CHAPTER 14 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

14.1 Legal System Concerning Environment and Social Consideration

In 1995, Uganda enacted "National Environment Statue" calling for Environmental Impact Assessment (EIA) for all development activities likely to negatively impact on the environment before they are implemented. National Environment Management Authority (NEMA) has been created and dated to operation and implement this request.

The statute also designates environmental inspectors who can enter on any premises or vehicle for environmental audit. In the environmental act, environment is defined as 'the physical factors of the surroundings of the human beings', 'the biological factors of animals and plants and the social factors'. According to this definition, all EIAs are expected to carry out assessments embracing the ecological, social and socio-economic aspects of the environment. It is for this reason that the practice so far has been not to separate Environmental Impact Assessment from social or health impact assessment as is the case in other jurisdictions.

Following are related statutes, regulations and guidelines about EIA and water.

■ Statute
- Constitution of the Republic of Uganda, 1995
- The National Environmental Statute, 1995
- The Water Statute, 1995

■ Statutory Instrument、Regulations
- The National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations, 1999
- The Environmental Impact Assessment Regulations, 1998
- The National Environment (Waste Management) Regulations, 1998
- The National Environment (Waste Discharge) Regulations, 1998
- The Sewerage Regulations, 1999
- The Water Supply Regulations, 1999
- The National Environment (Designation of Environmental Inspector) Notice, 2001
- The National Environment (Conduct and Certification of Environment Practitioners) Regulation, 2003

■ Guideline and Guideline Note
- Guideline for Environmental Impact Assessment in Uganda, 1997
- Environmental Standards and Preliminary Environmental Impact Assessment for Water Quality and Discharge of Effluent into Water and Land in Uganda
- Operational Guidelines for Environmental Inspectors, 1999
- Environmental Audit Guidelines for Uganda,1999
- Environmental Inspection Report (Form)

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14.2 EIA Scheme

It will be implemented EIA for the facilities on this project master plan (phaseⅢ, conceptual design level) according to the Guideline for Environmental Impact Assessment in Uganda. EIA framework is shown in Figure 14-1. It consists of three stages as follows.

Stage-I : Screening
Stage-II : Environmental Impact Study
Stage-III : Decision Making

Stage-I (Screening)

Development of particular project (Guideline Annex 3) has to submit a project brief to the Authority (NEMA: The National Environment Management Authority) for screening. Therefore, Developer will as well to check up the project plan according to the checklist (Guideline Annex 4, 5), and if it necessary, review mitigation plan during the early stage of the project planning cycle. According to the checklist, the proposed action is checked on the subject of socio-economical, aesthetic, cultural, biological, physical environment, about each stages of project (site selection, construction and implementation). Phase-I is divided in 3steps. First step, the project is judged if it exempt from EIA. And next step it is judged if it's required mandatory EIA. In the third step, it is confirmed if it undertakes appropriate mitigation measures. If after screening it is determined that a detailed Environmental Impact Study (EI Study) is required, the developer shall then initiate the necessary steps to get the EI Study done (Phase-II).

Stage-II (Environment Impact Study)

The initial step in the EI Study is to determine the scope of works to be undertaken in assessing the likely environmental impacts of proposal project. Usually this includes meetings with relevant agencies and stakeholders to obtain their comments on what should be included in the study and what alternatives should be considered. The developer shall undertake to prepare a scooping report which summarizes the results of scooping, and which shall also constitute part of Terms of Reference for the study. The Terms of Reference shall be reviewed by the Authority, in consultation with the responsible Lead Agencies before an Environmental Impact Study is conducted. Based on the information from the scooping exercise as contained in the Terms of Reference, an Environmental Impact Study shall be conducted and Environmental Impact Statement (EIS) will be prepared. The developer shall submit ten copies of the EIS to the Authority.

Stage-III (Decision Making)

Either on the basis of a finding that a project is exempt, appropriate mitigation measures have been incorporated for identified potential environmental impacts, or disapproves the environmental aspects of proposal project. If approved, the developer will be licensed or permitted to implement the project in accordance with the mitigation measures stipulated in the

Environmental Impact Statement. If it is denied, the developer may, if such denial is based on environmental considerations that can further be improved, be urged to revise the proposed action to eliminate adverse impact.

During 1996 to 2003, over 950 projects have been subjected to EIA, out of which no less than 800 have been approved for implementation, while up-to 20 have not been approved. Table 14-2 shows the reasons of not approve. Most of reasons are problem of location.
Like this, EIA system in Uganda seems to be established itself.

