Chapter 5
Issues on Water Resources Development and Management

CHAPTER 5 ISSUES ON WATER RESOURCES DEVELOPMENT AND MANAGEMENT

Issues on water resources development and management in Uganda can be summarized in Table 5-1 arranged from the latest version of NDP: National Development Plan (April 2010). Major issues taken up in this study are described below.

5.1 IWRM and Water Resources Development Plan

Water resources in Uganda have been managed since 1999 based on the concept of IWRM which was adopted in "National Water Policy (1999)" as shown in the short history on "Ugandan Water Resources Management" (refer to Table 5-2). However, there is a fundamental issue between water resources management under IWRM and water resources development namely, spatial expanse of them. The former has mainly river basin concept which focus on natural aspect of water resources. [1]

Meanwhile, water resources development has been planned and carried out in administrative units since before because water resources development plan or utilization plan has been formulated administrative-unit-wise. An advantage of this traditional way is to be able to use all kinds of statistic data stored administrative-unit-wise as basic information in order to formulate a water resources development plan. However, its deficit; it was the reason why IWRM was propounded, is anable to deal with the mutual influence that spans the border of administrative units as the small scale to international boundary as the large scale, because water resources settle quantitatively and qualifiedly in the river basin under natural conditions.

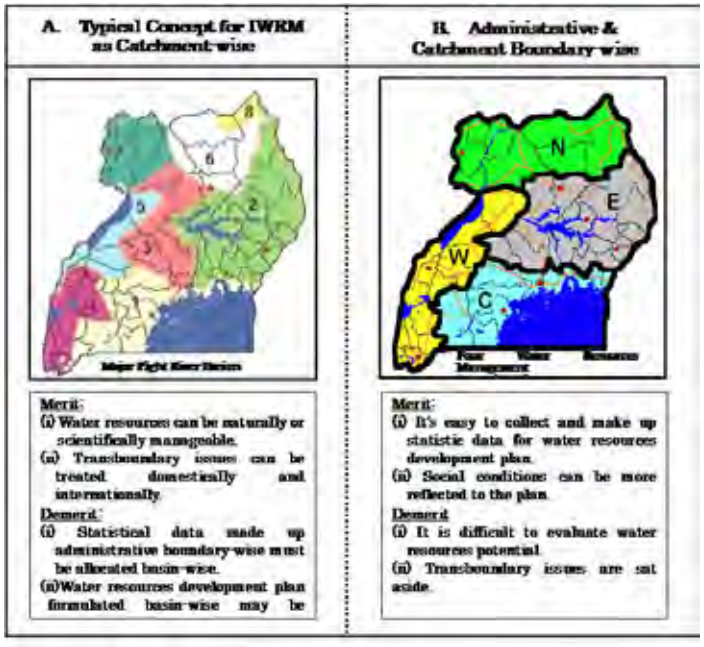


Figure 5-1 Two Concepts for Water Resources Development and Management

In Uganda, "Water Resource Management Zone" called as the compromised idea in a manner is proposed. Four water management zones are set up considering eight major river basins and socio-economic conditions, and conforming to the district boundaries in Uganda;

1. Another concept is groundwater basin, which differs from river basin through the view point of groundwater management. However, it is usually regarded as same as river basin because both water resources are generally in the same hydrological circulation.

however, each zone consists several partial river basins has an issue: how to incorporate river basin management as a basic concept of IWRM. A comparison of both concepts for water resource development and management is shown in Figure 5-1.

Table 5-1 Issues on the Related Sector to Water Resources Development and Management

Sector / sub-sector	No.	Constrains
Water Resources Management Sector	1	Limited institutional and human capacity especially skills in negotiating trans-boundary issues, regulating the use and pollution of water resources, and implementing catchment-based water resources management.
	2	Interference in the management of water resources especially in regulatory aspects.
	3	Weak policy, legal and regulatory framework.
	4	Weak enforcement of laws and regulations for water abstraction, releases and waste discharge.
	5	Lack of water resources data and information which limits analysis, negotiation on trans-boundary issues, proper management of the resources and community participation.
	6	Rigid and cumbersome regional and international agreements and protocols that slow the process of exploitation and use of trans-boundary water resources.
	7	Water hyacinth and other invasive weeds that affect the use of water especially for fisheries in the major lakes, hydropower generation at Jinja and Marine transport in Lake Victoria.
	8	Delayed implementation of land use policy.
Meteorology Sector	1	Obsolete and inadequate equipment which limits data collection, analysis and provision of meteorological services.
	2	Acute shortage of skilled human resources.
	3	Weak institutional set-up.
	4	Absence of a policy and legal framework to guide the provision of services.
	5	Inadequate funding for sector activities.
	6	Limited appreciation and use of meteorological services by other sectors of the economy.
Water Supply and Sanitation Sector	1	Unplanned settlement patterns lead to difficulties in supply of water and sewerage services.
	2	Lack of clear separation of institutional roles on policy formulation, planning, implementation, and regulation.
	3	Inadequate institutional capacity including limited skilled human resource to effectively plan and manage the supply of safe water.
	4	Weak local Private Sector players (contractors, consultants and private operators).
	5	Insufficient funding to meet the high population demands and limited financing options such as infrastructure bonds.
	6	Temporal and spatial variability of water resources leading to high investment costs. High energy costs and limited grid power network leading to high tariffs.
	7	Increasing unit cost partly due to reduction in cheap water source options.
	8	Lack of capacity to pay for the water services.
	9	Low prioritization of sanitation and hygiene.
Water for Production	1	Lack of a framework for operation and maintenance of the water for production facilities.
	2	High operation and maintenance costs for irrigation which are not affordable by the majority of farmers.
	3	Limited implementation of zoning, specialisation and large scale commercial production.
	4	Limited investment financing from both private and public sectors.
	5	Lack of collaborative and coordination mechanisms in planning, infrastructural development and financing between public and private sector institutions.
	6	Lack of knowledge and experience in adaptation of water harvesting techniques.
	7	Weak capacity for provision of critical expansion services for crop production, irrigation techniques and practices as well as marketing.
	8	Inadequate planning and coordination between water supply and water usage.
	9	Lack of a national irrigation strategy.
	10	Lack of coordination among stakeholders (MWE, MAAF, LGs, and MFPED, among others).
Disaster Management Sector	1	Inadequate policy and legal framework for disaster preparedness and management.
	2	Poor early warning systems largely due to inadequate meteorological services in the country.
	3	Limited resources to provide relief and rehabilitation assistance to disaster-affected people.
	4	Inadequate data especially on costs and implications of disasters.
	5	Inadequate capacity for mainstreaming disaster risk reduction at National and Local Government/community levels.
Environmental Sector	1	Poor compliance with environmental laws and regulations.
	2	Inadequate appreciation of the contribution of environmental management to economic development.
	3	Limited practical knowledge of environmental laws within law enforcement agencies (Police, prosecutors, magistrates, prison officers), to handle environmental offences effectively.
	4	Insufficient relevant information in a timely manner and in formats that can readily be used by investors, planners and decision makers.
	5	Inadequate institutional capacity in NEMA, DESS and Local Governments to execute their roles.
	6	Limited networking, collaboration and coordination among the national and international communities on information sharing and financial leverage.
	7	Inadequate funding.
	8	Weak regulation and control of counterfeits and other non-environmentally friendly goods.
Wetland Management Sub-sector	1	Lack of specific Sub-sector laws. Existing related laws are inconsistent and impose very weak penalties.
	2	Weak structures and mechanisms for enforcing laws and regulations.
	3	Inadequate funding for effective wetland management.
	4	Limited specialized skills and equipment.
	5	Inadequate research and data on key components of wetlands such as hydrology and soils.
	6	Delayed implementation of the national land use policy.
	7	Undervaluation of wetland products and services owing to lack of appreciation of their importance.
	8	Poor marketing strategies for wetland products which makes them less competitive on the local and international markets.
Climate Change Sector	1	Critical shortage of requisite expertise.
	2	Limited awareness at all levels about the causes of climate change and/or climate variability as well as their devastating impacts to socio-economic development plans and activities.
	3	Lack of policy, legislation, regulation and guidelines for mainstreaming climate change into development plans at all levels.
	4	Inadequate conceptualization of the importance of weather and climate information by strategic planners.
	5	Insufficient and unreliable scientific data and information especially weather and climate data necessary for forecasting scientific phenomena.
	6	Inadequate institutional and financial resources.
	7	Weak coordination mechanisms.

Source: "National Development Plan" (2010/11 - 2014/15), April 2010

Table 5-2 Short History on Uganda's Water Resources Management

Year	Main Project	Policy and Regulation Framework for WRM	Institutional Setup for WRM
Pre-1947			Hydrological Service Unit under the Ministry of Public Works
1947			Department of Hydrological Services
1956			Water Development Department (WDD)
1962		Independence of Uganda	
1986		The Start of Current Presidency	
1994		* The National Environment Management Policy (1994)	
		* Uganda Wildlife Policy (1994)	
1995		* The Water Action Plan (1995)	
		* The Constitution of Uganda (1995)	Water Resources Management Department (WRMD)
		* The National Policy for the Conservation and Management of Wetland Resources (1995)	
1996			
1997		* The Local Government Act (1997)	
		* Water Act	
		* Poverty Eradication Action Plan (PEAP)	
		* National Gender Policy (1997)	
1998	Water Resources Assessment Project (WRAP)	* The Land Act (1998)	
		* The Water Resources Regulations (1998)	
		* The Water (Waste Discharge) Regulations (1998)	
		* Environmental Impact Assessment Regulations (1998)	
		* The Water Supply Regulations (1998)	
		* The Sewerage Regulations (1998)	
		* The Water Supply Regulations (1998)	
1999	Lake Victoria Environment Management Project (LVEMP)	* The National Water Policy (1999)	
		* The Waste Management Regulations (1999)	
		* The National Environment (Standards for Discharge of Effluent in Water or Land) Regulations (1999)	
		* National Environment (Waste Management) Regulations (1999)	
2000	Water Sector Reform Study	* Forestry Policy (2000)	
		* The Water Act Cap. 152 (2000)	
		* The National Environment Act Cap. 153 (2000)	
2001		* Wetlands Sector Strategic Plan 2001-2010 (2001)	
2002			
2003		* The Fisheries Act (2003)	
2004		* Poverty Eradication Action Plan (PEAP2004/2007)	
		* The National Fisheries Policy (2004)	
		* Provisional Fisheries Sector Strategic Plan (2004)	
2005	Nile Basin Initiative	* The National Environmental Health Policy (2005)	
		* The National Environmental Health Policy (2005)	
		* Plan for Modernization of Agriculture (2005)	
		* Draft Irrigation Policy (2005)	
		* Water for Production Strategy (2005-2015)	
2006			
2007			Directorate of Water Resource Management (DWRM)
2008			
2009	JICA Study	* Starategic Investmet Plan (SIP)	
2010		* National Development Plan (2010/11 - 2014/15)	
2011			

5.2 Surface Water Resources Development and Management

Issues on the surface water resources development and management in the Basin are summarized below.

(1) Relation to Nile Treaty

Given the new political dispensation in the Nile Basin, the Nile Basin countries, in 1995, embarked on the process of negotiating and developing a new Nile Basin Cooperative Framework Agreement for the sustainable management and development of the shared Nile water resources. This process is still ongoing and it is envisaged that once these negotiations are successfully concluded, the

resulting agreement will supersede all the existing Nile water agreements. However, it is not practical to put this hopeful agreement on the prior condition of the Basic Plan of the surface water resources development and management. Therefore, it is necessary to make the Basic Plan under the water resources supplied by rainfall precipitated in the Lake Kyoga Basin itself.

(2) Imbalanced Distribution of Surface Water Resources in the Basin

The available surface water resource through the year is different in each sub-basin. The distribution has a tendency that northern sub-basins has poor surface water resources, on the other hands, southern sub-basins has relatively more surface water resources.

(3) Appropriate Water Allocation

It is necessary to build adequate water allocation system among water sectors for keeping economic efficiency, effectiveness and social equity.

(4) Effect of Climate Change

IPCC Fourth Report said that Climate Change in the 21st will cause increase of annual rainfall in East Africa. However, it cannot give reliable rainfall quantity at any given future point in time so that it is reasonable not to put the rainfall increase effect into the Basic Plan.

(5) Monitoring and Potential Evaluation of Water Resources

It is necessary to build up revised monitoring system on rainfall and surface water discharge, and information sharing system among water sectors: these are fundamentals for more precise water resources estimation. These monitoring data will bring more accurate estimation of water resources in future.

(6) Management of Surface Water Usage

On the other hands, to grasp current water use is also essential for IWRM so that the strengthening of maintenance system of the database on water allocation and the information sharing among water sectors are necessary.

5.3 Groundwater Resources Development and Management

(1) Groundwater Development Plan

There is no development plan of National or local level, and, planning is required early. Therefore, capacity development for planning of development plan is required at each district. Since groundwater should be main water source for rural area, capacity development for groundwater in each district water office (DWO) is recognized as prime task.

(2) Groundwater Mapping

Since the groundwater mapping has been conducted on the basis of National Groundwater Database ,which has an issue on data accuracy, it has to be updated after revising NGWDB through

checking existing data with WATSUP results and adding new data.

(3) Groundwater Potential

Many kinds and numbers of data are necessary to examine groundwater potential, since groundwater monitoring is generally more difficult than surface water, which can be measured directly. In the Study, groundwater recharge was analyzed by the water balance calculated by albedo and topography analysis estimated by satellite image analysis, because the meteorological, hydrological and hydrogeological data are insufficient. In near future, it is necessary to improve their monitoring network system satisfactorily to consider the climate change too and this technique using satellite image data as provisional and practical method. Capacity development for DWRM's staff needs to conduct this kind of analysis by them.

(4) Borehole Completion Report

Although borehole completion reports are very important for groundwater resources management, technical issues on their accuracy negatively affect groundwater potential evaluation because of no guideline for drilling, borehole structure and pumping test.

(5) Groundwater Monitoring

Only three groundwater monitoring stations are functioning in Lake Kyoga Basin so far. To grasp the fluctuation of quantity and quality of groundwater resources, the role of groundwater monitoring is essentially important. The number of monitoring station is required at least each one station at the typified place in the 11 sub-basins.

(6) Permission for Groundwater Withdrawal

Water balance analysis is fundamental matter for water resources management. Therefore, to grasp groundwater withdrawal volume as sort of expenditure is so important that DWRM should monitor withdrawal volume of bulk water-users in particular through granting groundwater withdrawal permission.

(7) Water Management Zone Office

The main roles of the WMZ are listed below;

- Implementing Integrated Water Resource Management (IWRM),
- Bringing practical WRM much closer to the users,
- Models for the assessment of water balance, water quality and pollution loading, and
- Community participation.

Capacity development for WMZ office and DWRM is needed. The former is expected not only for groundwater management but water resources management and the latter DWRM manages WMZ office.

5.4 Conservation of Water Environment

5.4.1 Water Quality

(1) Surface water (Rivers and Lakes)

Issue on conservation of surface water quality is to maintain at least the current conditions. Slightly high organic compounds detects now in the urban areas of the Basin. BOD value was not significantly high in most cases; however, this situation is likely to change drastically in near future and water resource would be deteriorated due to the rapid population growth and economical growth.

(2) Groundwater

Issue on groundwater in the Basin is contamination of Coliforms in many deep wells, shallow wells, and protected springs. Main cause seems to be pollutants deriving from livestock. The polluted water infiltrates to the aquifer due to the inappropriate blockage of contaminated water on the ground surface and the faulty sealing of wells.

5.4.2 Necessity of Ambient Water Quality Standards and Water Quality Monitoring

In general, a precautionary measure is much cheaper than backward incidence. It takes enormous cost, time and effort to restore a deteriorated environment although some cost need to forestall and prevent pollution. Water quality would be deteriorated for real in Uganda due to rapid population growth and economic development. Therefore, an appropriate system for water quality monitoring should be formulated in order to take countermeasures against pollution before it becomes a serious situation.

Some of the countermeasures are to install septic tank, construct sewerage treatment system and increase public awareness. However, reliable data of water quality by periodical monitoring works and ambient water quality standard including classification of type of water use as an environmental conservation target for planning and implementation of countermeasure are essentially needed.

Therefore, the ambient water quality standard and the monitoring system should be well- formulated rapidly as a first step to conserve water environment in Uganda.

5.5 Water Balance of Supply and Demand

5.5.1 Future Water Demand

(1) Population Frame

Table 5-3 Present and Future Population in Lake Kyoga Basin

Year	Whole Population in the Basin	Large Urban (NWSC)	Peri-urban/ Rural (NWSC Service Area)	Small Towns (Town Councils & Town Boards)	Rural (RGCs + Villages)
2008	9,321,959	392,351	481,972	604,295	7,843,341
2015	11,822,680	482,341	632,369	772,111	9,935,859
2020	13,979,550	587,059	748,386	925,437	11,718,668
2035	22,766,831	1,004,084	1,366,522	1,644,976	18,751,249

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

The future population is forecasted in the "Strategic Investment Plan for the Water and Sanitation Sub Sector, July 2009" (SIP). The future population is estimated for each district in the following four (4) categories of areas until 2035 applying the published population growth which estimated till 2017 by the Uganda Bureau of Statistics (UBoS) based on the population census data for 1992 and 2002.

- Urban areas (Large towns)
- Peri-urban areas
- Rural small towns
- Rural areas (RGCs and villages)

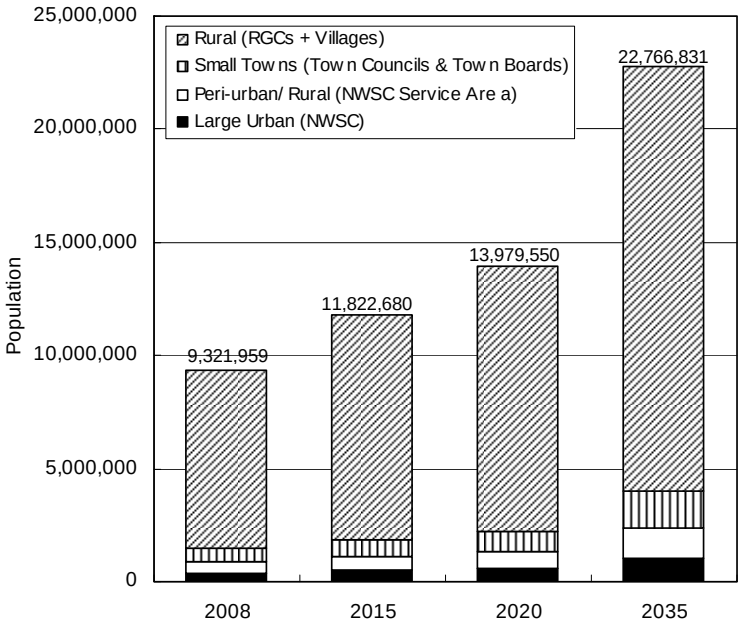


Figure 5-2 Present and Future Population in Lake Kyoga Basin

The population growth rates are set for the urban and the rural areas of each district based on the growth from 1992 to 2002, and same rates are applied for the estimation until 2035. Total population of the basin is estimated to 9,321,959 and 22,766,831 for 2008 and 2035, respectively, and the estimated values of the population for each category are summarized in Table 5-3 and Figure 5- 2 for some years indicative of milestones in the plan.

As seen in Figure 5-2, the rural population (RGC + Village) shares about 84% of the whole population, and its increase from 2008 to 2035 is calculated to be 239%, a bit smaller than those of urban areas calculated to be 272% for the sum of large urban, peri-urban and small towns.

Table 5-4 shows the area and population density of sub-basins in the Lake Kyoga basin (2008). The Mpologoma sub-basin has the highest population density of 140.62 person/km^2, while the lowest density of 9.94 person/km^2 is indicated in the Okok sub-basin. The sub-basins having rather higher population density are the Mpologoma, the Sezibwa, the Awoja, the Lumbuye and the

Victoria Nile sub-basins located in the southern and eastern parts of the Lake Kyoga basin. These sub-basins are located along the major national roads and their economic activities are considered to be growing rapidly, resulting in the urgent provision of water supply facilities.

Table 5-4 Area and Population Density in Each Sub-basin

Sub-basin	Population (2008)	Area (km^2)	Population Density (person/km^2)	Order
(1) Okok	266,139	5,512	48	11
(2) Okere	408,921	8,199	50	10
(3) Awoja	1,192,686	10,717	111	9
(4) Lwere	382,397	1,618	236	5
(5) Akweng	381,255	2,504	152	6
(6) Abalan	386,222	2,908	133	7
(7) Kyoga Lakeside	650,393	5,206	125	8
(8) Mpologoma	3,084,281	7,862	392	1
(9) Lumbuye	470,914	1,478	319	2
(10) Victoria Nile	985,698	3,456	285	3
(11) Sezibwa	1,113,054	4,225	263	4
Total/Average	9,321,959	53,685	174	-

(2) Future Water Demand

The water demands of drinking, agricultural and industrial water in the whole Lake Kyoga Basin and each sub-basin in 2008 to 2035 are estimated based on SIP as presented in Table 5-5 and 6. As shown in Figure 5-3, the water demand of the Mpologoma sub-basin is the largest in the Basin sharing about 75 % of the demand of the whole basin, but its increase is not so sharp as the other sub-basins. The demand of the Mpologoma sub-basin increases to 365.9 MCM equivalent to about 12 % of increase, and remains only at about 43 % of the whole basin, though the demand of the whole basin gains from 435.6 MCM to 844.1 MCM equivalent to about 94 % of increase.

As for the water demand for each sector shown in Figure 5-5 and Table 5-6, the demand of irrigation for crops is considered to be the largest throughout the project period. It shares about 55% only in 2035 though about 75% in 2008. Its increase from 2008 to 2035 is calculated to be 42% which is considered low comparing with the increase of the whole demand of the basin of about 94%.

