR and composed of about ten (10) members, and can be supported by various departments if necessary. The unit leader is appointed by the Minister of FMWR. In terms of introduction of advanced technology and human resources development, the PMU should be assisted technically by IDPs.

The PMU is a time-limited organization for five (5) years, which is the proposed time frame of periodical review of the M/P2013, and should establish the methodology for project promotion and acceleration in this period.

Besides, PMU’s activities should be monitored and evaluated, and then fed back to the M/P2013 for further utilization and improvement.