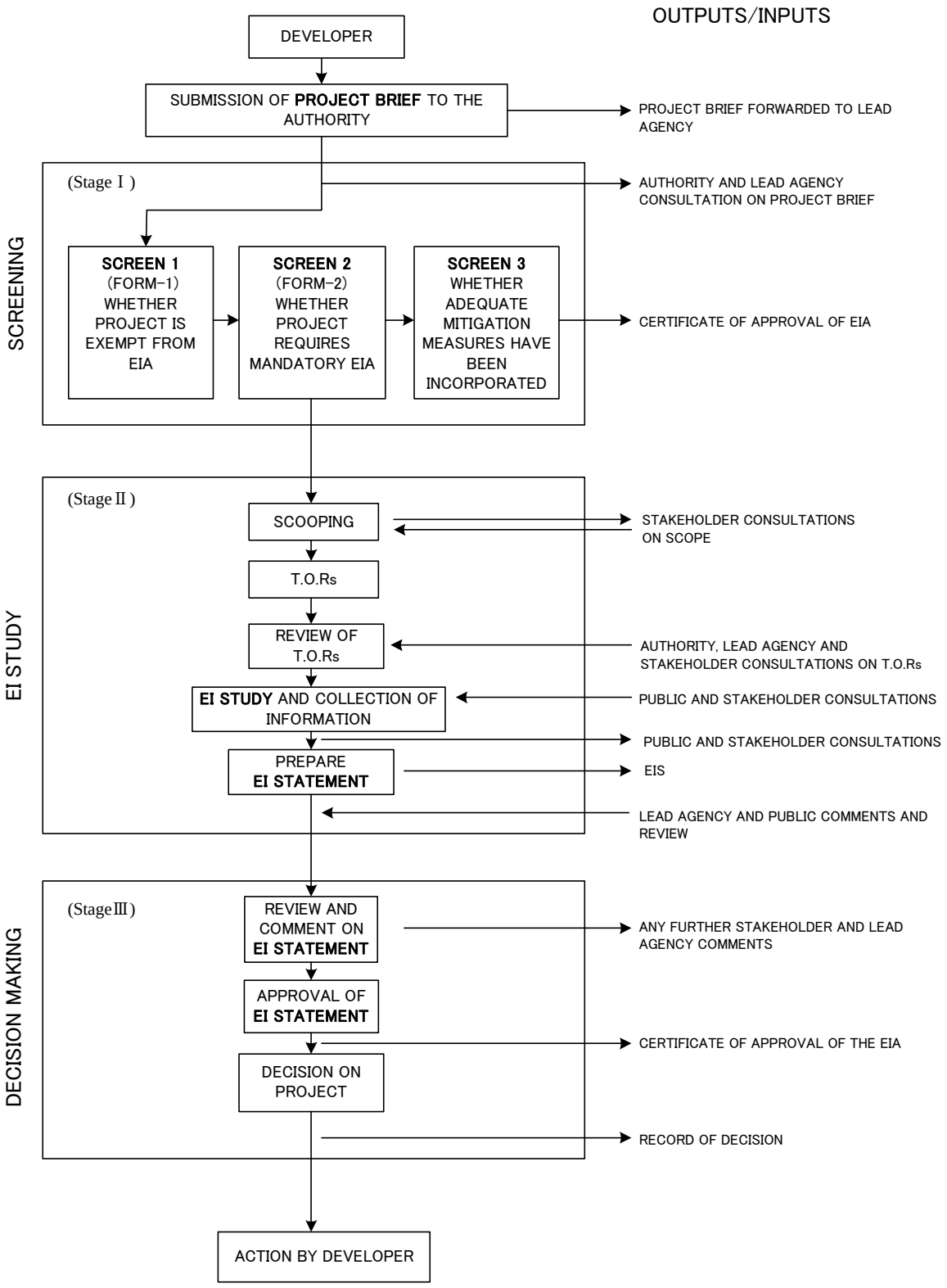


Figure 14-1 EIA Process Flow in Uganda

Table 14-1 Checklist in Guideline Annex.4

Will the proposed project adversely affect the following environmental parameters ?																	
Ticks as approprite	**Socio-economic**			**Aesthetic/Cultural**				**Biological**				**Physical**					
Stage of Project and Related Activity	Income	Employment	Displament	Landscape	Local Preferences	Gender	Cultural site	Plants	Animals	Human	Ecologically Sensitive Areas	Water	Land	Air	Noise	Other
1. Site selection and Preparation																
- Nature of Activity																
- Nature of Site																
- Alternative Activity																
- Alternative Sites																
- Other																
2. Site Preparation and Construction Phase																
- Site Clearing																
- Excavation																
- Access Roads																
- Movement of Equipment																
- Waste disposal																
- Reclamation																
- Other																
3. Implementation and operation Phase.																
- Occupation Health and Safety																
- Equipment operation																
- Energy requirements																
- Water requirement																
- Waste disposal																
- Spills and leaks																
- Pollution																
- Other e.g. Production																
4. Future and related Activites																
- Growth inducement																
- Popuration																
- Migration																
- Energy requirement																
Cumulative Impact																
- Other																

Guideline for Environmental Impact Assessment in Uganda (1997) 、Annex 4 Checklist for Environmental Impact Review