Table 5-5 Present and Future Water Demand for Sub-basins

(Unit:MCM)

Sub-basin	2008	2015	2020	2035
(1) Okok	7.7	12.4	16.1	26.7
(2) Okere	7.7	16.2	23.7	47.5
(3) Awoja	15.8	35.2	52.2	103.3
(4) Lwere	29.1	30.4	32.3	41.5
(5) Akweng	4.1	10.9	17.2	34.9
(6) Abalan	4.2	15.6	24.8	50.5
(7) Kyoga Lakeside Zone	12.3	24.7	35.4	65.4
(8) Mpologoma	327.6	322.4	325.5	365.9
(9) Lumbuye	6.2	8.7	11.3	20.5
(10) Victoria Nile	10.7	18.8	26.4	44.8
(11) Sezibwa	10.3	18.4	26.1	43.1
Total	435.6	513.6	590.8	844.1

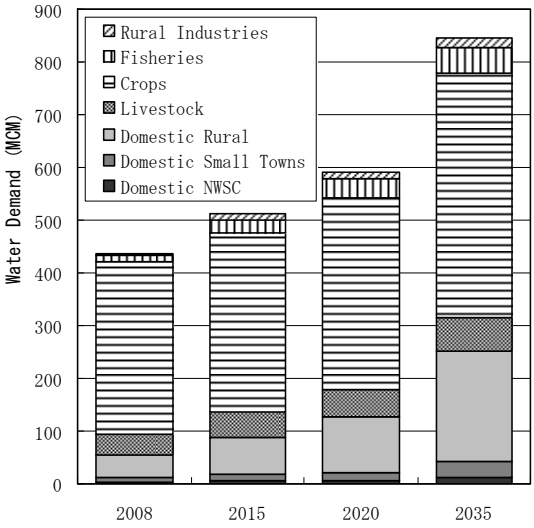


Figure 5-3 Present and Future Water Demand in Lake Kyoga Basin by Sector

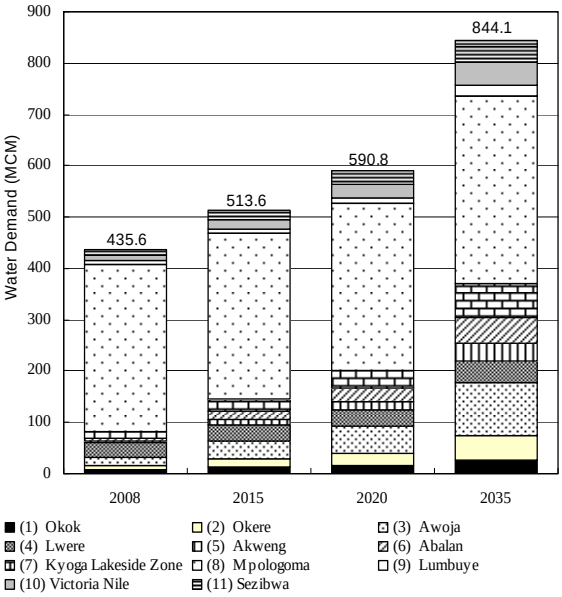


Figure 5-4 Present and Future Water Demand in Lake Kyoga Basin by Sub-basin

Table 5-6 Present and Future Water Demand for Sectors

(Unit:MCM)

Year	Domestic NWSC	Domestic Small Towns	Domestic Rural	Livestock	Crops	Fisheries	Rural Industries	Total
2008	3.9	8.22	42.94	37.82	326.95	12.02	3.78	435.7
2015	5.12	12.09	71.91	48.56	339.55	24	12.36	513.7
2020	6.33	16.31	105.85	51.54	361.31	36.03	13.45	591
2035	11.42	31.53	208.7	63.92	463.22	48.03	17.24	844.1

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

1) Drinking Water

The future demand of the drinking water supply is estimated based on the future population increase discussed in the previous section and the targets of coverage of water service and the consumption per capita as summarized below.

Table 5-7 Targets of Urban and Rural Water Supply

Description		Present	Target		
			2015	2020	2035
Urban Water Supply	Coverage (%)				
	Large Towns	70	80	-	100
	Small Towns	41	65	74	100
	Consumption (liter/day/capita)	35	30	45	60
Rural Water Supply	Coverage (%)	63	77	82	100
	Consumption (liter/day/capita)	15	20	25	30

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

2) Other Water Demands

i) Water for Crops (Irrigation)

The water demand for irrigation is estimated based on the present crop mix according to UBOS statistics on cultivated areas and water demands for crop irrigation based on the CROPWAT model that provides data for the major crops in the Basin. As shown in Table 5-8,

the cultivated areas are increased in 2035and all the areas in the arable lands will be utilized. The irrigation facilities will be constructed in both Areas A and B, and 25% and 5% of cultivated lands will be irrigated in 2035.

Table 5-8 Target Indices for Irrigation Requirement

Description		2008	2015	2020	2035
Cultivated Area in Arable Land			75%	100%	100%
Area Irrigated in Irrigable Land					
	Area A		5%	10%	25%
	Area B		1%	2%	5%
Technology Mix of Irrigation Method for Water Saving					
Area A	Drip	1%	2%	3%	5%
	Sprinkler	3%	10%	20%	30%
	Surface	81%	63%	57%	50%
	Low cost	15%	25%	20%	15%
	Irrigation Efficiency	45%	50%	54%	58%
Area B	Drip	5%	5%	18%	25%
	Sprinkler	40%	40%	50%	50%
	Surface	30%	30%	12%	10%
	Low cost	25%	25%	20%	15%
	Irrigation Efficiency	64%	64%	73%	76%

Note: The irrigation efficiencies vary depending on the irrigation methods applied as shown below.
- Drip: 90%, - Sprinkler:80%, - Surface: 40%, - Low cost: 60%

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

Saving water is one of the important aspect in SIP, especially for the irrigation it is important because it shares substantial part of the whole demand. In SIP, some advanced methods in water application in fields are considered; drip, sprinkler and surface methods as presented in the above Table. The irrigation efficiencies are planned to be increased from the present 45% and 64% to 58% and 76% in Areas A and B, respectively in the plan.

ii) Water for Livestock

The volume of water required for livestock feeding is estimated based on the future numbers of livestock expressed as Tropical Livestock Units (TLUs), which are estimated according to the rangeland capacity worked out from the rangeland areas and carrying capacities in the various agricultural zones on the UBoS statistics. (refer to Table 5-9)

iii) Water for Fisheries

The water volume necessary for fisheries is estimated based on the annual targets for production of fish from fishponds. The targets are set

Table 5-9 Target Indices for Livestock Requirement

Description	2015	2020	2035
Rangeland Utilized			
Cattle Corridor	60%	70%	100%
Non Cattle Corridor	30%	35%	50%
Cattles Fed with Water			
Cattle Corridor	30%	40%	70%
Non Cattle Corridor	10%	15%	30%

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

in accordance with the plans from the Fisheries Department as percentage increase of the present fish production as shown in the following Table.

Table 5-10 Target Indices for Fish Production

Description	2015	2020	2035
Fish production (% of 2006 fish production from ponds)	200%	300%	400%

Source: Strategic Investment Plan for the Water and Sanitation Sub Sector, 2009

iv) Water for Rural Industries

The water volume required for rural industries is estimated as a proportion of those in the above three (3) productive sub-sectors. Presently there is limited use of water for processing of agricultural produce; dairies and abattoirs are located in urban areas. However, the water use by rural industries is expected to increase with the emphasis on development of agricultural industries and food processing close to the production areas.

5.5.2 Water Balance of Supply and Demand

A relationship between a trend of future water demand and exploitable water resources in the Basin or sub-basins is described below.

(1) Lake Kyoga Basin

The extension of water demand and the exploitable volume of water resources in the whole Lake Kyoga Basin are shown in Figure 5-5, which implies their balance in 2008 as a current condition and, in 2015, 2020 and 2035 as future conditions. Although supply and demand relationship has no problem in a normal year, 556.1 MCM/year summing up surface water resources estimated with 10-year drought water discharge and groundwater in drought year cannot cover the future water demand before 2020. Since it is unreasonable to formulate any development plan based on 1/10 probable drought year because much excessive investment is needed in a short period, 1/3 probable drought year was adopted in this study. In that case, the exploitable water volume: 650.5MCM/year can manage to cover water demand quantitatively until

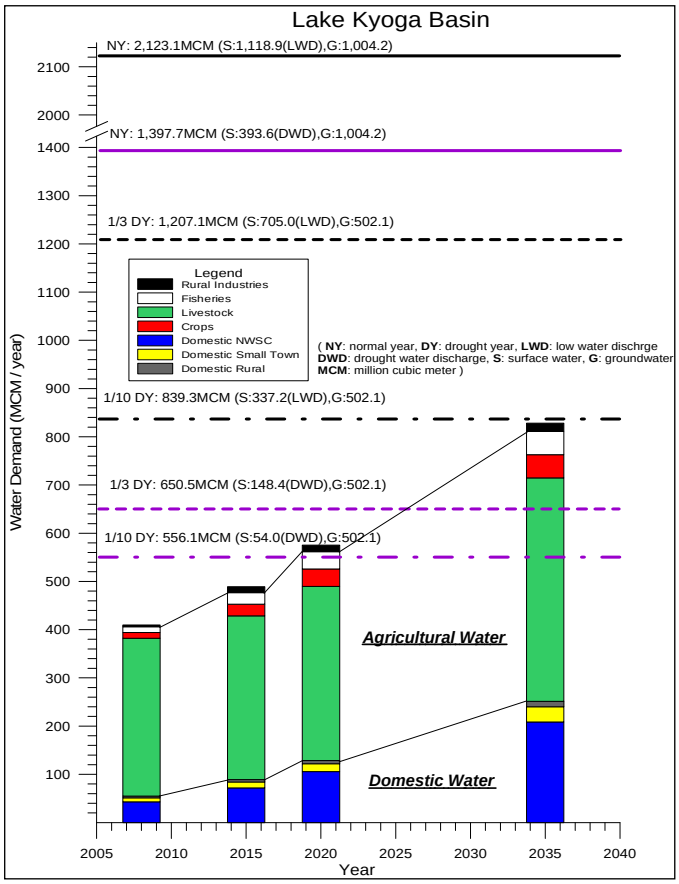


Figure 5-5 Water Balance of Supply and Demand in Lake Kyoga Basin

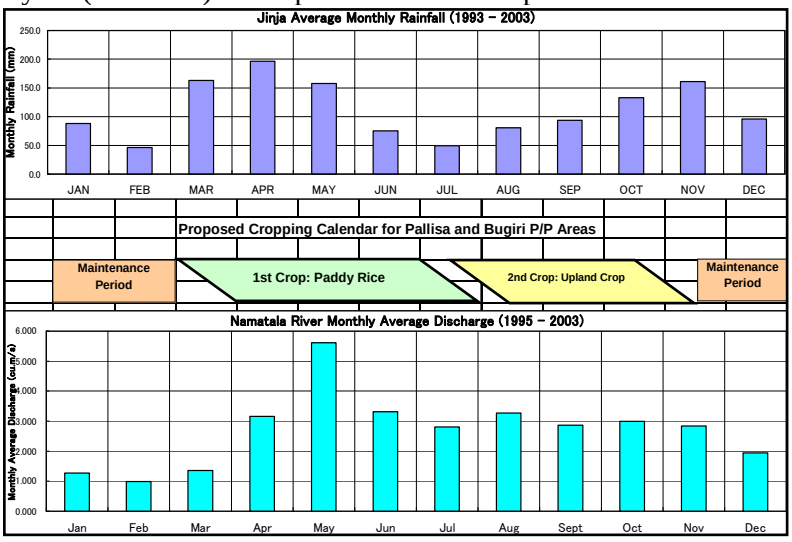
around 2025; however, since agricultural water, which occupies more than half of total water demand, depends almost on surface water, it is necessary to consider not only quantitative comparison but also water type of water sector.

(2) Sub-basins

Water supply-demand balances of each sub-basin in Lake Kyoga Basin are shown in Figure 5-7 to 9.

Total exploitable water volumes of each sub-basin were calculated to sum up surface water volume estimated by 3-year drought water discharge and exploitable groundwater in drought year. According to the results, deficiency of water resources will be happened by the target year 2035 in five sub-basins: Okok, Okere, Lwere, Kyoga Lakeside Zone and Mpologoma.

On the other hand, water demand for crops, which is majority of agricultural water, is not constant but seasonally changed by the pattern of planting crops that closely correspond to the pattern of rainfall. Figure 5-6 is a typical cropping calendar of Pallisa and Bugili and suggests that the water demand period of crops is seven months per year. Therefore, if 3-year low water discharge that means exploitable for 275 days a year (9 months) is adopted to estimate exploitable surface water resources for agricultural water use, the total water volume will rise to black dotted line in Figure 14-9 and, Lwere and Okere out of above-mentioned five sub-basins have no problem quantitatively. However, according to the water balance assessment considering water quantity and water type in Table 14-9, shortage of water will occur in agriculture sector of the five sub-basins after all. As for domestic water, if groundwater development goes well, the water demand growth in all sub-basins can be nearly covered. Supply and demand conditions of each sub-basin are as follows.



Source: JICA (2009) "Technical Assistance for Support to Sustainable Irrigated Agriculture Development Project in Eastern Uganda"

Figure 5-6 Typical Crop Calendar of Pallisa and Bugiri District

1) Okok

Since surface water resource for agriculture is near to the limitation of its demand even now, future water demand expected to be about three times until 2035 will not be covered. As for

domestic and industrial water withdrawing groundwater resources, it might reach the limit in 2035.

2) Okere

In terms of quantity of water resources, water demand in 2035 will be managed to be covered; however, it is difficult to do by surface water resources after 2015 because of six time's increase of agricultural water demand until 2035.

3) Lwere

Most of the water demand in this sub-basin is for crops. Fortunately, it levels off in the future; however, the supply-demand balance in the current situation is a delicate situation. Future domestic water demand in 2035: more than five times of the current demand could be covered by groundwater development.

4) Kyoga Lake-side Zone

Since the drainage area of this sub-basin is split into small catchments due to topographical conditions, surface water resources are scarce. Agricultural water demand closes to limit of surface water resources even now. Therefore, it is very difficult to cover the future demand, which will become 5.5 times of present demand in 2035.

5) Mpologoma

Mpologoma having more than 2.5 million people at present is the most active sub-basin in Lake Kyoga Basin in terms of economic activity. Its water demand is incomparably bigger than any other sub-basins and crop water especially accounts 90% of the current total water demand. According to SIP, agricultural water demand in this sub-basin plans to be cut about 10% rather than the current demand by water-savings until the target year. However, it seems that crop condition is disturbed by insufficient crop water even now because even 3-year low water discharge can cover only 2/3 of the demand.

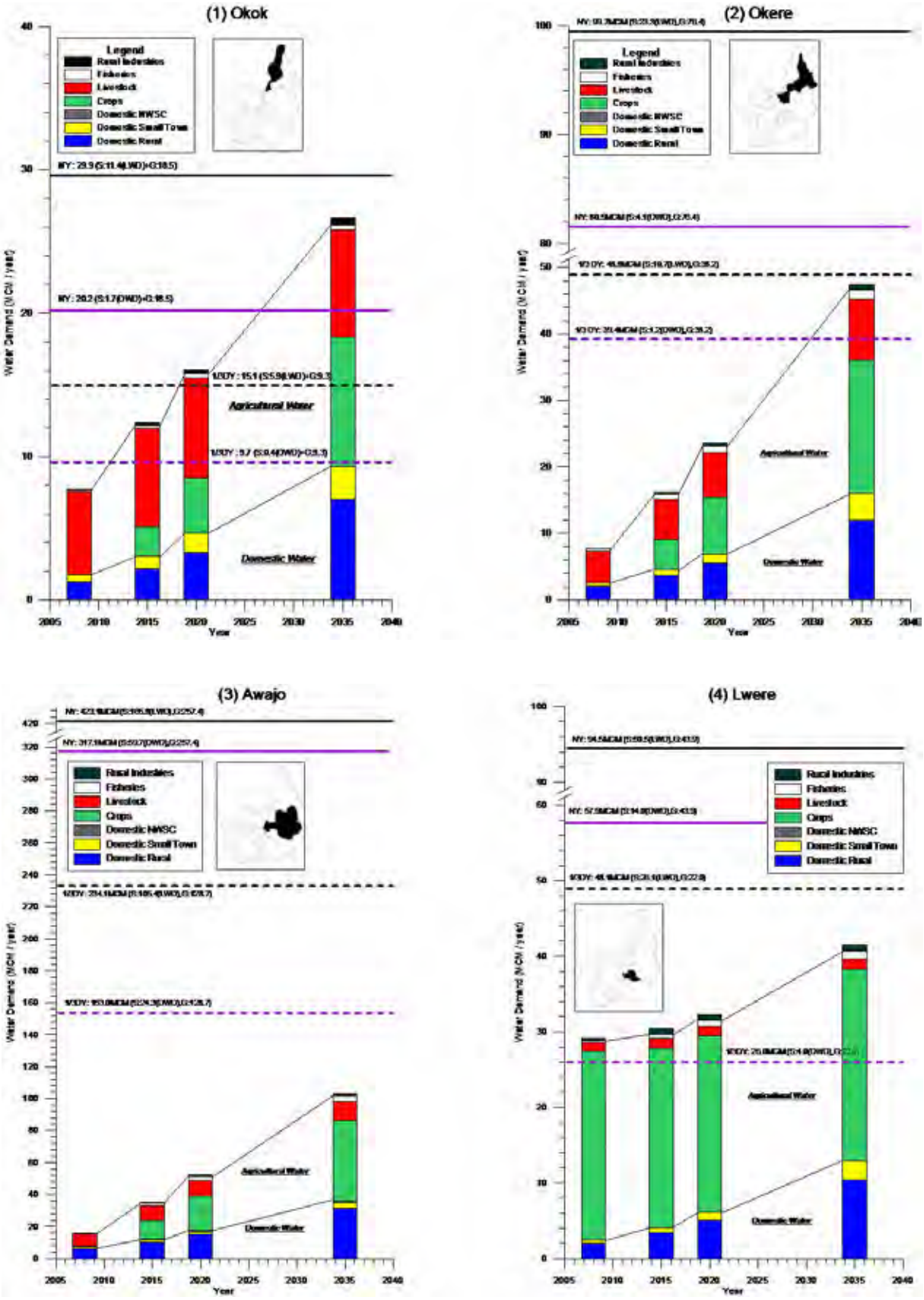
Predicted water shortage in these sub-basins is mainly agricultural water as shown in Table 5-11. Above-mentioned prediction implies that nobody can take an optimistic view on water resources conditions in the target year, and then the Basic Plan was formulated under such circumstances.

Table 5-11 Estimated Water Shortage in Five Sub-basins

Unit: MCM/year

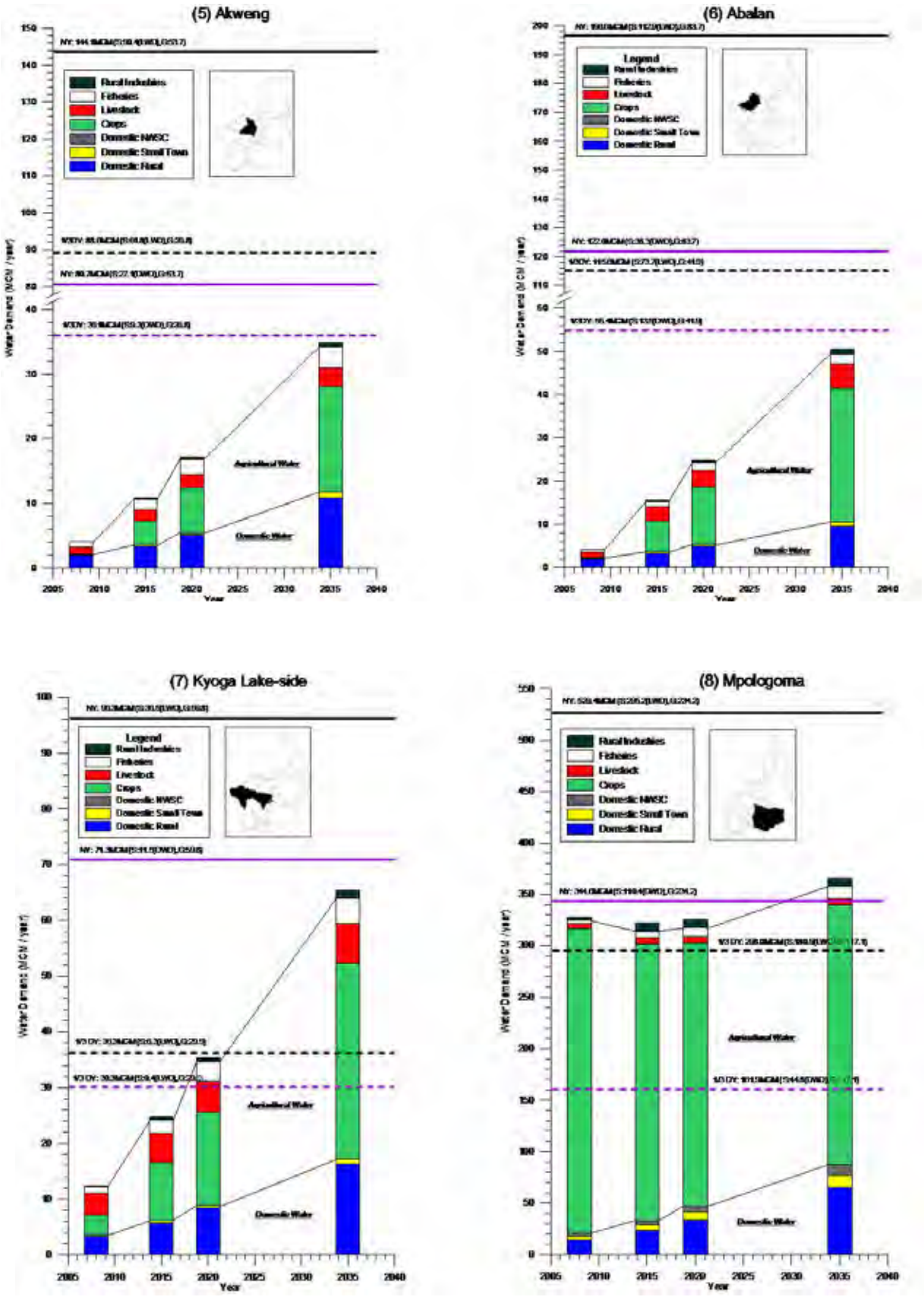
Sub-basin Name	2008		2015		2020		2035	
	GW for Domestic & Industrial Water	SW for Agricultural Water	GW for Domestic & Industrial Water	SW for Agricultural Water	GW for Domestic & Industrial Water	SW for Agricultural Water	GW for Domestic & Industrial Water	SW for Agricultural Water
(1) Okok				3.2		5.2	0.5	10.9
(2) Okere				0.7		5.7		19.9
(4) Lwere		0.3						1.7
(7) Kyoga Lakeside Zone		2.2		11.8		19.5		40.5
(8) Mpologoma		122.6		100.0		89.8		89.4

GW: groundwater, **SW**: surface water, **MCM**: million cubic met



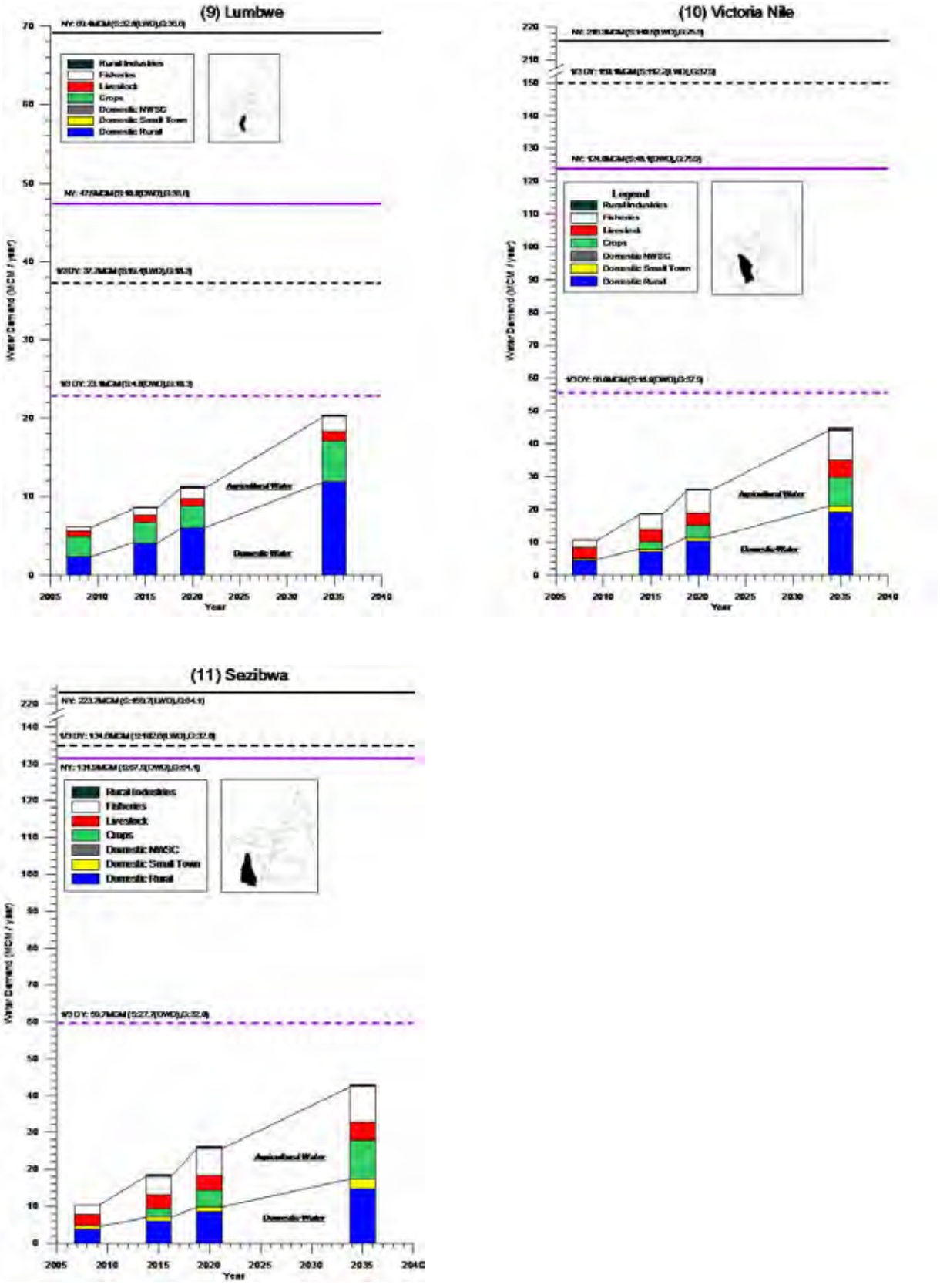
(**NY**: normal year, **DY**: drought year, **LWD**: low water discharge,
DWD: drought water discharge, **S**: surface water, **G**: groundwater)

Figure 5-7 Trend of Water Demand and Exploitable Water Resources (1)



(**NY**: normal year, **DY**: drought year, **LWD**: low water discharge,
DWD: drought water discharge, **S**: surface water, **G**: groundwater)

Figure 5-8 Trend of Water Demand and Exploitable Water Resources (2)



(**NY**: normal year, **DY**: drought year, **LWD**: low water discharge, **DWD**: drought water discharge, **S**: surface water, **G**: groundwater)

Figure 5-9 Trend of Water Demand and Exploitable Water Resources (3)

Table 5-12 Evaluation of Water Balance in Each Sector

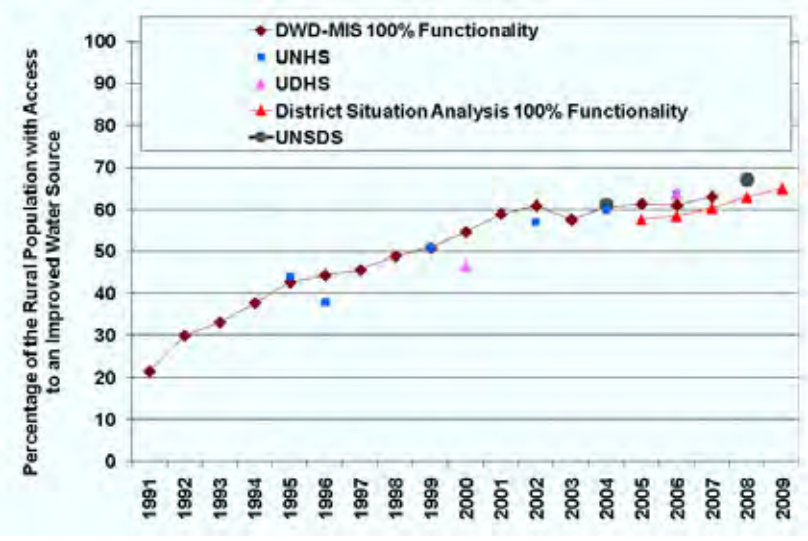
Sub-basin Name	Water Demand (MCM/year)																Exploitable Water Resource (MCM/year)									
	2008				2015				2020				2035				Normal Year					1/3 Drought Year				
	Domestic Water	Agricultural Water	Industrial Water	Total	Domestic Water	Agricultural Water	Industrial Water	Total	Domestic Water	Agricultural Water	Industrial Water	Total	Domestic Water	Agricultural Water	Industrial Water	Total	Surface Water		GW	Total		Surface Water		GW	Total	
																	DWD	LWD		DWD	LWD	DWD	LWD		DWD	LWD
(1) Okok	1.7	5.9	0.1	7.7	3.1	9.1	0.3	12.4	4.7	11.1	0.3	16.1	9.3	16.8	0.5	26.7	1.7	11.4	18.5	**20.2**	**29.9**	0.4	5.9	9.3	**9.7**	**15.1**
(2) Okere	2.6	5.1	0.1	7.7	4.5	11.4	0.3	16.2	6.8	16.4	0.5	23.7	16.0	30.6	0.9	47.5	4.1	23.3	76.4	**80.5**	**99.7**	1.2	10.7	38.2	**39.4**	**48.8**
(3) Awoja	6.8	8.3	0.1	15.2	11.5	22.4	0.7	34.5	16.9	33.6	1.0	51.5	35.2	65.1	2.0	102.2	59.7	165.8	257.4	**317.1**	**423.1**	24.3	105.4	128.7	**153.0**	**234.1**
(4) Lwere	2.4	26.4	0.3	29.1	4.1	25.5	0.8	30.4	6.1	25.5	0.8	32.3	12.9	27.8	0.8	41.5	14.0	50.5	43.9	**57.9**	**94.5**	4.0	26.1	22.0	**26.0**	**48.1**
(5) Akweng	2.0	2.0	0.0	4.1	3.5	7.1	0.2	10.9	5.4	11.4	0.3	17.2	11.8	22.4	0.7	34.9	27.1	90.4	53.7	**80.7**	**144.1**	9.3	61.8	26.8	**36.1**	**88.6**
(6)Abalan	2.2	2.0	0.0	4.2	3.6	11.6	0.3	15.6	5.3	18.9	0.6	24.8	10.6	38.8	1.2	50.5	38.3	112.9	83.7	**122.0**	**196.6**	13.5	73.7	41.9	**55.4**	**115.6**
(7) Kyoga Lakeside Zone	3.7	8.5	0.1	12.3	6.1	18.1	0.5	24.7	8.9	25.8	0.8	35.4	17.2	46.8	1.4	65.4	11.5	36.5	59.8	**71.3**	**96.3**	0.4	6.3	29.9	**30.3**	**36.3**
(8) Mpologoma	17.8	303.5	3.0	324.3	28.6	280.9	8.4	317.9	41.1	270.7	8.1	319.9	77.2	270.3	8.1	355.6	110.4	295.2	234.2	**344.6**	**529.4**	44.8	180.9	117.1	**161.9**	**298.0**
(9) Lumbuye	2.4	3.7	0.0	6.2	4.1	4.5	0.1	8.7	6.0	5.1	0.2	11.3	11.9	8.3	0.3	20.5	10.8	32.8	36.6	**47.5**	**69.4**	4.8	19.4	18.3	**23.1**	**37.7**
(10) Victoria Nile	4.9	5.7	0.1	10.7	7.9	10.6	0.3	18.8	11.3	14.7	0.4	26.4	20.9	23.2	0.7	44.8	48.1	140.5	75.9	**124.0**	**216.3**	18.0	112.2	37.9	**56.0**	**150.1**
(11) Sezibwa	4.6	5.6	0.1	10.3	7.0	11.0	0.3	18.4	9.8	15.8	0.5	26.1	17.4	25.0	0.7	43.1	67.9	159.7	64.1	**131.9**	**223.7**	27.7	102.6	32.0	**59.7**	**134.6**
Total	51.2	376.8	3.8	431.7	84.0	412.1	12.4	508.5	122.2	448.9	13.5	584.5	240.2	575.2	17.3	832.7	393.6	1,118.9	1,004.2	**1,397.7**	**2,123.1**	148.4	705.0	502.1	**650.5**	**1,207.1**

Shortage of Water Resource Marginal of Water Resource Coverage **DWD**: drought water discharge, **LWD**: low water dicharge, **GW**:groundwater

5.6 Plateaued Coverage Rate of Rural Water Supply

Drinking water supply, which is one of the keen needs for water resources development, is categorized into urban and rural water supply. Although urban water supply to large town and small town has been developed mostly on an economic basis by NWSC and Town Board respectively, rural water supply is apt to be left behind. A coverage rate of rural water supply had been improved rapidly until 2001 but it has been plateaued since 2002 as shown in Figure 5-10. It implies that additional facilities and maintenance of existing faculties cannot catch up growing water demand now.

Consequently, a practical and effective development plan should be formulated to meet the national target rate: 77% in 2015.



Source: MoWE (2009), "Water and Environment Sector Performance Report"

Figure 5-10 Coverage Rate of Rural Water Supply in Uganda

Chapter 6
Basic Plan on Water Resources Development and Management

CHAPTER 6 BASIC PLAN ON WATER RESOURCES DEVELOPMENT AND MANAGEMENT

According to the "National Development Plan (Draft Feb. 2008)", the government of Uganda (GoU) confesses that it has until recently accorded low priority to water management because of a wrongly persisting perception that the country has abundant, inexhaustible supplies of freshwater. Meanwhile, "the impending global crisis over water" caused by climate change, rapid population growth and so on has been recognized recently in Uganda.

Under the circumstances, GoU really feels the necessity of Integrated Water Resources Management (IWRM) and upgraded the Department of Water Resources Management under Directorate of Water Development (DWD) to Directorate of Water Resources Management (DWRM) based by the organizational reform of MoWE based on "Water Sector Reform Study (1999 – 2005)" in June 2006 in order to accelerate IWRM in Uganda. However, functions setting out by IWRM: "effective and stable water use", "appropriate water allocation", "conservation of water environment" and so on have not yet been well functioned in the Basin.

6.1 Approaches to IWRM

The concept of IWRM was officially adopted in "National Water Policy (1999)" which provided the overall policy framework for the water sector as a means to ensuring sustainable management and utilization of Uganda's water resources. The policy also emphasizes the recognition of water as being both a social and economic good, whose allocation should give first priority to domestic use.

IWRM is a conceptual framework and an implementation process that coordinate management of water and other related natural resources with the objective of promoting economic and social development and enhancing the environment. ("Recommendation on IWRM and Water Efficiency Plans" International Conference on IWRM, Tokyo, Dec. 2004) The recommendation also said that IWRM is a process rather than a goal. Emphasis should be put on the strategic process of IWRM and on ensuring participation of various stakeholders. Data availability is critical for making sound management decisions, and governments must support measures to gather and disseminate relevant information.

This Study was just the challenge to formulate the Basic Plan on water resources development and management (hereinafter referred as to the Basic Plan) as the first full-scale approach to IWRM in Lake Kyoga Basin.

6.2 Major Issues on Water Resources Development and Management in Lake Kyoga Basin

Major issues, which are come up through the Study and dealt with in the Basic Plan, are listed below.

- Shortage of reliable basic data for water resources development and management.
- Uncertain potential of water resources: surface water and groundwater
- Restriction of surface water due to "Nile Water Agreement"

- Climate change
- Fragile water balance between demand and supply
- Plateaud coverage rate of rural water supply
- Insufficient stakeholders collaboration for water resources development and management
- Lack of "Ambient Water Quality Standards" for conservation of water environment
- Mitigation of flood and sediment disaster
- Necessity of capacity development for the related organizations and their staffs to water resources development and management
- Necessity of community participation

6.3 Basic Course for the Basic Plan

The Basic Plan was formulated to mitigate or resolve issues as listed above on water resources development and management in the Basin based on conceptual frameworks of IWRM, which plays to aspire for harmonized water resource management in the Basin. The basic course for the plan is formulated as follows based on the study results.

- Name of the Plan: "The Basic Plan on Water Resources Development and Management for Lake Kyoga Basin"
- Target Year: Short Term 2015, Middle Term 2020 and Long Term 2035.
- Target Area: Lake Kyoga Basin (57,080km^2)[1]
- Related Districts: 38 Districts (August 2009)
- Target Population: Approximately 9.32 million estimated as at 2008.
- The Basin is subdivided into 11 sub-basins as basic unit for the Basic Plan. (Figure 6-1)
- Trans-boundary issue between Uganda and Kenya in the western side of the Basin is not included in the Basic Plan. The plan deals with Ugandan side of the Basin.
- In the case of demand-and-supply balance analysis for a water development plan in the Basic Plan, exploitable surface water resources will be estimated by 3-year drought water discharge; however, 3-year low water discharge will be used for agricultural water use considering its actual condition. (refer to 4.3.3)
- In general, self-contained water supply in each sub-basin is planned without interbasin diversion because of effectiveness and economic efficiency.
- Although impacts by climate change have been discussed in many ways, long-term prediction of rainfall in the east Africa based on the fourth evaluation report of IPCC (Intergovernmental Panel on Climate Change) indicate a tendency toward increase. However, the quantity of water resources in the Basic Plan is regarded as no change on the safe side.
- From the view point of cost-benefit performance and cost reduction, non-structural measures are adopted as much as possible instead of structural measures.

[1] except for Kenyan side from total area 58,230km^2

There are four major items in the Basic Plan as shown in Table 6-1, which is full picture for it including examples of action plan. In this study, the following items are involved in the Basic Plan in consideration of the current situations of the Basin and Uganda. Principally, the plan is formulated based on the assessment of water resources by sub-basins, which have been defined by the Study.

Table 6-1 Full Picture of Water Resources Development and Management Plan

Item of Guidelines			Example of Action Plan
1. Comprehensive Water Resources Management	Enhancement of Organization & Institutions	Unitary Water Resources Management	・Improvement of Organization * Transparency of Responsibility & Competence among Related Organizations ・Enhancement of Adjustability among Related Organizations ・Improvement of Manual, Guideline etc. for Enforcement of Laws & Regulations ・Training for Administrative Officer and Engineering Officials
	Watershed Management	Comprehension of Water Resources & Establishment of Integrated Water Resources Management Plan	* Estimation of Water Resources Volume and Water Demand * Establishment of Basic Concept & Guidelines in Watershed Level * Establishment of Integrated Water Resources Management Plan ・Formulation of Action Plan
		Appropriate Water Allocation	・Allocation of Usable Water Volume ・Formulation of Allocation Guideline among Sectors and Areas * Recommendation of Manner to bring Various Stakeholders in
		Selection of Countermeasure for Integrated Water Resources Management	・Formulation of Integrated Plan for Facility Construction in Watershed ・Construction of Dam (Sabo Dam, Multi Purpose Dam, Underground Dam etc.) ・Formulation of Forest Conservation Plan for Water Recharge
2. Effective and Stable Water Supply	Water Demand Control	Efficient Water Use	・Coordination of Water Right ・Recycle & Reuse Technology * Conversion to Water-saving Farming or Crop Conversion
		Promotion of Conserving Water	* Prevention Measure to Water Leakage * Introduction of Water-saving Facility or Instrument ・Improvement of Irrigation System ・Collection of Water Charge ・Improvement of Water Tariff System * Enlightenment of Water-saving to Residents
		Acceleration of Unitary Water Resources Management	* Reorganization of Administrative Agency, Establishment of Control Organization
	Increase of Water Supply Volume by Water Resources Development	Groundwater Use	* Estimation of Groundwater Storage * Water Quality Analysis ・Construction of Well * Monitoring of Groundwater Level & Water Quality
		Surface Water Use	* Measurement of River Flow & Water Quality ・Control of Intake Water Volume ・Purification System ・Construction of Water Resources Development Facility (Diversion Weir, Reservoir, Purification Facility etc.) ・Conservation of Water Source Forest
		Rainwater Use	・Reevaluation of Traditional Rain Water Use ・Construction of Rain Water Catchment Facility
3. Prevention of Flood and Sediments Disaster to Protect Lives and Properties	Enhancement of Mitigation Measure for Soil Hazard	Protection of Mountainous Area and Sloping Ground	* Forestation in Mountain Area or Sloping Ground * Establishment of Warning System and Enlightenment to Residents
		Construction of Sabo Facility	・Construction of Sabo Dam etc.
	Enhancement of Flood Mitigation Measure	Mitigation of Flood Run-off	* Forestation * Conservation of Green Space and Forest by Land Use Regulation ・Rain Water Infiltration Facility ・Door-to-Door Rain Water Storage Facility ・Regulating Reservoir
		Equalization of River Flow Rate	・Flood Control Dam and its Enlargement ・Flood Control Basin
		Protection and Strenthenment of River Bank	・Strengthening River Embankment ・Countermeasure to River Bank Erosion by Groyne, Bank Protection ・River Diversion
		Improvement of Capacity of River Channel	・River Improvement, Widening, Construction of Bank ・Aurgment of Existing Bank ・Construction of Short-cut ・Pumping Station, Drainage Pump ・Dredging River Bed, Excavation
		Improvement of Drainage Capacity	・Storm-water Drainage Network or its Extension * Storm Water Storage Facility ・Storm-water Infiltraton Facility ・Storm-water Drainage Pump
4. Conservation of Water Environment	Conservation of Water Quality	Formulation of Water Quality Conservation Plan	・Construction of Purification Facility * Construction of Sewage Treatment Facility ・Reduction of Pollutant from Factory
		Enhancement of Pollution Control System	* Establishment of Water Quality Standards or Guidelines * Water Quality Monitoring ・Waste Water Regulation ・Enforcement of Inspection & Direction System
	Improvement of Management Ability for Conservation of Water Environment	Empowerment of Implementation Capacity in Related Government	・Setting up Analytical Instrument for Environmental Monitoring ・Establishment of Monitoring System on Water Quality
		Enlightenment of Environment-conscious to Inhabitant	* Implementation of Environmental Education ・Promotion of Low Cost Sanitation Facility
		Establishment of Environmental Standards	* Establishment of Standards ・Establishment of Punishment
	Construction of Sewage Treatment Facility	Construction of Integrated Type of Sewage Treatment Facility	* Construction of Sewage Treatment Plant
		Construction of Scattering Type of Sewage Treatment Facility	・On-site Treatment
		Management of Industrial Waste Water	・Promotion of Recycle & Cleaner Production
	Promotion of Environmental Conservation in Public Water Area	Appropriate Preservation of Hydrological Cycle	・Conservation of Forest in Water Resource Area * Enlightenment of Evironment-consious * Development Control by Environmental Zoning ・Reuse of Treated Water

*: dealt in the Basis Plan

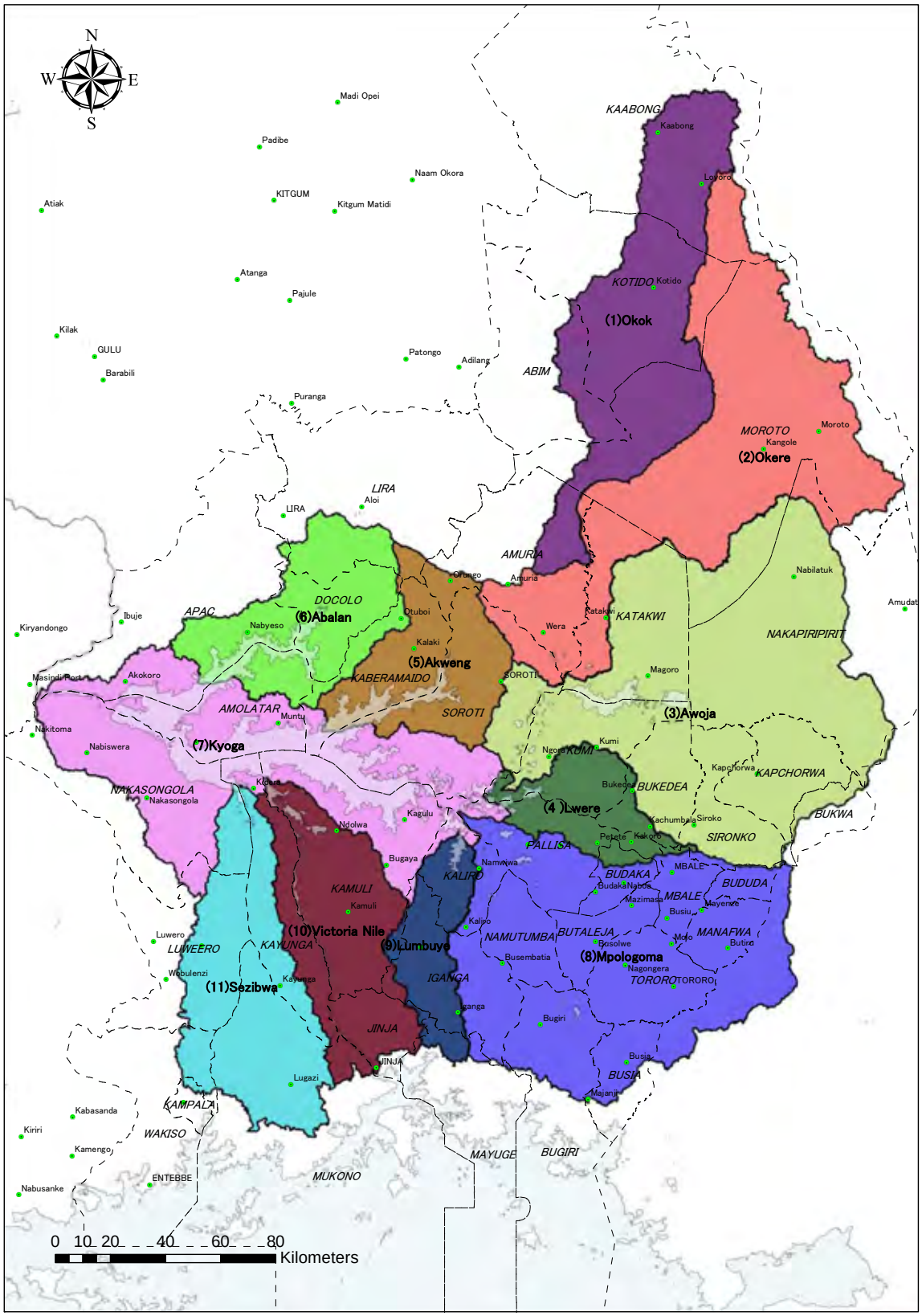


Figure 6-1 Distribution of Sub-basins and Related Districts

6.4 Basic Plan on Water Resources Development and Management

6.4.1 Comprehensive Water Resources Management

This section is a main part of the basic plan, and strengthening of this part will be a foundation of water resources development and management.