Table 14-2 List of projects not approved through the EIA Decision-making process

Annex 2: List of projects not approved through the EIA decision-making process

Project type	Reason for non approval
1. Proposed school in Bugolobi *	Location was in wetland
2. Proposed car show room in Seeta Kampala	Location was in wetland
3.Proposed use of herbicides for water hyacinth control in Lake Victoria	Due to risk factors and based on Precautionary principle as data available was not very conclusive for informed decision making
4. Proposed shopping complex at Kampala City square	Potential conflict with planning provisions of Kampala City
5. Proposed fish factory in Mwola Forest Reserve	Project was not compatible with Forest management requirements
6. Proposed warehouses in Kinawataka area, Kampala	Location potentially blocked a major drainage corridor for the Nakawa industrial area and flooding problem could be aggravated
7. Petroleum products installations at the shores of Lake Victoria, Bukakata and Kasensero (November 2002)	Project violated the Regulations on lakeshores and Riverbanks and no oil spill contingency plan was provided in case of major oil spill disaster. Risk factors were also taken into consideration.
8. Abattoir by Ssisa Sub-county in Kajansi	Project located in wetland and aeroplane flight path and aviation risks could result from bird hazards associated with abattoirs.
9. Proposed soap factory at Kigunga, Mukono	Factory was to discharge effluent into a stream which was being used as a source of water for a college a short distance downstream.
10. Proposed Golf course within Nakivubo wetland, Kampala	Project was not approved because of the importance of Nakivubo wetland in protecting the downstream lake Victoria from direct pollution loading from Kampala run-off.
11. Proposed Elephant center in Jubilee park Kampala	Project was stopped because it was to encroach on one of the few remaining gazetted green spaces in Kampala city.
12. Proposed car washing bay at Kansanga Kampala	Project stopped because it would introduce detergents into the water systems, which is being abstracted for domestic use by downstream communities.
13. Proposed school at Kansanga wetland Kampala	Location for the project was not suitable for the project due to regulations governing wetlands.
14.Proposd coffee factory within Nakivubo wetland	Project was not approved because of the importance of Nakivubo wetland in protecting the downstream lake Victoria

	from direct pollution loading from Kampala run-off
15. Proposed petrol station in Jinja taxi park	Project rejected because of inadequate space, encroachment into road reserve and due to opposition by local community
16. Proposed spices growing project in Natyonka Forest Reserve, Mukono District.	Project intended to grow spices through clearing of undergrowth in a natural tropical high forest and this was found to be detrimental to future regeneration of the forest as the undergrowth are the ones that eventually grow into the big forest trees and are also the basis of the rich forest biodiversity.
17. Proposal for breeding of tropical aquarium fish based on imported brood stock	The proposal violated fish regulations that prohibit importation of alien fish species.
18. Proposal for a car show room at Banda, Kampala	The location of the proposed site was below the regulated hydropower transmission way-leave for a 132 KV transmission line.
19.Proposal to collect and utilize municipal organic waste for fertilizer production	Project not approved because the developer could not prove that the source of waste would be from a location where waste segregation is practiced as municipal waste is largely un segregated.
20.Proposed landfill site for Kampala city off Entebbe road	Proposed site was in itself suitable but was very far and would make waste transportation un economical to the municipal authorities who are already constrained with heavy financial expenditure for waste transportation. KCC was advised to find alternative site.

* Project was for a serving Government Minister, who fortunately respected the decision taken based on preliminary EIA.

From : State of Environment Report for Uganda 2008,NEMA

14.3 EIA on the Project Basic Plan

The facility described in this Basic Plan is in a conceptual stage, and the size, location and the type of operation are not yet decided. Therefore, we have estimated environmental impacts according to the JICA guideline, instead of Uganda guideline. For reference, table 14-3 shows the result of compare with items of both guideline's Checklist. JICA guideline is including most of items of Uganda guideline.

Table 14-3 Compare with JICA Checklist to Uganda Checklist

	JICA Checklist	Uganda Checklist	Difference between two Guidelines
Pollution	Air Pollution	Air	
	Water Pollution	Water	
	Noise and Vibration	Noise	
	Soil Contamination	Land	
	Ground Subsidence		
	Offensive Odor	Not specified	Included in 'Other' on Uganda checklist
	Waste	Not specified	This Item is listed on impact factor on Uganda checklist
	Accident	Not specified	
Natural environment	Climate Change	Not specified	
	ecosystems, fauna and flora	Plants, Animals	'Human' is included in Uganda checklist
	Bottom Sediment	Not specified	
	Topography and Geographical Features	Not specified	Similar to 'Nature of site' in Uganda checklist?
	Ground Water	Not specified	Included in 'Water' on Uganda checklist (?)
	Soil Erosion	Not specified	Included in 'Land' on Uganda checklist (?)
	Hydrological Situation	Not specified	
	Costal Zone, Mangroves, Coral reefs, tidal flats, etc.	Not specified	Similar to 'Ecologically Sensitive Areas ' in Uganda checklist ?
	Meteorology	Not specified	
	Landscape	Landscape	
Social environment	Involuntary Resettlement	Displacement	
	Local economy such as employment and livelihood	Income, Employment	
	Land use and utilization of local resources	Not specified	
	Social institutions such as social infrastructure and local decision-making institutions	Not specified	
	Existing social infrastructures and services	Not specified	
	Vulnerable social groups such as poor and indigenous peoples	Not specified	Similar to 'Human' in Uganda checklist?
	Equality of benefits and losses and equality in the development process	Not specified	Similar to 'Local Preference' in Uganda checklist?
	Gender	Gender	
	Children's rights	Not specified	
	Cultural heritage	Cultural site	
	Local conflicts of interest	Not specified	
	Water Usage, Water Rights	Not specified	
	Infectious diseases such as HIV/AIDS	Not specified	
	Working conditions, occupational safety	Occupation Health and Safety	

14.3.1 Facilities and Project for Consideration of Environmental Impact

Consideration targets in this chapter are water supply facilities (level 2 class) which have been proposed in this basic plan, and other facilities and projects those are considered to be relatively large impact on the environment. Specifically, targets are reservoir for flood-control and anti-drought (Earth dam, valley Tank), and sewage treatment facilities for water conservation, and forestation project.