(1) Assessment of Water Resources

The water resources potential is basic and most important information in IWRM, and it is important to obtain more accurate water resources potential for implementation of more effective IWRM. This will be achieved by the decade of effort of accumulation of monitoring and collection of necessary data relevant to surface and groundwater and meteorology from the past to the future. The current situation in Uganda is not satisfactory for those issues; therefore, monitoring plans for surface water, groundwater and rainfall are proposed below to improve current monitoring system.

1) Surface Water Monitoring Plan (River and Lake)

i) Basic Policy

- Operating gauging stations should be expected to continue their observation.
- Unsuitable gauging stations due to technical problems should be terminated their observations (see Chapter 2).
- Placement of gauging stations with consideration of topography:
  The stations should be distributed to upper, middle and lower stream in each sub-basin.
- Gauging stations should be distributed to understand extensive river water usage such as water intake for drinking water supply, irrigation and so on.
- Some rivers run into wetland at middle or lower reach. In this case, it is difficult to observe total river discharge precisely, and more suitable observation method should be taken respectively at those points.
- Lake has high storage capacity of surface water so that it is very important to understand their water level changes (their storage volume changes). Therefore studying storage capacity curve at various water level and periodical observation should be conducted.
- Classification of degree of importance of each gauging station

ii) Surface Water Monitoring Plan

- Number of gauging stations and the locations.
  Guideline numbers of river discharge and lake water level gauging stations are shown Table 6-2 and エラー! 参照元が見つかりません。 for each sub-basin under the basic policy above mentioned. And their locations are roughly shown in Figure 6-2. It is necessary for determination of each location to conduct detail study and site survey.

- Data Processing:

  Data processing sometimes delay. The main reason is in the delay of data collection from self recording gauges or gauge-readers in the sites. Therefore, rapid data accumulation to DWRM should be realized through building up new data collection and processing system such as foundation of brunch offices and data processing in the offices.

- Strengthening of Financial Resource

  DWRM has been making an effort to maintain each gauging station, however, the maintenance work is not enough due to lack of the fund. Therefore increase of revenue is necessary.

- Disclosure of Monitoring Data

  Processed monitoring data should be open to public promptly. The data will be open in the office of DWRM on request base during the early stage, and in a website of DWRM at the end. The action causes more utilization of the data and advance of IWRM. To provide processed monitoring data for a price will be one of the methods to make up for revenue shortage for maintenance of gauging stations.

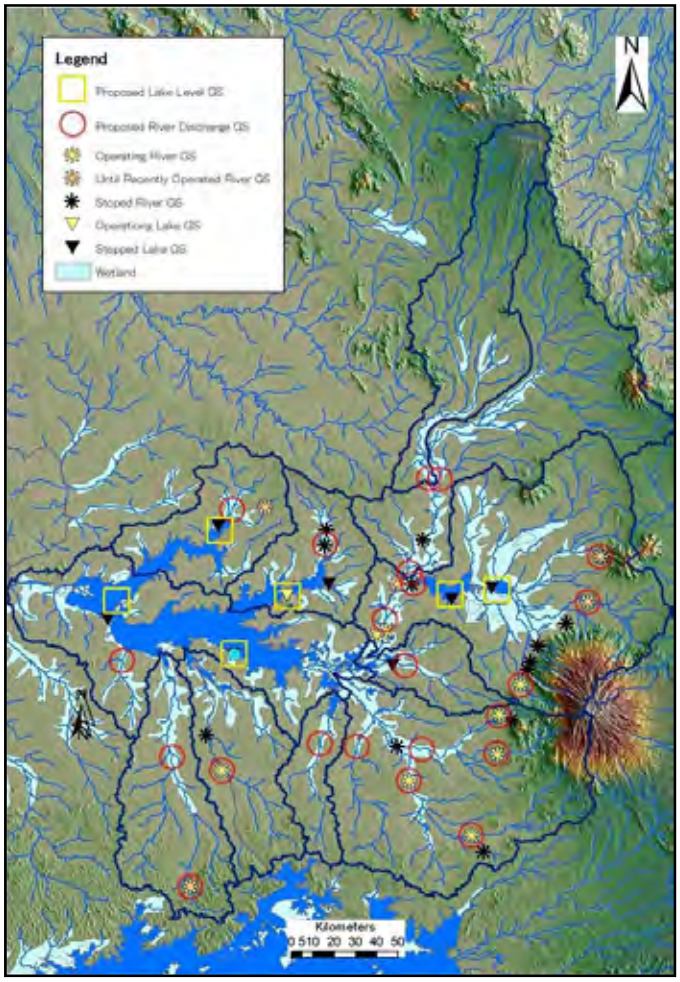


Figure 6-2 Surface Water Monitoring Plan

Table 6-2 River Discharge Monitoring Plan

No.	Sub-basin	Land Area (km^2)	No. of River Gauging Stations						
			Present Conditions			Future Conditions			
			Operating	Not Operating	Total	New	Existing	Rehabilita-tion	Total
1	Okok	7,036	0	0	0	1	0	0	1
2	Okere	6,645	0	1	1	2	0	0	2
3	Awoja	11,037	6	6	12	1	3	1	5
4	Lwere	1,501	0	0	0	1	0	0	1
5	Akweng	2,443	0	3	3	0	0	1	1
6	Abalang	2,912	1	0	1	1	0	0	1
7	Kyoga Lakeside Zone	5,654	0	0	0	1	0	0	1
8	Mpologoma	8,969	4	3	7	2	4	0	6
9	Lumbuye	1,394	0	0	0	1	0	0	1
10	Victoria Nile	3,427	1	1	2	0	1	0	1
11	Sezibwa	4,227	1	0	1	1	1	0	2
Total		55,245	13	14	27	11	9	2	22

Table 6-3 Lake Water Level Monitoring Plan

No.	Sub-basin	Lake	No. of Lake Gauging Stations						
			Existing Conditions			Future Conditions			
			Operating	Not Operating	Total	New	Existing	Rehabilita-tion	Total
3	Awoja	Bisina, Opeta	0	2	2	0	0	2	2
4	Lwere	Small lakes	0	1	1	0	0	0	0
5	Akweng	Kyoga	1	1	2	0	1	0	1
6	Abalang	Kyoga	0	1	1	0	0	1	1
7	Kyoga Lakeside Zone	Kyoga	0	2	2	1	0	1	2
Total		-	1	7	8	1	1	4	6

2) Groundwater Monitoring Plan

i) Basic Policy

- To obtain the basic data for understanding recharge and discharge mechanism, monitoring pollution and estimating groundwater storage.
- To measure everyday by water level recorders or hired gauge readers.
- To analyze groundwater quality twice a year.
- To set up at least two monitoring wells near the district capital as much as possible in each sub-basin.
- To convert the test drilling boreholes in the Study as monitoring wells.

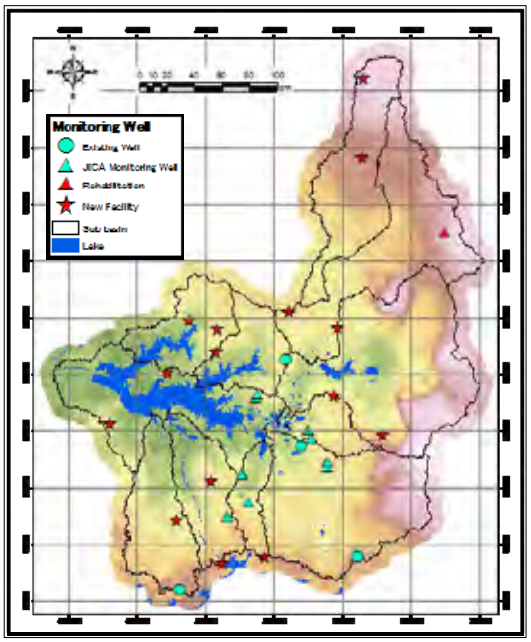


Figure 6-3 Location of Groundwater Monitoring Stations

ii) Groundwater Monitoring Plan

- According to the above basic policy, the number of monitoring stations in each sub-basin and their general locations are planned in Table 6-4 and Figure 6-3. Total 35 stations: 16 new, 1 re-

Table 6-3 Rainfall Monitoring Stations

No.	Sub Basin	Operating Number			Proposed Number			Counting		
		In the sub-basin	Near the sub-basin	Sub-total	In the sub-basin	Near the sub-basin	Sub-total	In the sub-basin	Near the sub-basin	Total
1	Okok	0	0	0	2	1	3	2	1	**3**
2	Okere	0	0	0	3	0	3	3	0	**3**
3	Awoja	1	0	1	3	1	4	4	1	**5**
4	Lwere	0	0	0	2	0	2	2	0	**2**
5	Akweng	1	0	1	2	0	2	3	0	**3**
6	Abalang	0	2	2	1	2	3	1	4	**5**
7	Kyoga Lakeside Zone	1	0	1	2	0	2	3	0	**3**
8	Mpologoma	3	0	3	11	0	11	14	0	**14**
9	Lumbuye	0	1	1	2	0	2	2	1	**3**
10	Victoria Nile	2	1	3	2	0	2	4	1	**5**
11	Sezibwa	8	4	12	2	2	4	10	6	**16**
Total		16	8	24	32	6	38	48	14	**62**

habilitated and 18 converted, will be set up in the whole basin.

- Data Processing
  DWRM has implementing data processing of observed data by them. In near future, WMZ office should play the role for new data collection, processing, and rapid data accumulation to DWRM.
- Strengthening of Financial Resource
  DWRM has been making an effort to maintain each gauging station, however, the maintenance work is not enough due to lack of the fund. Therefore increase of revenue is necessary.
- Disclosure of Monitoring Data
  Processed monitoring data should be open to public promptly. The action causes more utilization of the data and advance of IWRM

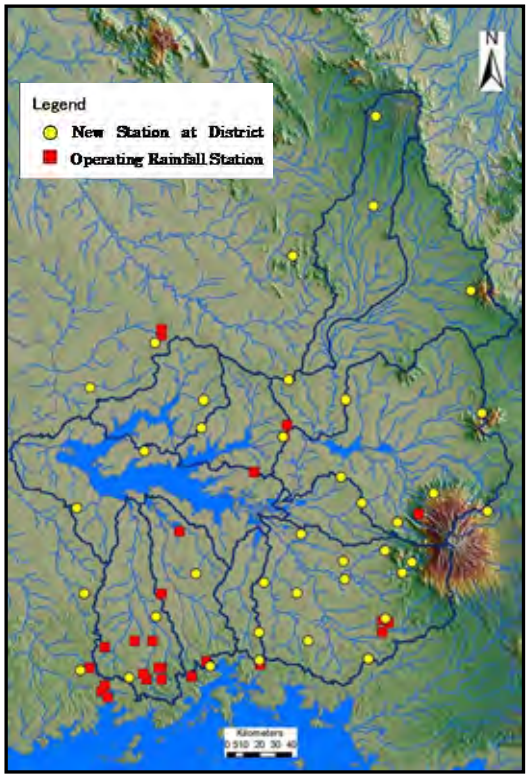


Figure 6-4 Rainfall Monitoring Plan

3) Rainfall Monitoring Plan

No matter what IWRM is for surface water or groundwater, it is clear that there are lack of the quantity, quality and data sharing of meteorological data, especially rainfall data.

i) Basic Policy

- Department of meteorology has been controlled synoptic stations, which observe wide range of meteorological phenomenon and are operating. Distribution of meteorological monitoring stations in the basic plan should be filled the observation gap of those synoptic stations.
- Rainfall observation is the most important item for water resources management and water shed management. Therefore, observation item should be daily rainfall. In addition, air temperature also should be observed as a basic item.
- The monitoring station should be installed in the distribution which can grasp rainfall distribution in whole Lake Kyoga Basin. One monitoring station should be installed at each district for the purpose.
- The DWRM, which is main organization of implementation Water Resource Management, has only the main office, but not their branch offices. On the other hand, each district has each water office, which has main roll on rural water supply, and has close relation to the DWD under the MoWE. Therefore, Each water office will be responsible for observation and maintenance of monitoring stations. The monitoring stations should be set up suitable place around each district water office out of regard for control easiness.

ii) Rainfall Monitoring Plan

- Number of gauging stations and the locations
  Guideline numbers of rainfall monitoring stations are shown in Table 6-3 for each sub-basin. And their locations are roughly shown in Figure 6-4 . As a result, the number of monitoring stations will be totally 62, and the breakout are 48 in Lake Kyoga Basin and 14 around the basin.
- Data Processing
  Observation and data processing system should be realized in each district water office, and data collection and database system among DWD, DWRM and Department of Meteorology also should be realized.
- Disclosure of Monitoring Data
  Processed monitoring data should be open to public promptly. The data will be open in the office of DWRM on request base during the early stage, and in a website of DWRM at the end. The action causes more utilization of the data and advance of IWRM. To provide processed monitoring data for a price will be one of the methods to make up for revenue shortage for maintenance of gauging stations.

(2) Strengthening Organization for Unified Management of Water Resources

IWRM aims to use water resources effectively, sustainably and equitably among stakeholders by unified management of water recourses, which have been developed and managed among related sectors separately, and to conserve water environment from disorder development as well. To realize this, a collaborative interaction among the related organizations is necessary. Although DWRM shall be the main organizer for this, it is almost impossible to cover regional and community level. Therefore, "Lake Kyoga Water Management Zone", which will function in the near future, is expected to be as one of the branch offices under DWRM. However, WMZ has some issues on water resources development and management as shown in Figure 5-1. Therefore, this Basic Plan proposes to establish "Sub-basin Liaison Council" consisting of the related districts (DWO etc.) under WMZ in order to coordinate issues on water resources among stakeholders within each sub-basin. On the other hand, a capacity development of DWRM as the responsible organization is necessary to play their roles.

(3) Guidelines of Borehole Drilling and Pumping Test

Although data of borehole drilling, pumping test and so on are fundamental for groundwater potential assessment, the guidelines are needed to standardize description and methodology of various types of borehole testing.

(4) Appropriate Water Allocation

Appropriate water allocation can be planned with estimation volume of exploitable water resources and water demand within each sub-basin. As for agricultural water covering major demand of surface

water resources, a detailed water allocation plan should be formulated by the numerical simulation model constructed in the Study.

Since DWRM has not captured the total water amount of heavy users directly, the amount has been estimated by water rights on surface water and withdrawal permits on groundwater. Even if such estimation is available, the coverage rate within all of heavy users is unclear. A monitoring system on heavy water users should be formulated soon because it is one of the essential elements for water balance analysis. Basically, WMZ office showld collect data with assistance from Sub-basin Liaison Council and send them to DWRM.（refer to 6.4.5）

(5) Selection of Method for Water Resources Development

In general, the topography of Kyoga Basin is swampy lowland except Mt. Elgon area and the northern part of Karamoja Area. Since the former has no topographically narrow area to collect surface water and is designated as the national park, and the latter belongs to tropical savanna climate receiving not much rainwater, both have no potentiality literally to develop extensively new water resources by big dam. Furthermore, the Nile Treaties intercept water resources development of Victoria Nile River and Kyoga Lake, which are a part of the international river network: the Nile River Basin. Therefore, Uganda has to use their limited water resources sustainably with appropriate management. The Basic Plan is formulated under these conditions.

(6) Community Participation

Comprehensive water resources management requires all stakeholders' participation including private sector. As for community participation to water resources management, WRM office and Sub-basin Liaison Council shall encourage community to engage water resources monitoring and water resources allocation procedure, attend seminars on water resources management put in awareness or public relations activities.

6.4.2 Effective, Stable and Equitable Water Supply

Water resources are originally recycling resource virtually and look like inexhaustible resources, however; actually usable or exploitable water resources of each sub-basin in Lake Kyoga Basin are estimated as 0.4 to 13.7 % (in the case of low water in 1/3 drought year and groundwater in drought year) of total annual rainwater. In these years, water quality degradation is running on along with economic activity decreasing the ratio of usable water resources. On the contrary, water demand increases constantly. In consideration of frequent drought by climate changes, it reveals that even Uganda needs to shift to water-saving society in order to ensure water quality and quantity.

(1) Basic Policy

- Domestic water supply in the Basic Plan is planned for each sub-basin based on SIP.
- As for agricultural water, no specific structural measure is planned but general schedule for 5 priority sub-basins is suggested. (refer to Table 5-12)

(2) Water Demand Control

The present water demand of 435.7 MCM in 2008 grows up to 844.1 MCM in 2035 in the Lake Kyoga Basin according to the demand estimation, and the demand may exceed its potential water resource in some sub-Basin. It is consequently required to establish balanced water utilization controlling the future water demand. Three (3) points of aspects such as effective water use, application of water saving technology and improvement of awareness of water users are considered in the Basic Plan.

1) Effective Water Use

Irrigation water is conveyed to irrigation area after diversion and distributed to farms with distribution networks. Irrigation canals are usually of the open canals which cause percolation from their bottoms without lining works, and evaporation volume from surface of which are considered large. Pipeline systems are considered to be applied for conveyance and main canals to reduce such losses of diverted water for the effective transmission of water.

As discussed in the previous chapter, the unaccounted for water is high in some town water supply systems in the Basin, and it is considered that volume of such loss water is remarkable in these systems. The loss of water is usually caused by leakage, and it is possible to improve unaccounted for water with taking measures against leakage. The SIP sets improvement of the unaccounted for water from the present 25% to 10% in 2035, and it is consequently indispensable to take measures for providing against leakage for sure.

2) Application of Water Saving Technology

The estimated irrigation water demand is shares substantial part of all demand, and the present demand of 326.95 MCM shares 75% of all the estimated. The future irrigation water demand is estimated at 463.22 MCM for 2035 equivalent to 142%, which is rather low comparing with that for the whole demand of 194% still sharing 55% of all. The irrigation water is usually diverted from rivers because its volume is considered large. It is necessary to apply water saving methods for irrigation water application to reduce the demand in the future, since there are some sub-basins in which the irrigation demands and the potential water resources are not balanced even at present. In SIP it is planned to apply the water saving technology such as drip method and sprinkler method to improve the irrigation efficiency, and consequently it is necessary to introduce these method to save water in sure.

3) Improvement of Awareness of Water User

Improvement of the awareness of common users on water saving is important to effective and sustainable utilization of water in urban water supply. Since their consumption of water will be increased with betterment of their living standard, it is important to educate the users through the me-

dias such as television and radio to make them to save water in the urban water supply managed by NWSC. The same water tariff is applied in the country at present, and 867 UGX/m^3 and 1,341 UXG/m^3 are applied for public taps and connection in residential areas, respectively according to the said tariff. It is considered to be ideal effective method to raise the tariff rates in order to improve the awareness of users on saving water.

(3) Increase of Water Supply Volume by Water Resources Development

The facility plan for the drinking water supply is planned below based on the demand forecasting of SIP presented in Chapter 5.

1) Drinking Water Supply

i) Urban Water Supply

a) Water Supply System for Large Towns and Peri-urban Areas

As shown in Figure 6-5, since the production capacities of the water treatment plants of Mbale, Soroti and Lira other than Tororo are considered quite enough to serve present demand, any expansion of the plants is not necessary till 2015 resulting in the present low utilization of the plants. The plant of Tororo which has poor capacity has to be expanded every two (2) or three (3) years to fulfill the water demand. The production capacities of all the facilities such as intakes, treatment plants and distribution networks are planned to be increased in stages rising the service levels to achieve 100% of coverage in 2035. In the facility of Soroti, the demand increase is sharp till 2015 and it is rather mild after 2015. The water supply facility of Soroti was recently completed and expansion of distribution networks and connection are still under way resulting in the present low number of house connections which are expected to be increased in a few years.

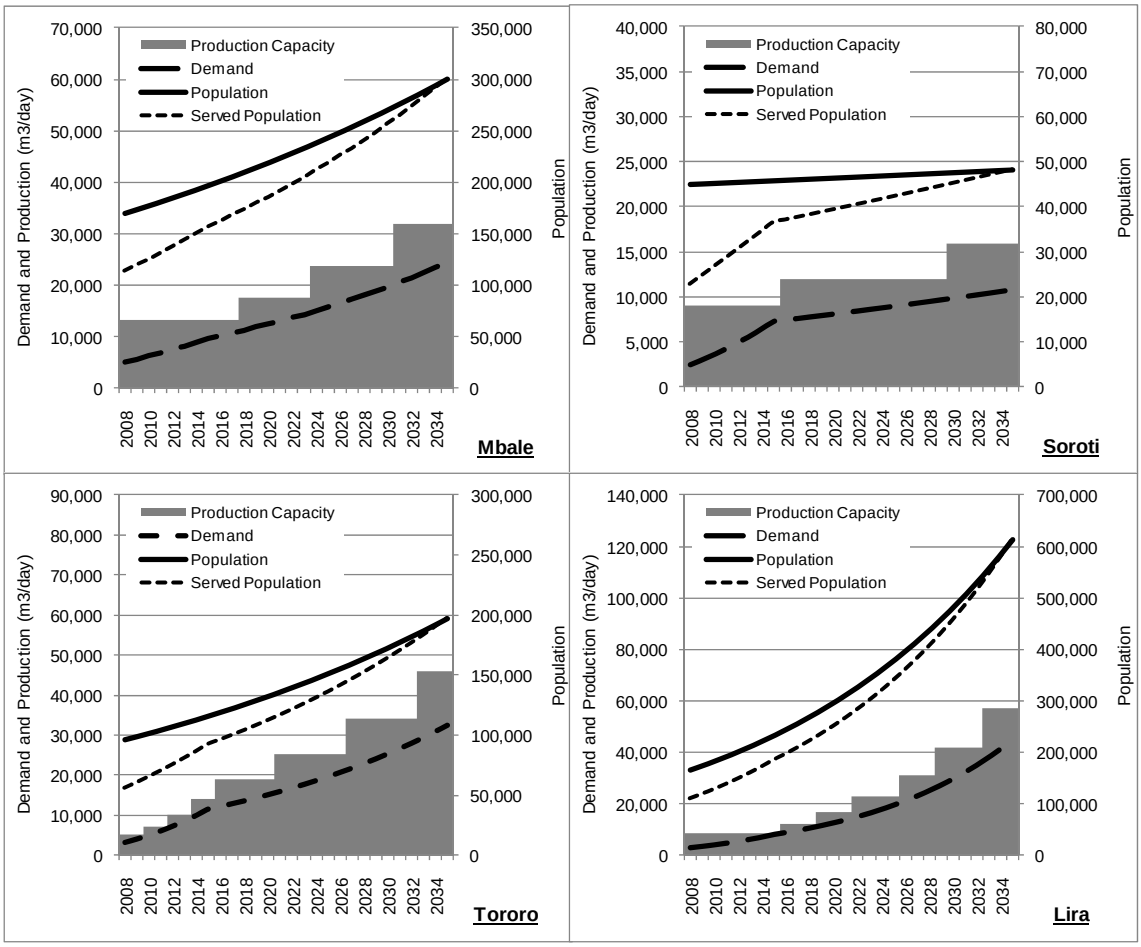


Figure 6-5 Expansion Plan of Urban Water Supply System for Large Towns and Peri-urban Areas (NWSC)

b) Urban Water Supply System for Small Towns

The population increase in the small towns in the Lake Kyoga Basin is forecasted to increase from the present of about 600,000 to the future of about 1,600,000 in 2035 with an annual growth rate of about 3.6% as shown in Figure 6-6. The coverage of the small towns is calculated as low as 42% for the whole basin, which is planned to be increased to 70% and 100% in 2015 and 2035, respectively. The increase of the population served is presented in Table 6-4.

Table 6-4 Expansion Plan of Water Supply System for Small Towns in Lake Kyoga Basin

Description	2008	2015	2020	2035
Population	604,295	772,111	925,437	1,644,976
Population Served	255,889	529,604	704,250	1,644,973
Coverage (%)	42%	69%	76%	100%

ii) Rural Water Supply

The present coverage of 63% is increased to 77% and 100% in 2015 and 2035, respectively in SIP. The water supply system is divided into the following six (6) technology types and the combination of these technologies is called the Technology Mix in SIP.

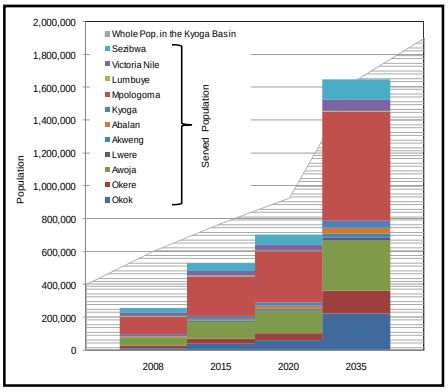


Figure 6-6 Population Served by Water Supply System for Small Towns in each Sub-basin

- Protected spring: Served population about 200/spring
- Deep well: Served population about 300/well
- Shallow well: Served population about 300/well
- Gravity flow scheme: Served population about 150/kiosk or public tap
- Piped water system: Served population about 150/kiosk or public tap
- Rain water harvesting: Served population about 3/facility

The technology mix of rural water supply facilities in the Lake Kyoga basin is shown in Figure 6-.

Table 6-5 Present and Future Techno logy Mix of SIP

Regions	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks
Technology Mix of Existing Facilities						
Central	20%	30%	47%	1%	2%	0.10%
Eastern	20%	53%	20%	4%	3%	0.10%
Northern	21%	60%	14%	2%	2%	0.10%
Western	41%	15%	21%	21%	1%	0.20%
Uganda total	27%	38%	25%	8%	2%	0.10%
Technology Mix for Facilities to be Constructed in Future						
Central	2%	29%	21%	0%	48%	0.13%
Eastern	2%	51%	9%	3%	35%	0.06%
Northern	2%	57%	6%	2%	33%	0.11%
Western	4%	15%	10%	20%	51%	0.23%
Uganda total	2%	36%	11%	8%	43%	0.14%

Source : SIP

Figure 6- shows the present and future population served by the type of technology, and all the type of facilities will be constructed resulting in the increase of total number of respective facilities. In particular, number of piped water system increases remarkably. It is because of the policy of the government puts emphasis on piped water system for the areas such as RGCs and trading centers where the population concentrates densely in order to realize effective water supply.

Table 6-6 Rural Water Supply Coverage of each Sub-basin

Sub-basin	2008	2015	2020	2035
(1) Okok	39	76	82	100
(2) Okere	62	77	82	100
(3) Awoja	63	76	82	100
(4) Lwere	55	75	82	100
(5) Akweng	82	82	85	100
(6) Abalan	71	79	83	100
(7) Kyoga	63	76	82	100
(8) Mpologoma	55	75	82	100
(9) Lumbuye	55	75	82	100
(10) Victoria Nile	60	75	82	100
(11) Sezibwa	70	75	82	100
Whole Basin	60	76	82	100

Unit: %

The coverage of rural water supply in each sub-basin is presented in Table 6-6. The present coverage is different among the sub-basins, but it is planned to increase to 77% in 2015 and 100% in 2035.

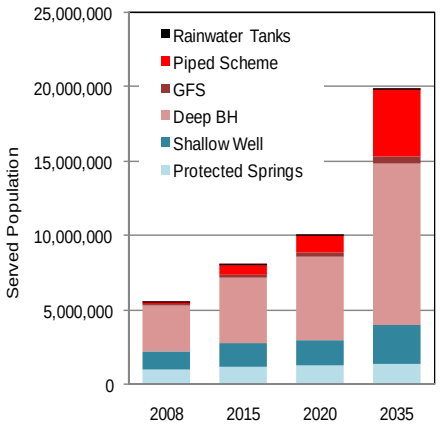


Figure 6-7 Present and Future Population Served by Each Technology in Lake Kyoga Basin

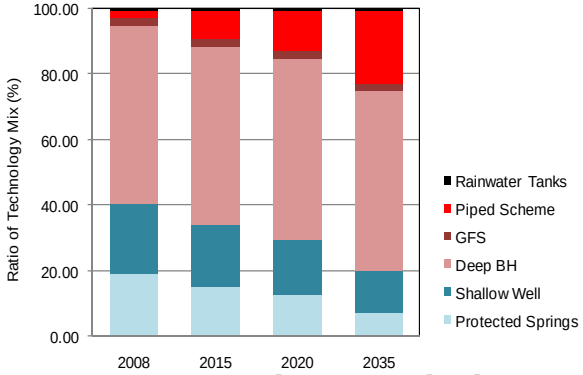


Figure 6-8 Present and Future Technology Mix

Table 6-7 Number of Facilities to be Constructed in 2008 to 2035

Year	Sub-basin	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks	Total Facility No.
2008 - 2015	1. Okok	3	415	18	1	77	12	**526**
	2. Okere	10	346	25	11	84	15	**491**
	3. Awoja	196	509	128	147	672	132	**1,784**
	4. Lwere	43	253	90	10	274	28	**698**
	5. Akweng	9	75	21	0	46	14	**165**
	6. Abalan	27	106	40	5	109	36	**323**
	7. Kyoga Lakeside	10	400	88	0	186	21	**705**
	8. Mpologoma	437	1,423	226	202	1,522	151	**3,961**
	9. Lumbuye	18	350	71	3	174	8	**624**
	10. Victoria Nile	24	546	181	1	305	2	**1,059**
	11. Sezibwa	86	215	187	2	490	13	**993**
	Total	**864**	**4,637**	**1,075**	**382**	**3,940**	**432**	**11,330**
2015 - 2020	1. Okok	1	242	7	1	45	8	**304**
	2. Okere	3	316	22	8	102	19	**470**
	3. Awoja	44	417	74	128	658	117	**1,438**
	4. Lwere	10	213	52	9	238	26	**548**
	5. Akweng	5	187	37	1	147	35	**412**
	6. Abalan	8	127	45	5	198	35	**418**
	7. Kyoga Lakeside	3	302	47	0	150	22	**524**
	8. Mpologoma	72	1,129	116	149	1,292	106	**2,864**
	9. Lumbuye	3	293	38	2	154	7	**497**
	10. Victoria Nile	7	410	104	0	293	2	**816**
	11. Sezibwa	26	202	110	5	511	16	**870**
	Total	**181**	**3,839**	**651**	**307**	**3,787**	**392**	**9,157**
2020 - 2035	1. Okok	3	1,056	29	4	270	34	**1,396**
	2. Okere	13	1,578	113	37	618	98	**2,457**
	3. Awoja	181	2,010	351	597	3,857	575	**7,571**
	4. Lwere	44	1,001	246	40	1,406	132	**2,869**
	5. Akweng	25	1,061	206	4	892	198	**2,386**
	6. Abalan	39	628	231	23	1,130	164	**2,215**
	7. Kyoga Lakeside	11	1,329	208	0	857	108	**2,513**
	8. Mpologoma	264	5,031	511	665	7,344	480	**14,295**
	9. Lumbuye	9	1,344	168	8	882	34	**2,445**
	10. Victoria Nile	28	1,760	443	2	1,576	8	**3,817**
	11. Sezibwa	109	875	480	25	2,832	75	**4,396**
	Total	**725**	**17,672**	**2,985**	**1,405**	**21,665**	**1,907**	**46,359**
Grand Total		**1,770**	**26,148**	**4,711**	**2,094**	**29,392**	**2,731**	**66,846**

2) Water for Production

The water for production consists of irrigation for crops, water for feeding cattle and fisheries, and the irrigation water demand shares largely in the whole demand of water for production. The SIP plans to apply intake facilities in rivers, transmission pipelines, pumping station and storage dams as well as the measures provided against the increase of demand. However, the land areas suitable for construction of dams and reservoirs are limited, and there is no such suitable land in some sub-basins, and then it is considered difficult to increase storage capacity of the sub-basin to meet the increased demand only by constructing dams actually.

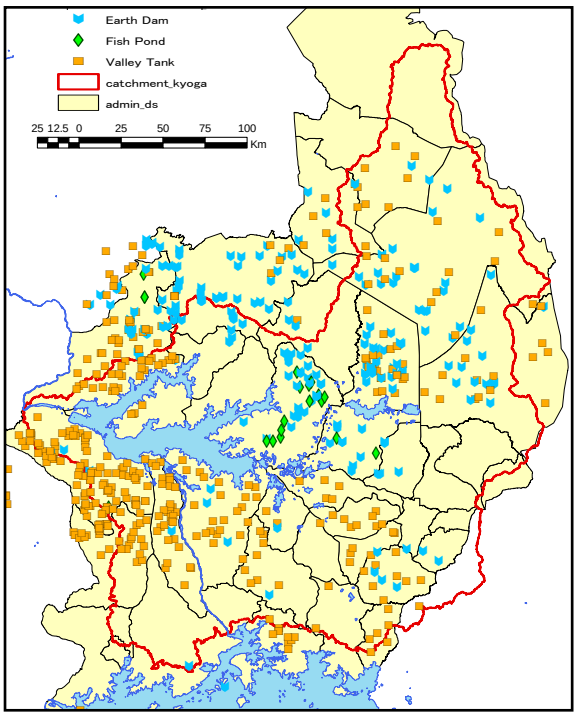


Figure 6-9 Distribution of Existing Surface Water Storage Facilities

Source: DWD Data (2009)

According to the analysis result of water demand-supply balance in section 5.5.2, five sub-basins have already faced or would do in future to shortage of agricultural water or mainly crop water. It is necessary to store high water in rainy season to supplement the shortage. Although many surface water storage facilities have been constructed in the Basin as shown in Figure 6-9 their functionality is supposedly very low. Thereafter, rehabilitation and the study for newly construction of them in five priority sub-basins should be carried out.

3) Industrial Water

There is no industry consuming much water in the basin, and rural cottage industries processing products relating to local fishery and agriculture are expected to use water in the basin, of which demand will be increased but shares a few percent of the whole demand.

6.4.3 Prevention of Flood and Sediments Disaster to Protect Lives and Properties

One of the main pillars in the Basic Plan is prevention of flood and sediments disaster to protect lives and properties. The northern part of the Basin including Lira district was suffered serious flood damage for three month from July 2007 and Bududa was hit by the sediment disaster in March 2010, which conduced to approximately 350 deaths and missed people. It is presumed that the main cause of these disasters are not only extraordinary heavy rain but also increased runoff ratio caused by deterioration of upstream coming from overgrazing, deforestation, slash-and-burn farming and so on. Therefore, three prevention plans for deforestation, flood and sediment disaster are mutually and closely related.

(1) Basic Policy

- The prevention plans for deforestation and sediment disaster targets mainly in hilly and mountainous area around Mt. Elgon area. The flood prevention plan which occurs in low-lying area mainly in northern and central part (such as Soroti, Pallisa, Kumi and Katakwi disticts) of Lake Kyoga Basin.
- The plan is not only for disaster prevention but multifunctional purpose.
- The plan weights to preparedness measures focusing on non-structural measures to enable to achieve a high effect by comparatively low cost aiming at protecting human lives and minimizing the impact to properties.
- The plan contributes to protect water source from the aspect of water use.
- The plan contributes to improve livelihood of inhabitants.
- Since large-scale flood mitigation measures by structural measures are considered to become necessary in future, basic data that are needed for concrete investigation and design for structural measures are obviously insufficient. Therefore, the plan includes measures for collection and accumulation of necessary data. However, these are dealt with “Plan for common measures”.

(2) Deforestation Prevention Plan

1) Deforestation Monitoring

Monitoring by satellite images and aero-photos and site investigation shall be conducted regularly.

2) Clarifying Boundary of Protected Area of Forest

Protected area is clarified and/or visualized. Past activities such as installation of sign boards in forest reserves and installation of pillars and trees to boarder with national park are continued and developed to the activities like high-density specified tree planting.

3) Enhancement of Public Awareness of Various Problems to be Caused by Deforestation

Workshop and seminar are held to enhance public awareness of problems to be caused by deforestation, which include defection of soil fertility by soil runoff, rise of flood risk by increasing runoff ratio, rise of sediment disaster risk, and so on.

4) Enhancement of Public Awareness of Forest Protection

Workshop and seminar are held to enhance public awareness of forest protection through explanation of function of forest and positive impact such as income increase by forest conservation and developed forest use (Agro Forestry) in addition to explanation of problems caused by deforestation. It is preferable that workshop and seminar include introduction of concrete technique and field exercise for proper forest management, as well as content to lead activities such as voluntary patrol by inhabitants for deforestation prevention.

5) Expansion of Landuse Regulation and Development Prohibition Area and Thoroughness of the Regulations

Momentum to spread forest reserve and community forest area is gathered through the activities of enhancement of awareness of local governments and inhabitants regarding importance and effectiveness of forest, and then regulated area is expanded. Besides, enhancement of public awareness or reinforcement of regulation is done to prevent activities of deforestation and degradation of forest in existing protected and regulated area.

6) Tree-Planting Program

Tree-planting program is aggressively promoted not only in protected area like forest reserve and national park but also in its adjacent area and private land aiming at water wellhead protection and mitigation of flood runoff, riverbank erosion and soil erosion.

7) Study and Research on Sustainable and Effective Utilization of Forest Resources such as Agro Forestry, Implementation of Pilot Project, and Preparation of Guideline/Manual

Study and research are conducted to clarify the methodology of the sustainable and effective utilization of forest resources suiting to the target area, which includes proper agro forestry to enable to create inhabitants' employment and increase their income by combining forestry, agriculture and/or livestock farming developing forest resources. Then, the pilot project and project including preparation of guideline/manual are implemented. Outputs from existing projects like FIEFOC are utilized at a maximum when projects implement.

8) Communication, Education and Public Awareness of Sustainable and Effective Utilization of Forest Resources

Workshop and seminar are held and practical training is conducted in order to publicize the outputs of the above 7) to inhabitants.

(3) Flood Prevention Plan

1) Construction and Rehabilitation of Earth Dam and Valley Tank

Earth dam and valley tank are newly constructed and existing facilities are rehabilitated, which may have a reservoir function in flood since main objective is water use like for livestock and domestic use. Since most of existing facilities has lost original storage capacity but existing facilities are considered to have been constructed in the place where water concentrates easily, it is recommended that rehabilitation is implemented in priority to new construction. Besides, Okok, Okere, Lwere and Mpologoma sub-basins are considered to have priority to implement measures from frequency of occurrence of water deficit in the result of the surface water simulation and frequency of past flood.

2) Advice to Road Development Aiming at Securing Transportation of Emergency Materials and Evacuation Route with a Function of Evacuation Site

Unpaved road condition is a major cause of expansion and lengthening of flood damage. Therefore, it is recommended that road development including raising of road surface height and installation of proper cross drainage facilities for improvement of drainage capacity is implemented aiming at securing transportation of emergency materials and evacuation route with a function of evacuation site. As an item of this Basic Plan, it is included what DWRM or district water officers give proper advice on the occasion to plan or construct roads whereas proper road development itself is not included.

3) Publicity and Thoroughness of Regulated Items in National Environment Regulations (Clarifying River Bank Protection Area, Thoroughness of Development Regulation etc.)

In order to prevent overdevelopment of wetland with flood mitigation function aiming at mitigation of flood runoff, conservation of the wetland is made thorough according to National Environment (Wetlands, River Banks and Lake Shores Management) Regulations. At first, the study for clarifying conservation area is conducted, and installation of wood/concrete pillars or tree-planting as a live fence is implemented in parallel.

(4) Prevention Plan for Sediments Disaster

1) Specifying Disaster Risk Area by Disaster Type

Disaster risk area is specified in each sediment disaster type. The study targets at all the hilly and mountainous area in Lake Kyoga Basin as well as the area in and around Mt. Elgon.

- Topple: To specify rocks to be able to topple by field reconnaissance
- Slope failure: To specify floating soil masses by interpretation of aerial photographs
- Debris flow or slope failure in mountainous area:
- To specify risk rivers of debris flow by surveys for slopes and deposited sediments in the upstream area of each river and the river profiles

The study result is arranged as geographic data and hazard map is prepared based on the arranged data. The prepared hazard map is used for designation of regulated area of land use and/or development as well as calling for attention by distribution and publicity of the hazard map to local government and inhabitants.

2) Designation of Regulated Area of Landuse and/or Development

Concrete regulated area of landuse and/or development is designated based on the prepared hazard map. Since regulation of the area where the slope exceeds 15% is considered to be able to correspond by applying existing National Environment (Hilly and Mountainous Area Management) Regulations, new relevant law and regulation are developed as needed.

It is recommended that the high disaster risk area clearly recognized from past and recent disaster occurrence situation and other information is designated as regulated area of landuse and/or development without waiting for preparation of the hazard map.

3) Relocation Planning

Relocation is planned and implemented targeting at inhabitants in disaster risk area.

4) Education of Disaster Management to Community about Forerunning Phenomena of Sediment Disasters

Materials such as a leaflet, a poster or a brochure, which introduce forerunning phenomena before occurrence of disaster in each type of sediment disaster, are prepared. Publicity and education activities by using them are done targeting at inhabitants of communities located in high risk area of sediment disasters and the adjacent area.

5) Development of Evacuation Site and Route

Evacuation site and route are established or designated in high risk area of sediment disasters.

(5) Plan for Common Measures for Flood and Sediment Disaster Prevention

1) Publicity and Thoroughness of Regulated Items in National Environment Regulations

In order to prevent flood and sediments disaster, river bank area shall be protected on the basis of National Environment Regulations. At first, a study for clarifying protected area is necessary, and installation of wood/concrete pillars or tree-planting as a live fence is implemented in parallel.

2) Establishment of System for Collection, Accumulation and Sharing of Disaster Information

The system for collection, accumulation and sharing of disaster information is established. The information from relevant ministries/agencies, local governments and inhabitants are comprehensively gathered and compiled to a database on the initiative of DWRM of MWE. The information to be collected is shown in Table 6-8.

3) Preparation of Hazard Map and Risk Map

Table 6-8 List of Disaster Information

Item	Detail Item
General Information	Disaster type, Occurrence day (occurrence period), Occurrence area (location), Affected area, Affected person, Death toll, Contents of damaged assets (type of damaged assets (infrastructure, crops, etc.), damage amount by type (damaged distance, number of damaged houses, damaged area, etc.)), Rainfall (hourly rainfall, daily rainfall), etc.
Flood	Water level, Inundated area, Inundated period, etc.
Sediment Disaster	Forerunning Phenomenon, Occurrence time, Type of phenomenon (type of sediment disaster), Landuse and geology in surrounding area, etc.

Hazard map and risk map are prepared based on the collected data. After preparing the hazard map, risk map can be prepared combining the hazard map and information on disaster vulnerability such as densely-populated area and inhabited area of low-income group.

Hazard map and risk map shall be prepared not only at national and local government level but also community level. More actual and higher effect can be expected from preparation activity of hazard map by community itself and mutual publicity among the community.

Table 6-9 Outline of Early Warning System for Flood and Sediments Disaster

Items		Flood	Sediments Disaster	
			Wide Area	Narrow Area
Purpose		Calling for attention to wide area.	Calling for attention to wide area.	Announcement of warning to surrounding inhabitants.
General of Monitoring	Item	Rainfall and water level	Rainfall	Rainfall and forerunning phenomenon.
	Site	Present and past monitoring sites (observation stations) of rainfall and/or water level. Additionally, sites to be considered to matter particularly from hydraulic viewpoint.	Existing rainfall observation stations.	One site per a village or a parish.
	Person in charge	Person in charge of monitoring in relevant ministry/agency or inhabitant near monitoring site.	observation in relevant ministry/agency	Inhabitant
	Method	Direct monitoring by monitoring person.	Direct monitoring	Direct monitoring, (simple measurement)
	Frequency	Once a day at the minimum in rainy season. When rainfall is heavy or water level is rapidly rising, every 8 hours. (however, which should be investigated based on accumulated data and be revised in future)	Once a day at the minimum in rainy season. When rainfall is heavy, every 8 hours (which should be investigated based on accumulated data and be revised in future).	Rainfall: Once a day at the minimum in rainy season. When rainfall is heavy, every 8 hours.Forerunning phenomenon: As needed depending on situation.
Monitoring Results	Communication Method	Telephone, SMS, Radio transmission.	Telephone, SMS, Radio transmission	Telephone, SMS, Orality (voice)
	Reporting Frequency	Same as monitoring frequency.	Same as monitoring frequency	Same as monitoring frequency
	Reporting Target	DWRM	DWRM, Responsible person of district	Leader of community
	Data Analyser	DWRM	DWRM, Responsible person of district	Leader of community
	Analysis Method	Judging risk allowances of disaster occurrence by comparing past data	Judging risk allowances of disaster occurrence by comparing past data	Judging risk allowances of disaster occurrence by comparing past data.
Early Warning	Criterion	Judging risk allowances of disaster occurrence by comparing past data.	Judging risk allowances of disaster occurrence by comparing past data.	Judging risk allowances of disaster occurrence by comparing past data.
	Releaser	DWRM	DWRM	Leader of community
	Target	Responsible persons of relevant ministries/agencies, Responsible person of district, Leader of community located in flood risk area, Inhabitants.	Responsible persons of relevant ministries/agencies, Responsible person of district, Leader of community, Inhabitants.	Inhabitants
	Communication Method	Telephone, SMS, Radio transmission, Television, Radio	Telephone, SMS, Radio transmission, Television, Radio	Telephone, SMS, Orality (voice)
	Expected Reaction to Target	Activities for disaster preparedness, which are preparation of emergency materials like food and equipments for disaster response at national and local government level, and are early harvesting of crops, remove of household goods, and preparation of water, food, cloths, etc. at community level.	Recognition of increased possibility of occurrence of disaster. Preparation of emergency response.	Preparation of evacuation. Evacuation

4) Establishment of Early Warning System for Disasters

Outline of the early warning system is shown in Table 6-9.

i) Early Warning System for Flood

a) Short-Team Plan

This early warning system targets at the flood which occurs in low-lying area in northern and central part of Lake Kyoga Basin and has a characteristic to take relatively long time from rainfall to runoff. The system is designed to utilize existing and past meteorological and hydrological data and monitoring facilities at a maximum. Outline of the system is shown below.