(1) Water Supply Facilities (Level 2 Class)

Water supply facilities (level 2 class), assuming up to about 5,000 persons, consist of wells and large water tank, water pomp to the water tank, water pipes (laying and construction), and the installation of water taps.

Photo 14-1 Water Tank (Soroti)

Photo 14-2 Water Pipe(Soroti)

(2) Reservoir (Pond, Valley Tank)

Valley tanks can inhibit flow of flood and mainly used as drinking water for livestock and irrigation. There are many of existing facilities in the basin. The size of those are not so large. Valley tank storage capacity is thousands m3 to several tens of thousands m3.

(3) Waste Water Treatment Facility

Typical sewage treatment facilities in Uganda are Oxidation Pond system. This system's removal rate is slightly, but the system is simple and its maintenance cost is low and suitable for organic pollution. Therefore this system prevails in many developing countries. In this report, processing method of sewage treatment facilities are assumed this system.

(4) Forestation

Forestation projects are taking place for recover of landslides and flood disaster. And recover deforestation areas, too.

Forestation improves water holding capacity in the basin, and perform the flood peak discharge.

Improved water holding capacity will lead to increase the base flow discharge. It also measures for drought. In addition, forestation will lead to reduce the turbidity by prevent the erosion during rainfall period.

14.3.2 Scoping Evaluation Results

Four kinds of project which described in Basic Plan, we considered and evaluate the effect about social environment, natural environment and pollution. The results of scoping evaluation are as follows.

(1) Water supply facilities

1) Living environment (pollution)

Some impacts are expected in construction periods, such as air pollution, noise, vibration and water quality (turbidity) by construction machines. But the facility level is small (class 2 level), and the construction scale is small, construction time is short. Therefore, the effect for living environment will be not serious.

During operation period, air pollution and some noise are expected by pumps. But the effect will be little because the pump is located inside the pump house.

2) Natural environment

Some impacts are expected on flora at the location site and groundwater around the site. But the size of facility is small, the effect will be little.

3) Social environment

Safe and stable water supply will reduce the work of women and children. They are carrying domestic water every day. And also, it's expected to contribute to disease prevention.

But it cause to result in difference between benefited peoples and non benefited peoples. It is need to consultation before decide the plan.

(2) Water storage facilities: Valley tank, Pond

1) Living environment (pollution)

Some impacts are expected in construction periods, such as noise, vibration and water quality (turbidity) by construction machines. But the facility level is small , so the impacts will be not serious.

2) Natural environment

It is necessary to consider about effects which are expected on flora and fauna at the submerged area.

3) Social environment

It is necessary to consider whether there is a cultural heritage at the location.

(3) Waste water treatment facilities: Oxidation pond

1) Living environment (pollution)

Some impacts are expected in construction periods, such as noise, vibration and water quality (turbidity) caused by construction machines. During the operation period, it is expected to reduce a disease through improving a water quality at the downstream. But it is necessary to concern about how to deal with increase of infection disease by expand a habitat of insect pest and how to dispose the sludge deposits in the facility. If sludge is used as fertilizer, it is good for local farmers.

2) Natural environment

Improvements on the ecosystem in the downstream areas are expected.

3) Social environment

This facility is necessary for sustainable development. It is necessary to improve river water quality to reduce a disease for the peoples who are using open waters at the downstream. When selecting candidate site, it is necessary to concern about presence of cultural heritage and the needs of resettlement.

(4) Forestation

1) Living environment (pollution)

In Uganda, it is not usual to use heavy machine for forestations, so the pollutions caused by machines are not expected. The vegetation cover will prevent soil erosion, and river runoff will be stabilized through ground seepage.

2) Natural environment

It is expected to increase biodiversity by planting native vegetation, and trees absorb greenhouse gases.

3) Social environment

It is expected to create new jobs through plantation and its maintenance. Forest provides a fuel for vulnerable social groups such as poor peoples.

On the other hand, if those areas are already used for residence or farmland, it is need to prepare alternative site or employ to forestation project for guarantee their life.

Table 14-4 Result of Scoping (Water Supply Facilities: Level 2 Class)