As for the analysis of monitoring result and warning criteria among the above items, responsible persons in DWRM may have to judge risk allowances of disaster occurrence based on the past data as required in the meantime. Therefore, it is crucial to accumulate, investigate and analyze data for judging risk allowances, which includes water level in flood, relationship between antecedent precipitation and water level rising, etc. in order not only to increase the precision of judgment but also to determine clear criteria to issue warning in future.

b) Long-Team Plan

The above system will be being developed to the system that proper correspondence can be done at any time by installing telemetering and automatic equipments for monitoring and information transmission, installing automatic analyzing system, etc.

ii) Early Warning System for Sediment Disaster

This early warning system targets at sediment disasters in hilly and mountainous area of Lake Kyoga Basin. Since sediment disaster occurs suddenly in a limited area, systems are respectively designed for wide area and narrow area.

As for the analysis of monitoring result and warning criteria among the above items, their precision shall be increased by accumulating, investigating and analyzing data for judging risk allowances, which includes forerunning phenomenon, relationship between antecedent precipitation and sediment disaster/phenomenon, etc. along with the system for flood.

5) Community Based Disaster Management Activities

The following activities are conducted targeting at communities with high potential of disaster.

- Workshops for lecture on disaster mechanism, relationship between rainfall and disaster, forerunning phenomena of disaster, etc.
- Town watching and preparation of community hazard map
- Rainfall observation using a simple rain gauge by inhabitants themselves
- Training of observation and judgment of forerunning phenomena of disasters especially for sediment disasters
- Training of warning dissemination and evacuation
- Formulation of disaster management committee at community level

6.4.4 Conservation Plan of Water Environment

Conservation of water environment is very important not only for natural ecosystem and people living environment but also reservation of good water resources for future water demand.

(1) Basic Policy

- General principle of this plan is to conserve the present level of water environment.
- Environmental conservation target for Lake Kyoga Basin is set up reasonably referring to Japanese ambient water quality standards, which can consider water use of sub-basin or water area and are convenient to manage water environment.
- According to the forecast of water demand, domestic orgasmic pollution due to rapid population growth is target item for conservation of water environment. Then, stabilization pond type of sewerage system is planned to cut down total pollution loads such as BOD.
- Strengthening monitoring system of water quality, water pollution control with waste water regulation is tightening by DWRM.

(2) Ambient Water Quality Standard

An ambient water quality standard for Lake Kyoga Basin is proposed as shown in Table 6-10 and its classification is defined as follows.

- AA Class: better quality than A Class
- A Class: for drinking
- B Class: for fishery and bathing
- C Class: for irrigation

Table 6-10 Ambient Water Quality Standards for River, Lake and Swamp

Ambient standards (River)

Type	pH	DO (mg/l)	BOD (mg/l)	SS (mg/l)	Total Coliform (MPN/100ml)
AA	6.5～8.5	≧7.5	≦1.0	≦25	≦50
A	6.5～8.5	≧7.5	≦3.0	≦25	≦50
B	6.5～8.5	≧5.0	≦5.0	≦50	≦1000
C	6.0～9.0	≧5.0	≦10.0	≦100	≦5000

Ambient standards (Lake・Swamp)

Type	pH	DO (mg/l)	BOD (mg/l)	SS (mg/l)	Total Coliform (MPN/100ml)	T-N (mg/l)	T-P (mg/l)
AA	6.5～8.5	≧7.5	≦1.0	≦1	≦50	0.1	0.005
A	6.5～8.5	≧7.5	≦3.0	≦5	≦50	0.2	0.01
B	6.5～8.5	≧5.0	≦5.0	≦15	≦1000	0.5	0.05
C	6.5～8.5	≧2.0	≦8.0	Floating matter not be observed	-	1	0.1

Furthermore, items of human health standard are listed in Table 6-11. Of this, 1.3-Dichloropropene, Thiram, Simazine and Thiobencarb are adopted for agrichemicals including weedicide and insecticide.

Table 6-11 Ambient Water Quality Standards for Human Health

(mg/l)

Item	Standard valuws
Cadmium	≦0.01
Total cyanoide	Not detected
Lead	≦0.01
Hexavalent chromium	≦0.05
Arsenic	≦0.01
Total Mercury	≦0.0005
Alkyl Mercury	Not detected
PCB	Not detected
1,3-Dichloropropene	≦0.002
Thiram	≦0.006
Simazine	≦0.003
Thiobencarb	≦0.02
Selenium	≦0.01

(3) Water Quality Monitoring Plan

Water quality monitoring plan is set up as shown below.

- Monitoring Points: As shown in Table 6-12, 30 points set up by DWRM are taken over as water quality monitoring point and water resource monitoring points: river gauging stations, lake water level gauging stations and groundwater monitoring stations are newly added.
- Frequency: Living environment items and human health items are monitored every month and every year respectively.
- Measuring Item and Method: pH, SS, and DO are measured by portable device on site. BOD, Total Coliform, T-N and T-P are measured at laboratory with water samples taken on site. As for groundwater, measuring items are pH, EC, Fe, F and Coliform.
- Implementation system: DWRM have been monitored basically ambient water quality by them. Since DWRM have no subordinate organization corresponding to TSU in the Basin, WMZ office and laboratory should monitor and an submit

Table 6-12 List of Water Quality Monitoring Point

NO.	Sub-basin	Existing Monitoring Points						Planned Monitoring Points					
		River	Lake	Borehole	Municipal	Potable water	Sub-total	River	Lake	Borehole	Municipal	Potable water	T
1	Okok			1			1	1		2			
2	Okere	2		2			4	2		2			
3	Awoja	3		1			4	5	2	2			
4	Lwere						0	1		2			
5	Akweng					2	2	1	1	2		2	
6	Abalang		1				1	1	1	3			
7	Kyoga Lakeside Zone	1	1				2	1	2	5			
8	Mpologoma	3		1	5		9	6		7	5		
9	Lumbuye	1					1	1		4			
10	Victoria Nile	1			3		4	1		4	3		
11	Sezibwa	1		1			2	2		2			

data to DWRM.

- Operation and Maintenance : Although DWRM have to prepare personnel, necessary equipment and materials for a while, whole O/M of monitoring works will transfer to WMZ office.

(4) Waste Water Regulation

DWRM shall enforce managing local factories based on waste water regulation together with water quality monitoring.

(5) Facilities for Conservation of Water Environment

In accordance with rapid population growth, water pollution load will increase dramatically. Therefore, sewage facilities are necessary for conservation of water environment. The facility plan is formulated in the Basic Plan based on the current water quality to meet the ambient standards defined above, considering the class of each Sub-basin.

1) Definition of Ambient Standard Class for each Sub-basin

Average values of water quality standard items and defined ambient standard class of each Sub-basin are shown in Table 6-13. The standard class of each Sub-basin is defined not to deteriorate the current conditions.

Table 6-13 Ambient Standard Class of each Sub-basin

Source Type	Sub-basin	Ambient Standard Class
Lake	(3) Awoja	AA
	(5) Akweng	A
	(7) Kyoga Lakeside Zone	B
	(8) Maplogoma	A
River	(2) Okere	A
	(3) Awoja	B
	(4) Lwere	B
	(5) Akweng	A
	(7) Kyoga Lakeside Zone	B
	(8) Maplogoma	B
	(9) Lumbuye	A
	(10) Victoria Nile	AA
	(11) Sezibwa	A

2) Sewerage Treatment System Plan

Since the stabilization process by the oxidation pond method is applied in Uganda as well as in the large towns in the Lake Kyoga Basin, this method is adopted in this plan. The flow of the stabilization process is shown in Figure 6-10.

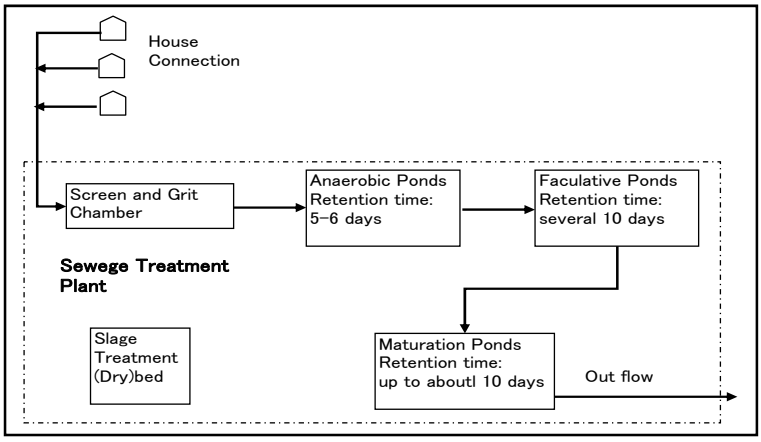


Figure 6-10 Flow Chart of Stabilization Process

i) Scale and Schedule of Sewerage System

Necessary number and overall construction schedule of the sewerage system in each sub-basin base on the standard specification of it in Uganda as listed below to meet the ambient water quality

Table 6-14 Construction Schedule of Sewerage System

Year / Sub-basin	Short Term 08→15	Mid. Term →20	Long Term →35	Total
1. Okok	1	1	6	8
2. Okere	1	0	3	4
3. Awoja	2	1	6	9
4. Lwere	1	0	1	2
5. Akweng	1	0	1	2
6. Abalan	0	0	2	2
7. Kyaga	1	0	1	2
8. Mpologoma	0	2	18	20
9. Lumbuye	1	1	2	4
10. Victoria Nile	6	2	5	13
11. Sezbwa	19	6	32	57
Total	**33**	**13**	**77**	**123**

standards are estimated in Table 6-14.

- Type of system: oxidation pond (no aeration)
- Capacity: 550m^3/day
- Elimination efficiency: 50%
- Hydraulic retention time: 20-25 days
- Influent quality: BOD 150mg/l
- Drainage water quality: BOD 75mg/l
- Service Coverage: 10% of urban population

Table 6-14 indicates that three sub-basins: 8.Mpolagoma, 10.Victoria Nile and 11.Sezbwa need to adopt more large-scale type of stabilization pond or higher grade sewerage system because their rapid urbanization require too many standard facilities.

6.4.5 Information System for Water Resources Development and Management

Integrated information system for data collection, arrangement, storage and sharing information related to water resources development and management, in other words: the Basic Plan having four major items: (i) “Comprehensive water resources management”, (ii) “Effective, stable, equitable water supply, (iii) “Prevention of flood and sediments disaster to protect lives and properties” and (iv) “Conservation of water environment”, shall be constructed. Outline of the system is illustrated in Figure 6-11.

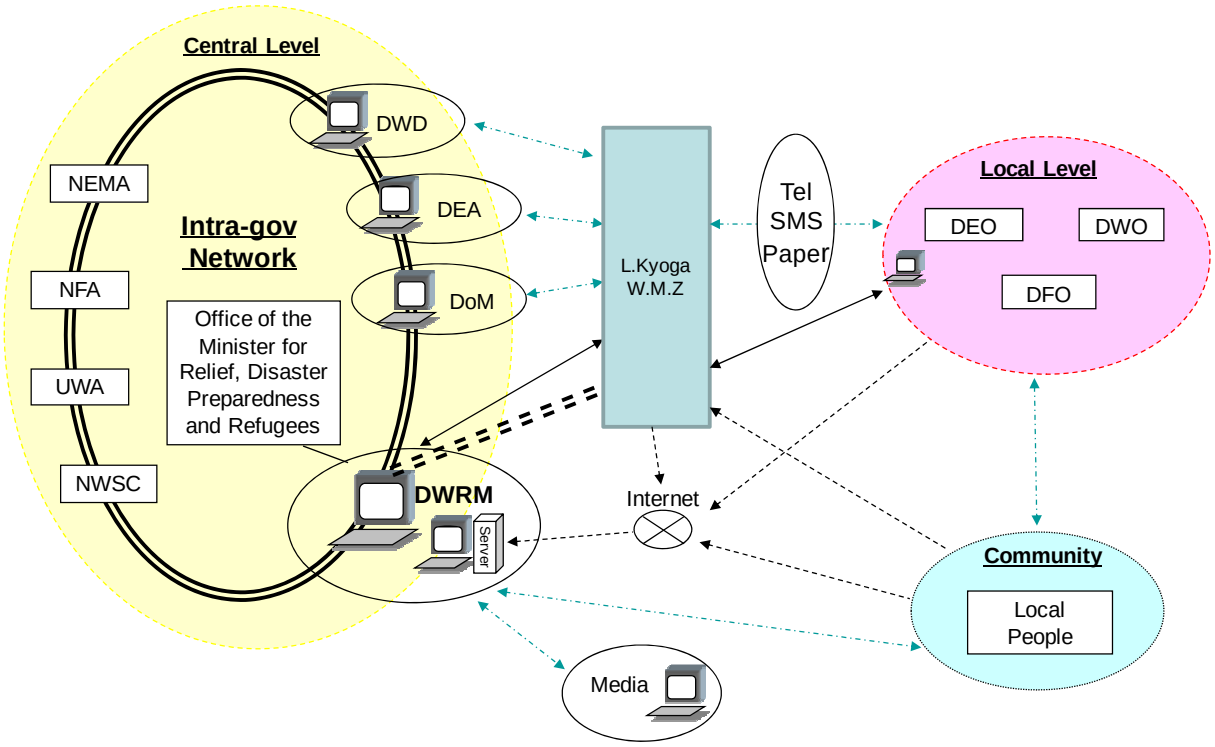


Figure 6-11 Outline of Information Sharing System

6.4.6 Total Schedule of the Basic Plan

Total schedule of the Basic Plan is shown in Table 6-16. The basic policy for the schedule is descried below.

(1) Comprehensive Water Resources Management

Although water resources assessment is fundamental for water resource development and management, it needs monitoring data storage for several decades. Therefore, a formulation of the monitoring system shall be implemented until 2015 as a short period plan. Since organization strengthening needs more time, it plans to be complete in the early middle term.

(2) Effective, Stable, Equitable Water Supply

A controlling water demands is so difficult for short term that it plans to complete in a middle term. However, it shall be bring into long term view as well. As for domestic water supply, its plan is discloses in public in SIP. According to SIP, the coverage rate of the domestic water supply in the Basic Plan shall be 100% in 2035. On the other hand, the agricultural water supply plan consists of study and planning stage for five priority sub-basins, which are regarded as serious water balance, in the short term and implementation stage in the middle term to the early long term.

(3) Prevention of Flood and Sediments Disaster to Protect Lives and Properties

Flood and sediments disaster have been conspicuous recently in the Basin, which may be caused by climate change; however, ultimate measure against them needs huge budget and very long period. In this

Basic Plan, non structural measure, which can be carry out soon, is mainly planned in the short and middle term. Structural measures in part, tree-planting and so on are planned in the long term.

(4) Conservation Plan of Water Environment

Setting up environmental conservation target and strengthening water quality monitoring system are planed in the short term but sewerage system as the structural measure belongs to the long term plan in consideration of its cost.

(5) Setting up System for Collection, Sharing and Transmission of Relevant Data on Water Resources Development and Management

Information sharing system as shown in Figure 6-11 is planed in short term on a parallel with setup of other monitoring systems because this system is expected to play an important role quickly in order to integrate management of relevant data for water resources development and management.

Table 6-16 Schedule of the Basic Plan on Water Resources Development and Management for Lake Kyoga Basin

Item			Sub-basin No.											Planning Phase																							Responsible Organization
			1	2	3	4	5	6	7	8	9	10	11	Short Term (2010-2015)								Middle Term (2016-2020)					Long Term (2020-2035)												
			Ok	Or	Aw	Lw	Ak	Ab	Ky	Mp	Lu	Vi	Se	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
1.	**Comprehensive Water Resources Management**																																						
	1-1	Water Resources Assessment																																					
		(1) River Gauging Station Network	X	X	X	X	X	X	X	X	X	X	X																										DWRM
		(2) Lake Water Gauging Station Network			X		X	X	X																														DWRM
		(3) Groundwater Monitoring Network	X	X	X	X	X	X	X	X	X	X	X																										DWRM
		(4) Meteorological Monitoring Network	X	X	X	X	X	X	X	X	X	X	X																										DWRM
		(5) Guidelines of Well Drilling and Pumping Test	DWRM																																				DWRM
		(6) Water Resources Database System	DWRM, L.Kyoga WMZ																																				DWRM
	1-2	Organization Strengthening for WRDM																																					
		(1) Setting up Sub-basin Liaison Council	X	X	X	X	X	X	X	X	X	X	X																										DWRM
		(2) Capacity Development of DWRM	DWRM, L.Kyoga WMZ																																				MoWE, DWRM
2.	**Effective, Stable and Equitable Water Supply**																																						
	2-1	Controlling Water Demands																																					
		(1) Effective Water Use	X	X	X	X	X	X	X	X	X	X	X																										DWD
		(2) Introduction of Water-saving Technology	X	X	X	X	X	X	X	X	X	X	X																										DWD, MAAIF
		(3) Awareness of Water User	X	X	X	X	X	X	X	X	X	X	X																										MAAIF, DWD, DWO
	2-2	Increasing Water Supply through WRDM																																					
		(1) Urban Water Supply (Small Town Dominant)	X	X	X	X	X	X	X	X		X	X	Coverage Rate 42% to 69%								Coverage Rate 69% to 76%					Coverage Rate 76% to 100%													DWD, NWSC
		(2) Rural Water Supply	X	X	X	X	X	X	X	X	X	X	X	Coverage Rate 60% to 77%								Coverage Rate 77% to 83%					Coverage Rate 83% to 100%													DWD
		(3) Agricultural Water Supply	X	X		X			X	X							Basic Study			M/P、F/S		Implementation																		MAAIF, DWD
3.	**Prevention of Flood and Sediment Disaster for Life and Property**																																						
	3-1	Deforestation Prevention Plan																																					
		(1) Clarifying Boundary of Protected Area of Forest	X	X	X	X			X																															NFA, DFO
		(2) Expansion of Landuse Regulation and Development Prohibited Area and Thoroughness of the Regulations	X	X	X	X			X																															MoLG
		(3) Tree-Planting Program	X	X	X	X			X																															NFA
		(4) Study and Research on Agro Forestry	X	X	X	X			X																															DEA
		(5) Enhancement of Public Awareness of Forest Protection	X	X	X	X			X																															DFO
	3-2	Flood Prevention Plan																																					
		(1) Construction and Rehabilitation of Surface Water Storage Facility	X	X	X	X	X	X	X	X	X																													MAAIF
		(2) Road Development for Transportation of Emergency Materials and Evacuation Route	X	X	X	X	X	X	X	X	X																													MoWT
	3-3	Erosion and Sediment Management Plan																																					
		(1) Specifying Disaster Risk Area by Disaster Type	X	X	X	X			X																															MoDPR, DWRM
		(2) Designation of Regulated Area of Landuse and/or Development	X	X	X	X			X																															MoLHU
		(3) Relocation	X	X	X	X			X																															MoDPR
		(4) Education of Disaster Management to Community	X	X	X	X			X																															MoDPR
		(5) Development of Evacuation Site and Route	X	X	X	X			X																															MoDPR, MoWT
	3-4	Common Measures for Flood and Sediment Disaster																																					
		(1) Publicity and Thoroughness of Regulated Items in National Environment Regulations	X	X	X	X	X	X	X	X	X																													DOE,NEMA
		(2) Establishment of System for Collection, Accumulation and Sharing of Disaster Information	X	X	X	X	X	X	X	X	X	X	X																											MoDPR, DWRM
		(3) Preparation of Hazard Map and Risk Map	X	X	X	X	X	X	X	X	X																													DWRM
		(4) Establishment of Early Warning System for Disasters	X	X	X	X	X	X	X	X	X																													MoDPR, DWRM
		(5) Community Based Disaster Management Activities	X	X	X	X	X	X	X	X	X																													District
4.	**Conservation Plan of Water Environment**																																						
	4-1	(1) Establishment of Ambient Water Quality Standards	X	X	X	X	X	X	X	X	X	X	X																											DEA
		(2) Strengthening Water Quality Monitoring System	DWRM, L.Kyoga WMZ																																				DEA
		(3) Sewerage Treatment System	X	X	X	X	X	X	X	X	X	X	X																											NWSC
5.	**Setting up System for Collection, Sharing and Transmission of Relevant Data on WRDM**		DWRM, L.Kyoga WMZ																																				DWRM

Note: **Ok**: Okoke,**Or**: Okere, **Aw**: Awaja, **Lw**: Lwere, **Ak**: Akuweng, **Ab**: Abalan, **Ky**: Kyoga Lake-side, **Mp**: Mpologoma, **Lu**: Lumbuye, **Vi**: Victoria Nile, **Se**: Sezibwa, **WRDM**: Water Resources Development and Mangement, **WMZ**: Water Management Zone
DWD:Directorate of Water Development, **DWRM**: Directorate of Water Resources Management, **MoWE**: Ministry of Water and Environment, **MAAIF**: Ministry of Agriculture, Animal Industry and Fisheries, **DWO**: District Water Office
NWSC: National Water and Sewerage Corporation, **NFA**: National Forestry Authority, **DEA**: Directorate of Environment Affaires, **DFO**: District Forestry Office, **MoWT**: Ministry of Works and Transportation, **MoDPR**: Ministry of Diaster Preparadness and Refugees

6.5 Priority of the Basic Plan on Water Resources Development and Management

This study has been conducted to contribute to PEAP (Poverty Eradication Action Plan). On the other hand, Uganda ratified Millennium Development Goals for reducing global poverty, which was the final declaration at the United Nations Millennium Summit in September 2000. Therefore, each relative contribution degree to the eight goals in the declaration was adopted to evaluate the priority of each item of the Basic Plan. As shown in Table 6-18, drinking water supply plan, particularly rural water supply features high on the evaluation list of priority.

6.6 Outline Schedule and Approximate Cost of Water Supply Plan

Outline schedule and approximate cost of water supply plan, which is valued at the high priority item in the Basic Plan, are descried below.

6.6.1 Outline Schedule

In the Basic Plan, the construction and expansion of the water supply system are proposed to be implemented simultaneously in each sub-basin without any emphasis put on any sub-basin.

6.6.2 Method for Cost Estimate

The costs for construction and expansion of the water supply facilities are estimated considering the following items of conditions.

- Time of estimate: 2008
- Temporary works, transportation, site expenses are set at 15% of direct construction cost in accordance with Water Supply Design Manual of Ministry of Water, Land and Environment.
- Contingency is set at 10% of the sum of direct construction cost and the above items such as temporary works, etc. in accordance with Water Supply Design Manual of Ministry of Water, Land and Environment.
- VAT (Value Added Tax) of 18% is not considered.

6.6.3 Result of Cost Estimation

The construction costs of each technology applied for rural water supply are shown in Table 6-17.

Table 6-17 Summary of Estimated Project Costs

(Unit: mUGX)

Water Supply Facilities	2008 - 2015	2015 - 2020	2020 - 2035
1. Urban Water Supply			
1.1 Large Town + Peri-urban areas			
Construction Costs	54.254	77,088	330,725
O & M costs	6,963	2,557	11,714
Total	61,217	79,646	342,429
1.2 Small Towns			
Construction Costs	71,311	51,054	327,108
O & M costs	7,712	5,380	34,208
Total	79,023	56,434	361,316
2. Rural Water Supply			
Construction Costs	71,311	51,054	327,108
O & M costs	7,629	5,464	34,566
Total	78,940	56,519	361,675

Table 6-18 Priority Evaluation of Basic Plan on Water Resources Development and Management for Lake Kyoga Basin

Item of Basic Plan for Water Resources Development & Management	* Millennium Development Goals	Eradicate Extreme Poverty & Hunger	Achieve Universal Primary Education	Promote Gender Equality and Empower Women	Reduce Child Mortality	Improve Maternal Health	Combat HIV/AIDS, Malaria & other Diseases	Ensure Environmental Sustainability	Develop a Global Partnership for Development	Priority Evaluation
		Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015	Reduce by two thirds, between 1990 and 2015, the under-five mortality rate	Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio	Have halted by 2015 and begun to reverse the spread of HIV/AIDS	Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	Address the special needs of landlocked countries and small island developing States	**Contribution Degree to Millennium Development Goals**
	** Targets of Millennium Development Goals in Uganda	Halve, between 1990 and 2015, the proportion of people who suffer from Hunger	-	-	-	-	Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	Halve by 2015 the proportion of people without sustainable access to safe drinking water	Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term	**Evaluation Legend**
		-	-	-	-	-		By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers	In cooperation with developing countries, develop and implement strategies for decent and productive work for youth	**5: very high** **4 : high** **3 : middle** **2 : low** **1: very low** **- : not applicable**
		-	-	-	-	-	-	-	In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	
1.	**Comprehensive Water Resources Management**									
1-1	Water Resources Assessment									
(1)	River Gauging Station Network	-	-	-	-	-	-	4	-	4
(2)	Lake Water Gauging Station Network	-	-	-	-	-	-	4	-	4
(3)	Groundwater Monitoring Network	-	-	-	-	-	-	4	-	4
(4)	Meteorological Monitoring Network	-	-	-	-	-	-	4	-	4
(5)	Guidelines of Well Drilling and Pumping Test	-	-	-	-	-	-	3	-	3
(6)	Water Resources Database System	-	-	-	-	-	-	4	-	4
1-2	Organization Strengthening for WRDM									
(1)	Setting up Sub-basin Liaison Council	-	-	-	-	-	-	3	-	3
(2)	Capacity Development of DWRM	-	-	-	-	-	-	4	-	4
2.	**Effective, Stable and Equitable Water Supply**									
2-1	Controlling Water Demands									
(1)	Effective Water Use	1	-	-	-	-	-	3	-	4
(2)	Introduction of Water-saving Technology	1	-	-	-	-	-	3	-	4
(3)	Awareness of Water User	-	-	-	-	-	-	3	-	3
2-2	Increasing Water Supply through WRDM									
(1)	Urban Water Supply (Small Town Dominant)	2	1	-	2	2	2	4	-	13
(2)	Rural Water Supply	4	3	2	4	4	3	5	-	25
(3)	Agricultural Water Supply	5	2	1	1	1	-	-	-	10
3.	**Prevention of Flood and Sediment Disaster for Life and Property**									
3-1	Deforestation Prevention Plan									
(1)	Clarifying Boundary of Protected Area of Forest	-	-	-	-	-	-	3	-	3
(2)	Expansion of Landuse Regulation and Development Prohibited Area and Thoroughness of the Regulations	-	-	-	-	-	-	3	-	3
(3)	Tree-Planting Program	1	-	-	-	-	-	4	-	5
(4)	Study and Research on Agro Forestry	3	1	-	-	-	-	3	-	7
(5)	Enhancement of Public Awareness of Forest Protection	-	-	-	-	-	-	3	-	3
3-2	Flood Prevention Plan									
(1)	Construction and Rehabilitation of Surface Water Storage Facility	2	1	-	-	-	-	2	-	5
(2)	Road Development for Transportation of Emergency Materials and Evacuation Route	1	-	-	1	1	1	1	-	5
3-3	Erosion and Sediment Management Plan									
(1)	Specifying Disaster Risk Area by Disaster Type	-	-	-	-	-	-	2	-	2
(2)	Designation of Regulated Area of Landuse and/or Development	-	-	-	-	-	-	3	-	3
(3)	Relocation	-	-	-	-	-	-	2	-	2
(4)	Education of Disaster Management to Community	-	-	2	-	-	-	1	-	3
(5)	Development of Evacuation Site and Route	-	-	-	1	1	1	1	-	4
3-4	Common Measures for Flood and Sediment Disaster									
(1)	Publicity and Thoroughness of Regulated Items in National Environment Regulations	-	-	-	-	-	-	2	-	2
(2)	Establishment of System for Collection, Accumulation and Sharing of Disaster Information	-	-	-	-	-	-	3	-	3
(3)	Preparation of Hazard Map and Risk Map	1	-	-	-	-	-	2	-	3
(4)	Establishment of Early Warning System for Disasters	-	-	-	2	-	-	2	-	4
(5)	Community Based Disaster Management Activities	-	-	1	-	-	-	2	-	3
4.	**Conservation Plan of Water Environment**									
4-1	(1) Establishment of Ambient Water Quality Standards	-	-	-	-	-	-	4	-	4
(2)	Strengthening Water Quality Monitoring System	-	-	-	-	-	-	4	-	4
(3)	Sewerage Treatment System	-	-	-	2	2	3	5	-	12
5.	**Setting up System for Collection, Sharing and Transmission of Relevant Data on WRDM**	-	-	-	-	-	-	4	-	4

Source: * United Nations: Millennium Development Goals (http://www.un.org/millenniumgoals/)
** Millennium Development Goals of Uganda: (http://www.indexmundi.com/uganda/millennium-development-goals.html)

6.7 Evaluation of the Basic Plan on Water Resources Development Management

6.7.1 Technical Evaluation

Since construction of drinking water supply facilities for safe and stable water supply, and sewerage treatment facilities for conservation of surface water quality incorporated in "the Basic Plan on Water Resources Development and Management" have been implemented beforehand in Uganda, there are no technical problem to deal with them using stored experiences and technology for years in Uganda.

As for meteorological, hydrological and hydrogeological monitoring network to capture the most basic information for water resources development and management, rehabilitation of existing stations or same technical level of new stations are planned without any technical difficulty. Furthermore, non-structural countermeasures against flood and debris flow disaster in the eastern part of the Basin are under similar circumstances.

6.7.2 Economical and Financial Evaluation

(6) Economical Evaluation

1) Economical Condition of Uganda

The real economic growth rate of Uganda has fluctuated as shown in Figure 6-12 due to domestic and overseas economical conditions since 1990. It rises ever year at an average rate of one percent in this decade. Ugandan economy is still steady. In spite of the recent world economical recession, the Ugandan economical growth rate is forecasted over 5% in 2010. The Standard & Poor's Co. in 2008 and Fitch Ratings in 2009 evaluated the Sovereign ranking of Uganda from B rank to B+ rank. Figure 6-13 indicates the inflation rate of Uganda in 2010 will become approximately double of 2000. The increase rate of it has become bigger since 2008. On the other hand, the inflation rate year on year has been changed more or less six percent since 1994. (Figure 6-14) The value of 2009/10: 14.1% was much bigger than the government target: 5%.

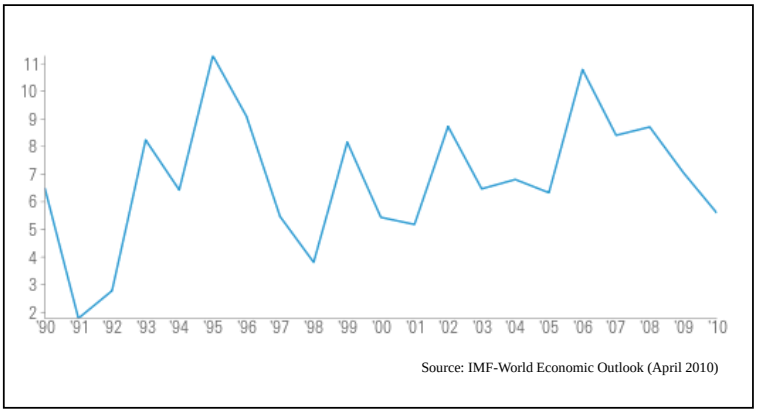


Figure 6-12 Transition of Real Economic Growth Rate (%)

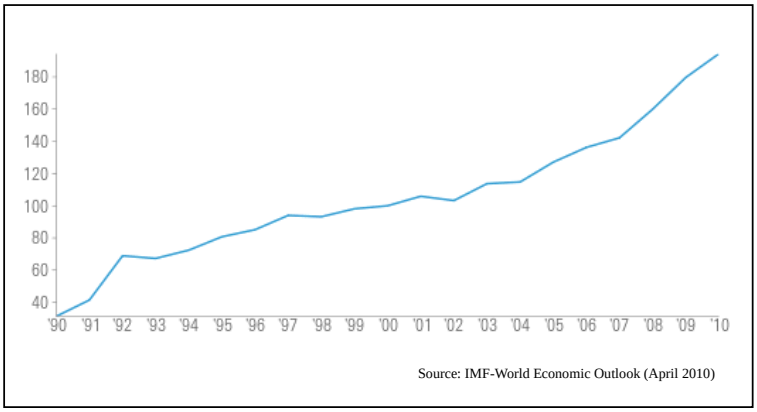


Figure 6-13 Transition of Inflation Rate (%)

2) Economic Evaluation of Rural Water Supply Plan

Economic evaluation was conducted on the rural water supply plan having high priority in the Basic Plan.

Economical benefit from the planned rural water supply are assumed using average monthly water related expenditure and opportunity loss calculated with time required to fetch water. These values were captured by the household survey in the Study.

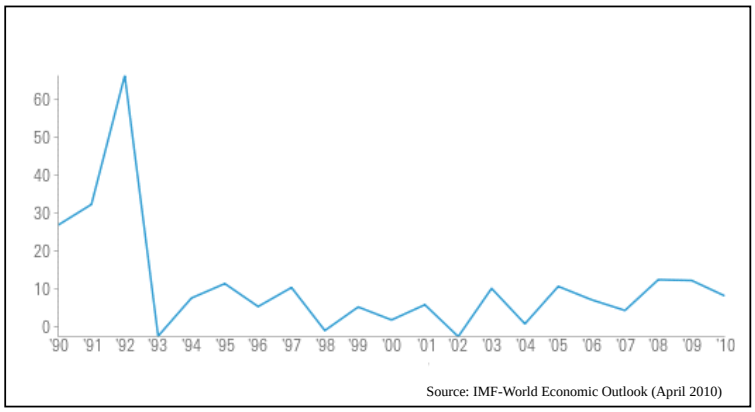


Figure 6-14 Transition of Year on Year of Inflation Rate

Average monthly water related expenditure was 9,452UGX/house which is equivalent to 7% of total monthly expenditure. This water related expenditure can be regarded as amount of willingness to pay for water service. Time required to fetch water is 94 min/day/house on average and it is equivalent to 113 UGX/day/house which is calculated from average annual income. Economical evaluation result is that NPV and EIRR are 279billionUGX and 12.7% respectively as shown in Table 6-19. Since the EIRR value is larger than Discount rate, the implantation of this rural water supply plan is reasonable.

Table 6-19 Economic Evaluation of Rural Water Supply Plan

	NPV (Billion UGX)	EIRR	B/C
Rural Water Supply	+279	12.7%	1.08

Note: Discount Rate = 10%

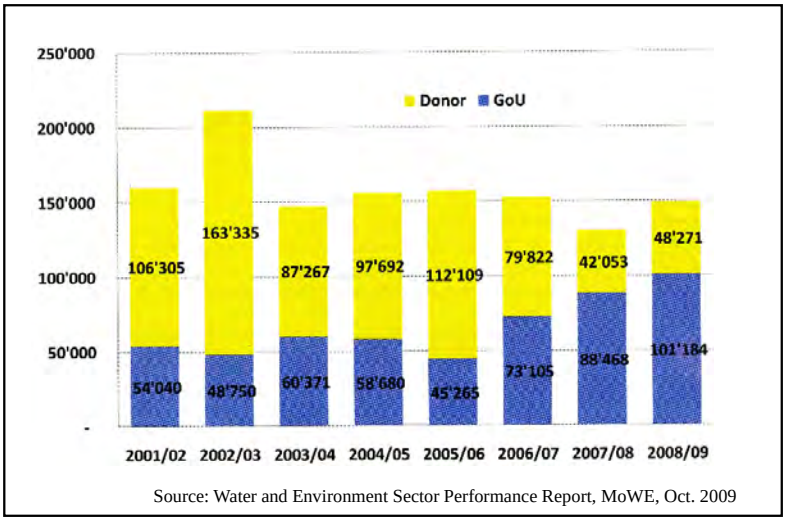
(7) Financial Evaluation

1) Financial Condition of Uganda

The budget for the water and sanitation sector is approximately 150 billion UGX every year after 2001/02 as shown in Figure 6-15. Donor portion of the budget from 2001/02 to 2005/06 was 60 to 70%; however, it has decreased since 2006/07. On the contrary, the government portion increased and it became 68%in 2008/09. An increase of the government budget can be expected due to the steady economical conditions; however, since 3.3% of population growth rate in Uganda is very high on a global basis, the budget for the construction of infrastructure is more and more needed together with the donor's financial assistance.

2) Financial Condition of Rural Water Supply Sub-sector

Average of monthly water related expenditure was 9,452UGX/house, which is 7% of average monthly expenditure in the Basin. It is almost impossible to care for new water supply system and set up operation and maintenance system by only this expenditure or appropriate water tariff. Since these projects are highly public and essentially needed for PEAP, an initial cost for construction and renovation should be covered by the government budget and donor's support, and the operation and maintenance cost should be borne by water users.



Source: Water and Environment Sector Performance Report, MoWE, Oct. 2009

Figure 6-15 Transition of Budget for Water and Sanitation Sector

6.7.3 Evaluation on Social Environmental Consideration

It was assessed that the impacts of the four items (water supply facilities, water storage facilities, water treatment facilities, and forestation) described in the Basic Plan on the living environment, natural environment, and social environment. Details are in the supporting report.

(8) Water Supply Facilities

- Living Environment (pollution)

Air and water pollution, noise, and vibration are expected from operation of the construction machinery. However, the impact of these will be limited due to the short construction period and the small size of the facilities to be built. Water pumps will generate some noise but the effect will be kept minimum as they will be installed inside a building.

- Natural Environment

Some impacts are expected on the local ecosystem and water levels in the vicinity of the facilities, but the effect will be very small because of the small size of the facilities.

- Social Environment

Safe and stable water supply will reduce the workload of the women and children who carry domestic water every day. It will also contribute to reduce diseases in communities. However, the new water supply can also create new differentials between those who benefits from it and those who do not. Therefore, careful consideration and planning are needed before construction of facilities.

(9) Water Storage Facilities: Valley Tank, Pond

- Living Environment (pollution)

Air and water pollution, noise, and vibration are expected from operation of the construction machinery. However, the impact of these will be limited due to the short construction period and the small size of the facilities to be built.

- Natural Environment

Impacts on the local ecosystem in the vicinity as well as the downstream of the water storage facility need to be considered.

- Social Environment

Cultural and historical sites inside or near the target areas need to be considered.

(10) Waste Water Treatment Facilities: Oxidation Pond

- Living Environment (pollution)

Air and water pollution, noise, and vibration are expected from operation of the construction machinery. Though a water treatment facility improves the environment in the downstream areas, they also produce undesirable waste as a result of the water purification process. Proper disposal of such waste is important to prevent new pollution near the facility. Therefore, careful planning is necessary prior to the construction of a water treatment facility.

- Natural Environment

Improvements on the ecosystem in the downstream areas are expected.

- Social Environment

Water treatment facilities are necessary for sustainable development of the downstream communities as they can provide convenient and healthier living to the people in the communities. Preservation of cultural and historical sites and resettlement of the local people need to be considered for selection of a target site.

(11) Forestation

- Living Environment (pollution)

Since heavy machinery is not normally used for forestation in Uganda, noise and air pollution are not of a concern. A target area of forestation will be initially prone to land erosion due to lack of the strong foundation of the trees. Therefore, forestation of a large area at the same time can result in a major land erosion and displacement of a large amount of soil. However, as trees grow, they start acting as a water storage preventing erosion and flood and stabilizing water supply.

- Natural Environment

Preservation and enrichment of the vegetation in the target areas by proper forestation are expected. Reduction of CO_2 is also expected.

- Social Environment

New jobs will be created around the target areas. They can also serve as a fuel source for poor people.

On the other hands, when those areas have been used already for residence or farmland, it is necessary to prepare alternative site or employ residents in the forestation project in order to mitigate inconvenient of their life as much as possible.

Chapter 7
Master Plan of Rural Water Supply in Priority Districts

CHAPTER 7 MASTER PLAN OF RURAL WATER SUPPLY IN PRIORITY DISTRICTS

7.1 Selection of Priority Districts

Among various programs proposed in the study on the water resources and management of Lake Kyoga Basin, the rural water supply is given the highest priority to increase the water supply through Water Resource Development and Management, and some priority districts are selected among 38 districts in the basin to prepare the rural water supply master plan. The priority districts for the rural water supply master plan are selected among 17 districts narrowed down from the viewpoints of water resources management and security, considering the socio-economic aspects such as poverty ratio, waiting time for fetching water, rural water supply coverage, and equality in accessing safe water, and the natural conditions such as drilling depth, static water level of well, yield, recharge potential and water quality. The priority districts are determined through the discussion with the counterpart agencies such as DWD and DWRM.

Out of the 38 districts in the Basin, three (3) districts are selected as the priority districts for the master plan of the rural water supply. The priority districts are selected based on the discussions with DWD and DWRM, the counterpart organizations for this project considering the priority lists prepared for the socio-economic and the natural conditions.

7.1.1 Water Source for Rural Water Supply

Generally, the deep groundwater is considered as the most permissible and safest water source for rural water supply among the sources such as surface water, spring water, etc. taking into account the following advantages,

- More resistant to drought (draught tolerant)
- Safe water quality without any prior treatment
- Stable yield throughout a year (less seasonal variation than surface water)
- Protected from contamination
- Found close to the point of demand

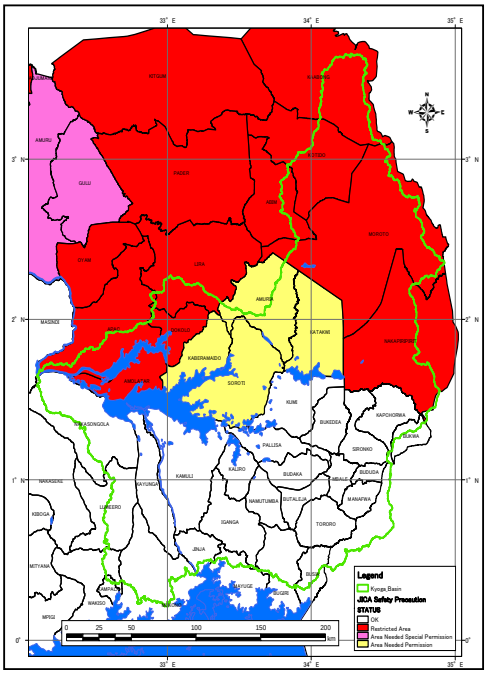


Figure 7-1 Districts to Which Entrance is Limited by JICA

The surface water is prone to require treatment facilities for coagulation, sedimentation and filtering to improve the quality for drinking water, and the operation of these facilities require rather high level operation practice and expenses for chemicals also. Considering that in the rural water supply and sanitation the water supply facilities have to be operated and maintained by the beneficial communities themselves, the surface water source is not generally suitable for the

rural water supply.

In the districts other than those located around the Mt. Elgon in the Basin, the groundwater is considered to be the most secured and safest water source for the rural water supply since the further development potential of groundwater resources is expected in the most of those areas. In the viewpoint of water resources management, the demand of utilization of perennial river flow for the irrigation water supply is increasing rapidly. Although the further exploitation of groundwater resources is expected in the Basin, its potential is limited, and is not considered enough to fulfill the irrigation requirement. Therefore, it is recommended to exploit surface water resources for irrigation purpose mainly and groundwater for the rural water supply in order to conserve the groundwater resources.

7.1.2 Districts to be Considered for the Selection

As mentioned in Chapter 5, the groundwater basins are generally regarded to extend as same as those of the surface water, and then the groundwater resources management is also considered to be treated in the same manner as the surface water. The 17 districts that extend over the boundary of the Basin to other neighboring basins are excluded from those considered for the selection because of the water-resource management reason and the 21 districts remain. Figure 7-1 shows the area where access is restricted by the JICA Uganda office regulations for safety. The two (2) districts of the Amolatar and the Dokolo districts are excluded due to security reason, and then the 19 districts remain as shown in Table 7-1. Since among the districts around Mt. Elgon, the Bududa and the Manafwa districts are considered as the hilly areas where the spring/stream flow is abundant but groundwater potential is less, these districts are also excluded form those for the selection, and as a result the 17 districts remain as the candidates for the selection of the priority districts.

Table 7-1 Candidate Districts for Selection of Priority Districts

District	Over Boundary	Off-limits by JICA	Near Mt. Elgon	Candidate	District	Over Boundary	Off-limits by JICA	Near Mt. Elgon	Candidate
Kayunga				x	Katawi				x
Luwero	x				Kumi				x
Mukono	x				Manafwa			x	
Nakasongola	x				Mayuge	x			
Wakiso	x				Mbale				x
Amuria	x				Namutumba				x
Budaka				x	Pallisa				x
Bududa			x		Sironko				x
Bugiri	x				Soroti				x
Bukedea				x	Tororo				x
Bukwa	x				Abim	x			
Busia	x				Amolatar		x		
Butaleja				x	Apac	x			
Iganga				x	Dokolo		x		
Jinja	x				Kaabong	x			
Kaberamaido				x	Kotido	x			
Kaliro				x	Lira	x			
Kamuli				x	Moroto	x			
Kapchorwa				x	Nakapiripirit	x			
					Total Nos.	17	2	2	17

Note: the shaded columns indicate the candidate districts for selection.

7.1.3 Prioritization Criteria

In order to evaluate the districts fair, the parameters of two (2) aspects; social and natural conditions are considered in selecting the priority districts as described below.

(1) Social Conditions

- Poverty Ratio: The county-wise poverty ratios in Uganda are applied. The districts with a high poverty ratio should be given high priority for the selection.
- Waiting Time at Water Source in Dry seasons: The average waiting time at water sources in dry seasons of the districts in the Basin are applied. The districts with long waiting time are considered to be given high priority for the selection.
- Rural Water Supply Coverage: The districts with lower water supply coverage considered to be given higher priority for the selection.
- Rural Water Supply Equity: The deviation of the population a point water source of sub -county from the average of a district is considered as an indicator of equity. The districts with high values of the indicator are considered to be given high priority for the selection.
- Functionality: The districts with higher functionality are generally considered to have rather many communities prepared for mobilization activities, and then it is expected that the smooth and positive facilitations can be conducted for such communities.