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
Pollution	1	Air Pollution	－	C-	C-	Some impacts are expected from construction machines, and pumps, but very slight
	2	Water Pollution	－	C-	－	Some turbidity is expected during construction and drilling
	3	Noise and Vibration	－	C-	－	Some noise and vibration are expected during construction
	4	Soil Contamination	－	－	－	No impact is expected
	5	Ground Subsidence	－	－	C-	Slight impacts are expected by pump up ground water（In this case, almost no impact）
	6	Offensive Odor	－	－	－	No impact is expected
	7	Waste	－	C-	－	It is necessary to proper disposal of waste soil excavated during construction
	8	Accident	－	－	－	No impact is expected
Natural environment	9	Climate Change	－	－	－	No impact is expected
	10	ecosystems, fauna and flora	－	C-	C-	Depends on location, some impact to fauna and flora are expected（if there are rare species）
	11	Bottom Sediment	－	－	－	No impact is expected
	12	Topography and Geographical Features	－	－	－	No impact is expected
	13	Ground Water	－	－	C-	Some impact to the wells around the site is expected by groundwater pumping
	14	Soil Erosion	－	－	－	No impact is expected
	15	Hydrological Situation	－	－	－	No impact is expected
	16	Costal Zone, Mangroves, Coral reefs, tidal flats, etc.	－	－	－	There is no appropriate place
	17	Meteorology	－	－	－	No impact is expected
	18	Landscape	－	C-	C-	Some impact is expected by elevated supply tank
Social environment	19	Involuntary Resettlement	－	C-	－	Depends on location, some impact is expected
	20	Local economy such as employment and livelihood	－	C+	C+	Although the amount is small, new jobs are expected for facility construction and management in operation
	21	Land use and utilization of local resources	－	－	C+	Upgrade of land use by improve the convenience
	22	Social institutions such as social infrastructure and local decision-making institutions	－	－	－	It is difficult to assume about the impact of existence or using the facility
	23	Existing social infrastructures and services	－	－	B+	Improve of social service by basic infrastructures
	24	Vulnerable social groups such as poor and indigenous peoples	－	－	B+	It is expected to be contribute to disease prevention by supplying safe water
	25	Equality of benefits and losses and equality in the development process	－	－	C+/-	It's expected to cause a result in difference between benefited people and non benefited people
	26	Gender	－	－	B+	It's expected to lightening a daily work of water carrying by housewives
	27	Children's rights	－	－	B+	It's expected to lightening a daily work of water carrying by children
	28	Cultural heritage	－	C-	－	Depends on location, some impact is expected
	29	Local conflicts of interest	－	－	C-	It's expected to cause a result in difference between benefited area and non benefited area
	30	Water Usage, Water Rights	－	－	B+	Safe water become available

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
	31	Infectious diseases such as HIV/AIDS	－	－	B＋	It's expected to be contribute to disease prevention by supplying safe water
	32	working conditions, occupational safety	－	－	－	No impact is expected

A+/−: Significant positive/negative impact is expected.
B+/−: Positive/negative impact is expected to some extent.
C+/−: Extent of positive/negative impact is slight or unknown.
(A further examination is needed, and the impact could be clarified as the study progresses)
"−": No impact is expected.
*1 D: Design Stage, C: Construction Stage, O: Operation Stage

Table 14-5 Result of Scoping (water storage facility)

＜valley tank＞

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
Pollution	1	Air Pollution	－	C-	－	Some impacts are expected on air pollution by road construction and work of construction machines
	2	Water Pollution	－	C-	B-	Some impacts are expected on water pollution by turbidity in construction and deposition of wastes
	3	Noise and Vibration	－	C-	－	Some impacts are expected by work of construction machines
	4	Soil Contamination	－	－	－	No impact is expected
	5	Ground Subsidence	－	－	－	No impact is expected
	6	Offensive Odor	－	－	－	No impact is expected
	7	Waste	－	C-	C-	It's necessary to proper disposal of waste soil excavated during construction
	8	Accident	－	－	－	No impact is expected
Natural environment	9	Climate Change	－	－	－	No impact is expected
	10	ecosystems, fauna and flora	－	C-	B+/-	It's expected to expand a habitat for fishes and to destruct a habitat for existing flora. It's necessary to survey the rare species
	11	Bottom Sediment	－	－	B-	It's expected to deposition of sludge and soil
	12	Topography and Geographical Features	－	C	C	There is a possibility of impact on topography, but at present the extent of impact is unknown
	13	Ground Water	－	－	－	No impact is expected
	14	Soil Erosion	－	－	－	No impact is expected
	15	Hydrological Situation	－	－	C+/-	There is a possibility of impact on topography, but at present the extent of impact is unknown
	16	Costal Zone, Mangroves, Coral reefs, tidal flats, etc.	－	－	－	There is no appropriate place
	17	Meteorology	－	－	－	No impact is expected
	18	Landscape	－	C +/-	C+/-	There is a possibility of impact on topography, but at present the extent of impact is unknown
Social environment	19	Involuntary Resettlement	－	C-	－	Depends on location, some impacts are expected
	20	Local economy such as employment and livelihood	－	C+	C+	Although the amount is small, new jobs are expected for facility construction and management in operation
	21	Land use and utilization of local resources	－	－	－	No impact is expected
	22	Social institutions such as social infrastructure and local decision-making institutions	－	－	－	No impact is expected
	23	Existing social infrastructures and services	－	－	B+	Improve of social service by basic infrastructures
	24	Vulnerable social groups such as poor and indigenous peoples	－	－	B+	It's expected to be contribute a disease prevention by supplying safe water for poverty groups. And also to manage a floods
	25	Equality of benefits and losses and equality in the development process	－	－	C+/-	It's expected to cause a result in difference between benefited people and non benefited people
	26	Gender	－	－	B+	It's expected to lightening a daily work of water carrying by housewives
	27	Children's rights	－	－	B+	It's expected to lightening a daily work of water carrying by children
	28	Cultural heritage	－	C-	C-	Depends on location, some impact is expected

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
	29	Local conflicts of interest	－	－	C-	It's expected to cause a result in difference between benefited area and non benefited area
	30	Water Usage, Water Rights	－	－	B+	Safe water become available
	31	Infectious diseases such as HIV/AIDS	－	－	C-	There is a possibility to increase infection disease by expand a habitat of insect pest
	32	Working conditions, occupational safety	－	－	－	No impact is expected

A+/−: Significant positive/negative impact is expected.
B+/−: Positive/negative impact is expected to some extent.
C+/−: Extent of positive/negative impact is slight or unknown.
(A further examination is needed, and the impact could be clarified as the study progresses)
"−": No impact is expected.
*1 D: Design Stage, C: Construction Stage, O: Operation Stage

Table 14-6 Result of Scoping (West water treatment facility)

＜Oxidation pond＞

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
Pollution	1	Air Pollution	－	C-	－	Some impacts are expected on air pollution by works of construction machines
	2	Water Pollution	－	－	B+/-	It's expected to improve water quality, but sometimes, untreated water will overflow during floods
	3	Noise and Vibration	－	C-	－	Some impacts are expected by work of construction machines
	4	Soil Contamination	－	－	－	No impact is expected
	5	Ground Subsidence	－	－	－	No impact is expected
	6	Offensive Odor	－	－	B-	On the treating process, it's expected to be cause of foul odor.
	7	Waste	－	C-	B+/-	It's necessary to proper disposal of waste soil excavated during construction. And need to proper disposal of sludge of deposited (fertilizer for example)
	8	Accident	－	－	－	No impact is expected
Natural environment	9	Climate Change	－	－	－	No impact is expected
	10	ecosystems, fauna and flora	－	C-	C-	Depends on location, some impact to fauna and flora are expected（It's necessary to survey the rare species）
	11	Bottom Sediment	－	－	B+	It's expected to improve river water and bottom sediment
	12	Topography and Geographical Features	－	－	－	No impact is expected
	13	Ground Water	－	－	－	No impact is expected
	14	Soil Erosion	－	－	－	No impact is expected
	15	Hydrological Situation	－	－	－	No impact is expected
	16	Coastal Zone, Mangroves, Coral reefs, tidal flats, etc.	－	－	－	There is no appropriate place
	17	Meteorology	－	－	－	No impact is expected
	18	Landscape	－	－	－	No impact is expected
Social environment	19	Involuntary Resettlement	－	C-	－	Depends on location, some impacts are expected
	20	Local economy such as employment and livelihood	－	C+	C+	Though the amount is small, new employments are expected for facility construction and management in operation
	21	Land use and utilization of local resources	－	－	C+	Improvement of water quality in down stream
	22	Social institutions such as social infrastructure and local decision-making institutions	－	－	C+	Connect to water treatment facility, and maintain a maintenance organization
	23	Existing social infrastructures and services	－	－	B+	Improve of social service by basic infrastructures
	24	Vulnerable social groups such as poor and indigenous peoples	－	－	C+	It's expected to be contribute disease prevention by supplying better water for poverty groups.
	25	Equality of benefits and losses and equality in the development process	－	－	C+/-	There is a different from beneficiaries(improved water quality) and people who use the facility.
	26	Gender	－	－	－	No impact is expected
	27	Children's rights	－	－	－	No impact is expected

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
	28	Cultural heritage	－	C-	－	Depends on location, some impact is expected
	29	Local conflicts of interest	－	－	C-	It's expected to cause a result in difference between benefited area and non benefited area
	30	Water Usage, Water Rights	－	－	B+	Better water will available in downsriver
	31	Infectious diseases such as HIV/AIDS	－	－	C-	There is a possibility to increase infection disease by expand a habitat of insect pest
	32	working conditions, occupational safety	－	－	－	No impact is expected

A+/－: Significant positive/negative impact is expected.
B+/－: Positive/negative impact is expected to some extent.
C+/－: Extent of positive/negative impact is slight or unknown.
(A further examination is needed, and the impact could be clarified as the study progresses)
"－": No impact is expected.
*1 D: Design Stage, C: Construction Stage, O: Operation Stage

Table 14-7 Result of Scoping (Forestation)

＜Forestation＞

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
Pollution	1	Air Pollution	－	C-	C+	Some impacts are expected on air pollution by works of construction machines. Reforestation contributes air quality improvement.
	2	Water Pollution	－	－	C+	It's expected to reduce turbidity
	3	Noise and Vibration	－	－	－	No impact is expected
	4	Soil Contamination	－	－	－	No impact is expected
	5	Ground Subsidence	－	－	－	No impact is expected
	6	Offensive Odor	－	－	－	No impact is expected
	7	Waste	－	－	－	No impact is expected
	8	Accident	－	－	－	No impact is expected
Natural environment	9	Climate Change	－	－	C+	It's expected to absorb greenhouse gas by plantation
	10	ecosystems, fauna and flora	－	－	B+/-	Depending to plantation species, it is expected to increase bio-diversity. Native vegetation is better. If not, fauna will be simpler.
	11	Bottom Sediment	－	－	－	No impact is expected
	12	Topography and Geographical Features	－	－	－	No impact is expected
	13	Ground Water	－	－	C+	It's expected to recharge groundwater
	14	Soil Erosion	－	－	B+	It's expected to prevent soil erosion by vegetation cover
	15	Hydrological Situation	－	－	C+	It's expected to stabilize river runoff by underground seepage
	16	Coastal Zone, Mangroves, Coral reefs, tidal flats, etc.	－	－	－	There is no appropriate place
	17	Meteorology	－	－	－	No impact is expected
	18	Landscape	－	－	C+	It's expected to improve landscape by trees
Social environment	19	Involuntary Resettlement	－	C-	－	Depends on location, some impacts are expected (Planed site is already used as residence or farmland)
	20	Local economy such as employment and livelihood	－	C+	B+	New jobs are expected for plantation and its maintenance
	21	Land use and utilization of local resources	－	－	B+	It's expected to restrict the land use by trees. And also expected to increase the forest resources
	22	Social institutions such as social infrastructure and local decision-making institutions	－	C+	C+	Social institution will be organized for plantation and its maintenance
	23	Existing social infrastructures and services	－	－	－	No impact is expected
	24	Vulnerable social groups such as poor and indigenous peoples	－	－	B+	Forest provides a fuel for Vulnerable social groups such as poor peoples
	25	Equality of benefits and losses and equality in the development process	－	－	C+/-	It's expected to cause a gap between people who are improved convenience and not be improved
	26	Gender	－	－	－	No impact is expected
	27	Children's rights	－	－	－	No impact is expected
	28	Cultural heritage	－	C-	－	Depends on location, some impact is expected
	29	Local conflicts of interest	－	－	C-	It's expected to cause a result in difference