Table 7-2 Evaluation of Priority District by Social Condition

District Name	Social Condition Evaluation											
	Poverty Condition		Waiting Time in Dry Season		Rural Water Supply Coverage						Total Point	Ranking
	1. Poverty Ratio (%)	Index Point	2. Waiting Time (min)	Index Point	3. Coverage Rate (%)	Index Point	4. Functionarity	Index Point	5 Equity	Index Point		
Budaka	48.9	56.8	58.0	32.4	59	80.5	90	87.7	230	57.8	315.2	**4**
Bukedea	56.3	77.8	94.0	66.7	81	26.8	76	44.0	59	6.3	221.7	**12**
Butaleja	51.3	63.6	24.0	0.0	60	78.0	91	91.3	70	9.6	242.6	**10**
Iganga	43.2	40.6	57.0	31.4	58	82.9	91	89.2	83	13.6	257.8	**8**
Kaberemaid	58.9	85.2	41.0	16.2	92	0.0	76	43.7	38	0.0	145.1	**16**
Kaliro	56.8	79.3	64.0	38.1	57	85.4	92	92.5	58	6.0	301.3	**6**
Kamuli	46.7	50.6	64.0	38.1	56	87.8	91	89.2	125	26.2	291.9	**7**
Kapchorwa	28.9	0.0	38.0	13.3	65	65.9	61	0.0	107	20.8	100.0	**17**
Katakwi	62.0	94.0	129.0	100.0	71	51.2	83	65.9	76	11.4	322.6	**2**
Kayunga	35.9	19.9	44.0	19.0	61	75.6	88	82.0	52	4.2	200.8	**14**
Kumi	57.5	81.3	94.0	66.7	53	95.1	79	53.6	75	11.1	307.8	**5**
Mbale	30.2	3.7	35.0	10.5	52	97.6	83	66.2	174	41.0	218.9	**13**
Namutumba	55.3	75.0	57.0	31.4	80	29.3	93	95.8	68	9.0	240.5	**11**
Pallisa	54.9	73.9	58.0	32.4	51	100.0	90	86.2	114	22.9	315.4	**3**
Sironko	32.1	9.1	40.0	15.2	71	51.2	84	69.2	73	10.5	155.3	**15**
Soroti	64.1	100.0	68.0	41.9	79	31.7	87	78.4	370	100.0	352.1	**1**
Tororo	47.1	51.7	24.0	0.0	62	73.2	94	100.0	118	24.1	249.0	**9**

1 "Nature, Distribution and Evolution of Poverty and Inequity in Uganda, 1992-2002 (UBOS and ILRI 2007)"
2 "Gender Disaggregated Data for Water and Sanitation Sector" (MFPED Jan.2008)
3 "Water & Sanitation Sector Performance Report 2008"
4 "Water & Sanitation Sector Performance Report 2008"

(2) Natural Conditions

- Drilling Depth: Drilling depth is the most important factor that affects the initial cost of a

production well, and this parameter is used as one of those indicating groundwater potential. The shallower depth is considered as higher priority.

- Static Groundwater Level: For the same water yield, the performance required for a pump is determined by the static groundwater level. It also affects the operating cost a well, and used as one of the parameters of the groundwater potential. The shallower water level is considered as higher priority.
- Water Yield: Water yield is a fundamental parameter for designing water supply facilities, and it is an important factor for quantitative evaluation of a groundwater potential. The larger yield is considered as higher priority.
- Groundwater Recharge Potential: Vertical recharge provided by rain is the most important source of the recharge for a groundwater source. The relative evaluation of recharge potentials performed with water balance analysis is used as one factor of ground water recharge potential. The larger potential is considered as the higher priority.
- Water Quality: The Total Dissolved Solids (TDS) values are used as that representing water quality in groundwater source evaluation in the Basin. The lower TDS is considered as the higher priority.

Table 7-3 Evaluation of Priority District by Natural Condition

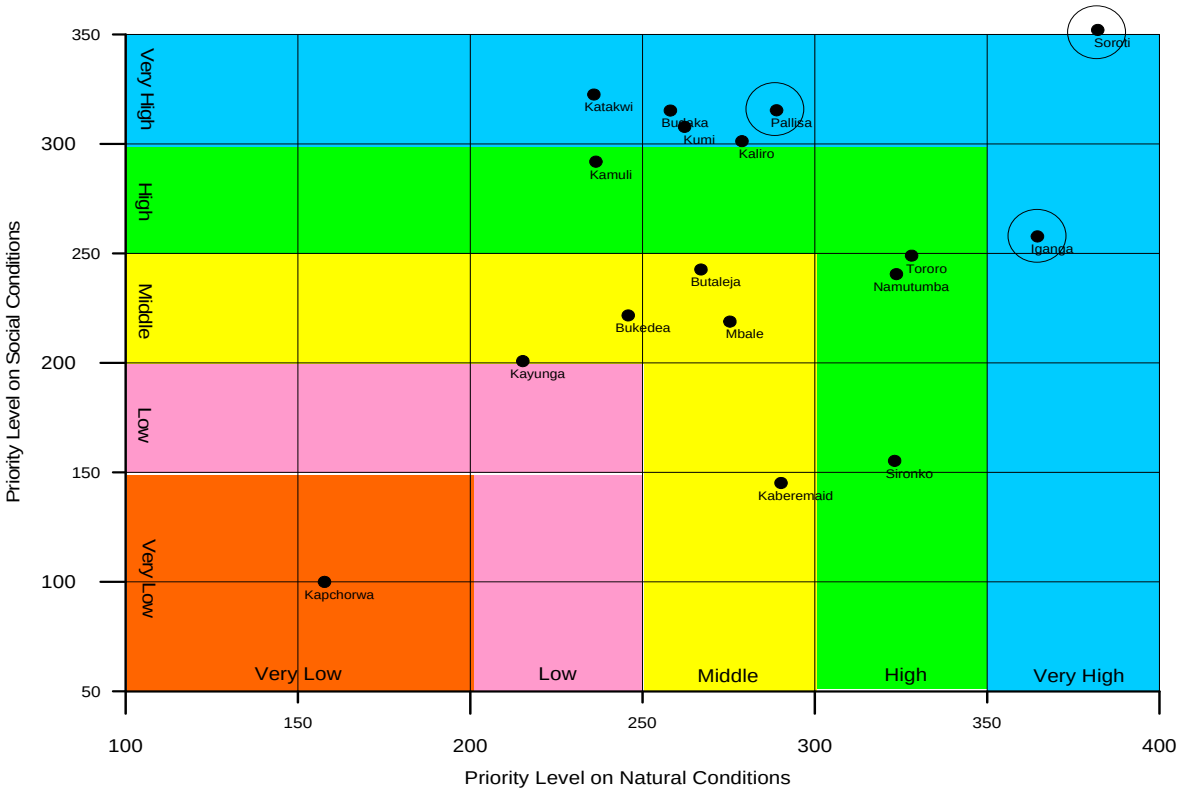
District Name	Natural Condition Evaluation (Hydrogeological Evaluation)											
	Adopted Indices and Evluation Points										Total Point	Ranking
	1. Drilling Depth (m)	Index Point	2. Static Water Level (bgl m)	Index Point	3. Yield (m^3/h)	Index Point	4. Water Quality (TDS mg/l)	Index Point	5. Recharge (mm)	Index Point		
Budaka	61.5	77.4	9.6	86.3	1.5	14.1	268.3	80.2	130.0	0.0	258.1	**12**
Bukedea	78.0	36.1	11.0	80.1	2.4	70.6	444.8	27.4	243.0	31.7	245.9	**13**
Butaleja	66.2	65.9	6.6	100.0	1.3	0.0	256.8	83.7	192.0	17.4	267.0	**10**
Iganga	55.4	92.7	13.6	67.8	2.6	81.8	225.8	93.0	234.0	29.2	364.6	**2**
Kaberemaid	58.1	86.0	11.9	76.0	2.1	51.5	397.5	41.6	255.0	35.1	290.2	**6**
Kaliro	52.9	99.1	12.8	71.7	2.4	70.4	536.4	0.0	264.0	37.6	278.9	**8**
Kamuli	60.1	81.0	17.5	50.2	1.7	27.4	376.5	47.9	237.0	30.1	236.5	**14**
Kapchorwa	92.4	0.0	28.5	0.0	1.8	32.2	451.0	25.6	486.0	100.0	157.7	**17**
Katakwi	70.0	56.3	12.2	74.5	1.6	22.0	273.8	78.6	146.0	4.5	235.9	**15**
Kayunga	66.3	65.6	20.4	36.8	1.3	0.6	202.3	100.0	174.0	12.4	215.3	**16**
Kumi	80.4	30.1	9.2	88.3	1.6	18.4	243.2	87.8	264.0	37.6	262.2	**11**
Mbale	64.1	71.0	11.2	78.9	1.9	35.7	254.3	84.4	149.0	5.3	275.4	**9**
Namutumba	52.5	100.0	9.8	85.3	1.7	27.8	243.9	87.6	212.0	23.0	323.7	**4**
Pallisa	57.3	88.1	9.9	84.9	1.8	32.0	382.7	46.0	265.0	37.9	288.9	**7**
Sironko	58.9	84.1	11.4	78.1	1.9	39.9	402.4	40.1	418.0	80.9	323.2	**5**
Soroti	55.7	92.1	8.9	89.6	2.9	100.0	277.9	77.4	212.0	23.0	382.1	**1**
Tororo	56.6	89.8	7.6	95.7	1.8	32.6	268.1	80.3	236.0	29.8	328.1	**3**

7.1.4 Evaluation Methods and Prioritization

Each parameter of the social and the natural conditions is linearly scaled to the range from 0 to 100 corresponding the lowest to the highest values. High values represent high priority for the selection. Table 7-2 and Table 7-3 show the results of prioritization for the social and natural conditions of the 17 candidate districts.

7.1.5 Selection of Priority Districts

Figure 7-2 Selection of Priority District for Master Plan of Rural Water Supply shows a scatter plot of the social and natural condition scores. The Soroti district is the highest both in social and natural conditions. Iganga district is also the second highest in groundwater potential and gets rather high score in social condition. The social scores of Pallisa, Katakwi, Budaka, Kumi and Kaliro districts are high, and Pallisa district marks the highest score of natural condition among them. Therefore, Soroti, Iganga and Pallisa districts are selected for the three (3) priority districts.



Social and natural conditions are classified as follows:

- Social condition: very high (300<), high (250-300), medium (200-250), low (150-200), very low (<150)
- Natural condition: very high (350<), high (300-350), medium (250-300), low (200-250), very low (<200).

Figure 7-2 Selection of Priority District for Master Plan of Rural Water Supply

7.2 Inventory Survey for Water Supply Situations in Sub-counties and RGCs in Selected Priority Districts

To grasp the present situation of rural water supply in the sub-counties of the selected priority districts, the results of the inventory survey for Water Atlas Up-date Project (WATSUP Survey) conducted by DWD in 2010 are applied. The inventory survey for the RGCs in the priority districts (Rural Growth Center (RGC) Survey) was also conducted by the Study Team to grasp the present water supply situation in the RGCs situated in the priority districts.

7.2.1 WATSUP Survey

It is necessary to grasp the rural water supply situations of the sub-counties in the selected priority districts. The results of the WATSUP（Water Atlas Up-date Project) survey done by DWD in 2010 are utilized for this purpose. As for the RGCs in the priority districts, it is difficult to grasp the socio-economic and water supply situations through the existing data and information, and the RGC (Rural Growth Center) survey on the socio-economic and water supply situations was conducted for RGCs in the priority districts.

- Strengthening the capacity of Districts in the field of data management
- Up-date of the water sources baseline survey carried out between 1998-2002
- Production and dissemination of an up-dated Water Atlas and improvement of accuracy, effectiveness and easiness in access

The survey includes the following items.

Table 7-4 Survey Contents of WATSUP Survey

Item	Point Water Source	Piped Water System
1	Location of water source including GPS readings and information on whether the water source is located in an urban area, an RGC or a IDP camp.	Location of water source including GPS readings (readings to taken at the source for the piped scheme, i.e. whether the water is drawn from)
2	General information including year of construction, source number, source of funding and current ownership and estimated number of households served.	Service levels and service areas - overview of total number of connections, specification on connected institutions, service areas in rural and urban settings. General information including year of construction, source number and source of funding.
3	Type of point water source (protected spring, shallow well, borehole, rainwater harvesting tank, public stand post etc.)	Type of piped system - GFS, pumped piped system (groundwater based)
4	Operation anad maintenance - type of management, information on existence and functionality of the WSC including no. of women in key positions.	Operation anad maintenance - type of management, information on existence and functionality of the WB/WSC including no. of women in key positions.
5	Operational status (functionality) including time for non-functionality, reasons for non-functionality and details of recent major repairs.	Operational status (functionality) including time for non-functionality, reasons for non-functionality /non-use, reasons for reduced functionality and details of recent major repairs/replacements.

Source: WATSUP Data Collection Guideline (2009)

The water sources located in the rural areas of the selected priority districts are plotted in Figures from 7-3 to 7-5. Numbers of safe water sources such as deep boreholes in the rural areas are 1,324 in Iganga district, 927 in Pallisa district and 1,143 in Soroti district. On the other hand, numbers of

non-functional sources are 139 in Iganga, 94 in Pallisa and 168 in Soroti district, resulting the functionalities of 89.5 %, 89.9 % and 85.3 %, respectively.

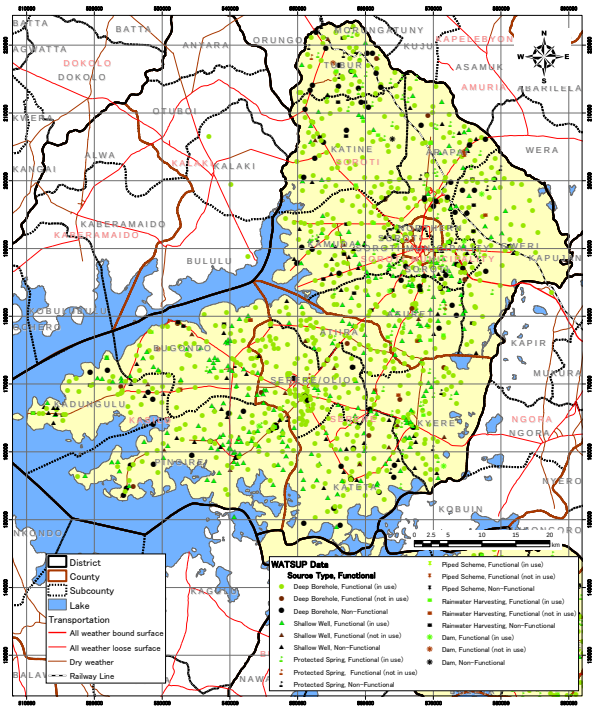


Figure 7-3 Position of Water Sources in Soroti District

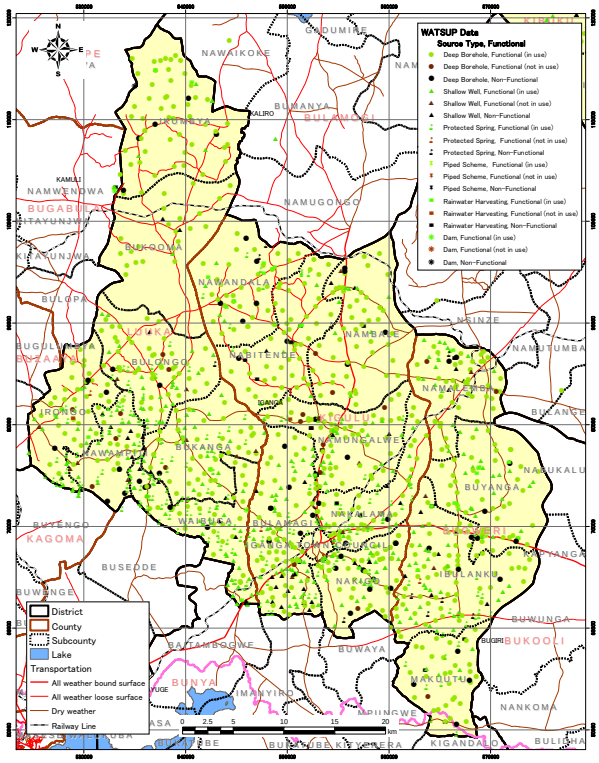


Figure 7-4 Position of Water Sources in Iganga District

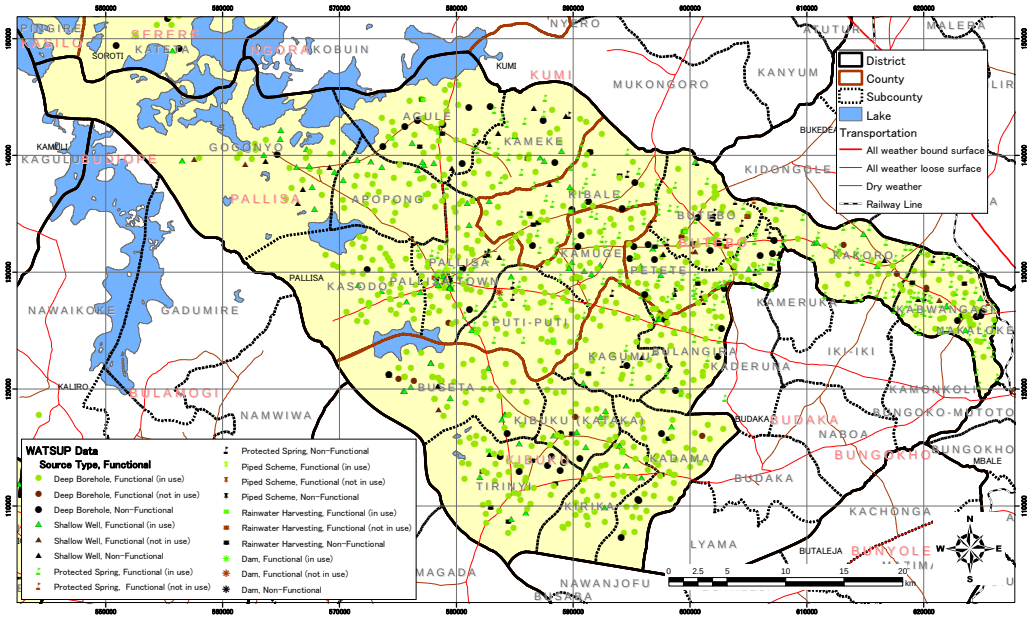


Figure 7-5 Position of Water Sources in Pallisa District

7.2.2 Rural Growth Center Survey

(1) Background and Objectives of Survey

As a result of the recent population concentration, there are many rural villages of which population increase is considered high, and these villages with high population densities are defined as the Rural Growth Centers (RGC). The RGCs are considered neither as administrative units justified legally nor as the ones based on any town and rural development plans, but are defined as those villages having trading center and/or public facilities such as school, health center administrative office etc., of which population is rapidly growing. It is also defined generally as the village of which population is in a range from 500 to 5,000. The water supply of the villages of which population exceed 5,000 is treated as town water supply basically, but rural water supply often includes those of which population is over 5,000 also if they are not gazetted as towns. The population density of these villages is rather higher than the other ones and it is considered desirable to apply the piped water supply systems but not the deep boreholes with a hand pump unit. The DWD takes up the water supply by this piped water supply system as one of the policies for the future water supply facilities. Therefore, the rural water supply master plan is required to be prepared for both of the two (2) types of areas such as the RGCs and the other rural villages. In the study on the plan for RGCs, however, there are some problems to be solved as follows:

- The population thereof may not be counted, since the boundary of RGC is not clearly defined.
- The population thereof may not be worked out from the statistical data and information, because most of the RGCs develop and extend around the intersections and it may traverse some village areas.
- The definition of RGC is considered to vary from administration to administration, and it is difficult to discuss on them on the same manner.

As stated above, the information necessary to prepare the rural water supply master plan for RGCs are lacking. It is, therefore, necessary to conduct the baseline survey (RGC surveys) to collect the data and information required for the master planning prior to the planning study. The total of 59 RGCs consisting of 11, 19 and 29 in the Soroti, Pallisa and Iganga districts, respectively were listed through hearing from the district water offices as those requiring rural water supply system, and surveyed in the RGC survey. The RGCs listed for the RGC survey are shown in Table 7-5, and the locations of RGCs are plotted on Figure 7-7.

Table 7-5 List RGCs for RGC Survey

1. Iganga Distgrict				2. Pallisa District		3. Soroti District	
No.	RGC	No.	RGC	No.	RGC	No.	RGC
1	Namungalwe	20	Ikonia	1	Kasasira	1	Acuna
2	Nambale	21	Busiiro	2	Kameke	2	Kidetok
3	Nabitende B.	22	Nabitende K.	3	Kibale	3	Pingire Etem
4	Nawandala	23	Busalamu	4	Kagumu	4	Kadungulu
5	Bugono	24	Kabira	5	Kapala	5	Kagwara Port
6	Nakalama	25	Nakigo	6	Kamuge	6	Mugarema
7	Bumanya	26	Wailama	7	Buseta	7	Kasilo Corner
8	Kiwanyi	27	Ibulanku TC	8	Tirinyi	8	Pingire Corner
9	Nakivumbi	28	Buwologoma	9	Kabole	9	Gweri
10	Busesa	29	Waibuga	10	Petete	10	Mulondo
11	Nondwe			11	Butebo	11	Iningo
12	Ikumbya			12	Gogonyo		
13	Naigobya			13	Kadama		
14	Bukoova			14	Nabiswa		
15	Namusisi			15	Bulangira		
16	Nakabugu			16	Kibuku		
17	Kyanvuma			17	Agule		
18	Lambala			18	Kabweri		
19	Nawampiti			19	Boliso I TC		

(2) Procedures

The RGC survey was carried out as follows:

1) Confirmation of Areas and Shapes of RGCs by Satellite Image Analyses

To set the boundary of RGC, the AVNIR2 and PRISM images of the Advanced Land Observing Satellite "DAICHI" of Japan were used for the configuration of RGC, and the base maps were prepared after extracting the locations of road and houses in the RGC areas.

2) Setting RGC Areas

RGC areas for the survey were delineated on the base maps prepared above, confirming with the counterpart agency such as DWD and DRAM.

3) Baseline Survey of RGC

The interview survey was conducted dispatching interviewers to the target RGCs, and the various information were collected including population of RGC, number of administrative and public facilities as well as business and commercial facilities, and number of water sources available for the water supply in the respective RGCs. In addition, the information relating to operation and maintenance situation of the available water sources is also collected as much as possible to grasp the actual situation of the operation and maintenance of water supply facilities. The results of survey were summarized and compiled in the map forms as shown in Figure 7-6, and the collected data and information are used for master planning of water supply for RGCs.