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
						between benefited area and non benefited area
	30	Water Usage, Water Rights	－	－	－	No impact is expected
	31	Infectious diseases such as HIV/AIDS	－	－	－	No impact is expected
	32	working conditions, occupational safety	－	－	－	No impact is expected

A+/－: Significant positive/negative impact is expected.
B+/－: Positive/negative impact is expected to some extent.
C+/－: Extent of positive/negative impact is slight or unknown.
(A further examination is needed, and the impact could be clarified as the study progresses)
"－": No impact is expected.
*1 D: Design Stage, C: Construction Stage, O: Operation Stage

CHAPTER 15 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, Table 15-1 arranged from the latest version of NDP: National Development Plan (April 2010) points out many constrains and challenges in the sectors which are strongly related to water resources development and management, and implies that 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.

15.1 Approaches to IWRM

An introduction of IWRM to Uganda was started from "Water Action Plan (1995)" supported by DANIDA as shown in a short history of Uganda's water resources management (refer to Table 15-2) and 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 in Phase-I and II is 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.

Table 15-1 Constraints to the Performance of 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
	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
	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 15-2 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)	
	Lake Victoria Environment Management Project (LVEMP)	* The Water Supply Regulations (1998)	
		* The Sewerage Regulations (1998)	
		* The Water Supply Regulations (1998)	
1999		* 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			

15.2 Major Issues for 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.
- Uncertain water balance between demand and supply.
- Plateaued 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

15.3 Basic Course for the Basic Plan

The Basic Plan is 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 base on the study results through the Phase-I and II.

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（[1]53,685km^2）.
- Related Districts: 38 Districts (August 2009).
- Target Population: Approximately 9.32 million in 2008.
- The Basin is subdivided into 11 sub-basins as basic unit for the Basic Plan. (Figure 15-1)
- 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 14.5.3)
- In general, self-contained water supply in each sub-basin will be planned without interbasin diversion because of effectiveness and economic efficiency.

[1] except for Kenyan side from total area 57,667km^2

- 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 (International Panel of 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.

There are four major items in the Basic Plan as shown in Table 15-3, 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 15-3 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

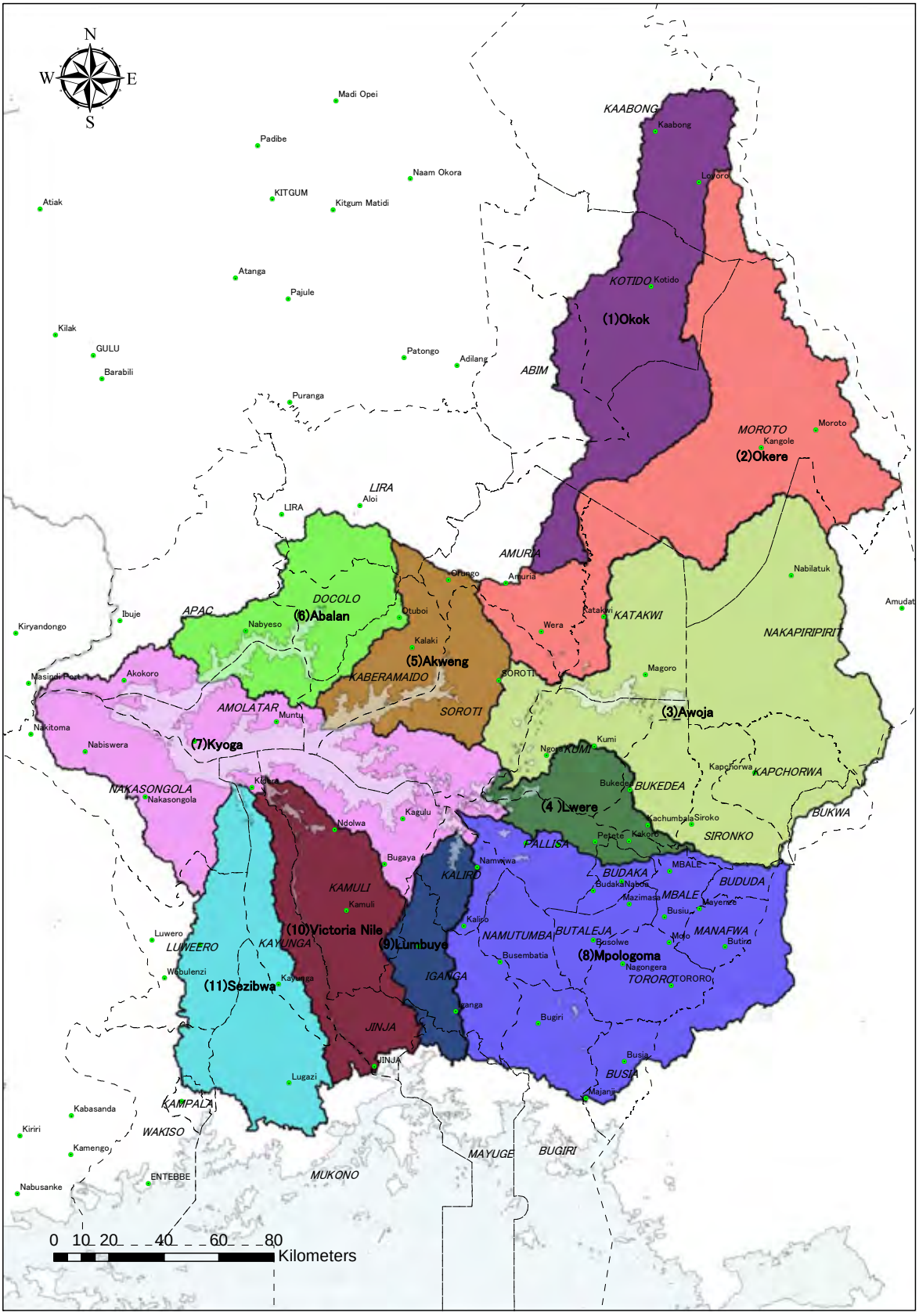


Figure 15-1 Distribution of Sub-basins and Related Districts

15.4 Basin Plan on Water Resources Development and Management

15.4.1 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

JICA Study Team has endeavored to assess more accurate water resources potential of surface and groundwater than ever before, and set the assessment results as the starting point of the basic plan. 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.

i) Surface Water Monitoring Plan (River and Lake)

a) Basic Policy

- Data accumulation is one of fundamental elements for understanding hydrological phenomenon, especially surface water potential. Therefore operating gauging stations should be expected to continue their observation.
- Unsuitable gauging stations due to technical problems such as backwater should be terminated their observations. （See Table 1-3 in Chapter 1 in the supporting report, the proposed future situations of existing gauging stations are described in the Table.
- Placement of gauging stations with consideration of topography:
  Many of existing gauging stations are located at upper reaches of rivers due to easiness of observation. This distribution is not suitable for understanding water resources potential so that 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. That is to say, gauging stations should be distributed at upper and lower points of major water intakes.
- Improvement of observation method:
  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:
  Frequency of maintenance of gauging station should be determine as fund permits and its degree of importance for water resources management in Lake Kyoga Basin.

b) Surface Water Monitoring Plan

- Number of gauging stations and the locations

  Guideline numbers of river discharge and lake water level gauging stations are shown in Table 15-4 and 15-5 for each sub-basin under the basic policy above mentioned.. And their locations are roughly shown in Figure 15-2. Installation of new gauging stations are proposed when there are shortage of stations from the point of view of knowing influence of geomorphology for river discharges and large water usage in rivers. However, it is necessary for determination of each location to conduct detail study and site survey.

- Data Processing

  DWRM has been implementing data processing of observed river discharge and lake water level by them. However, it sometimes caused delay of data processing. 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.

Table15-4 River Discharge Monitoring Plan

No.	Sub-basin	Land Area (km^2)	No. of River Gauging Stations						
			Present Condition		Future Condition				
			Total	Operating	New	Existing	Rehabili-tation	Displace-ment	Total
1	Okok	7,036	0	0	1	0	0	0	1
2	Okere	6,645	1	0	2	0	0	0	2
3	Awoja	11,037	12	6	1	3	1	0	5
4	Lwere	1,501	0	0	1	0	0	0	1
5	Akweng	2,443	3	0	0	0	1	0	1
6	Abalang	2,912	1	1	1	0	0	0	1
7	Kyoga Lakeside Zone	5,654	0	0	1	0	0	0	1
8	Mpologoma	8,969	7	4	2	2	2	0	6
9	Lumbuye	1,394	0	0	1	0	0	0	1
10	Victoria Nile	3,427	2	1	0	1	0	0	1
11	Sezibwa	4,227	1	1	1	0	0	1	2
Total		55,245.	27	13	11	6	4	1	22

Table 15-5 Lake Water Level Monitoring Plan

No.	Sub-basin	Lake	No. of Lake Gauging Stations					
			Existing Conditions		Future Conditions			
			Total	Operating	New	Existing	Rehabilita-tion	Total
1	Okok	-	-	-	-	-	-	-
2	Okere	-	-	-	-	-	-	-
3	Awoja	Bisina, Opeta	2	0	0	0	2	2
4	Lwere	Small lakes	1	0	0	0	0	0
5	Akweng	Kyoga	2	1	0	1	0	1
6	Abalang	Kyoga	1	0	0	0	1	1
7	Kyoga Lakeside Zone	Kyoga	2	0	1	0	1	2
8	Mpologoma	-	-	-	-	-	-	-
9	Lumbuye	-	-	-	-	-	-	-
10	Victoria Nile	-	-	-	-	-	-	-
11	Sezibwa	-	-	-	-	-	-	-
Total		-	8	1	1	1	4	6

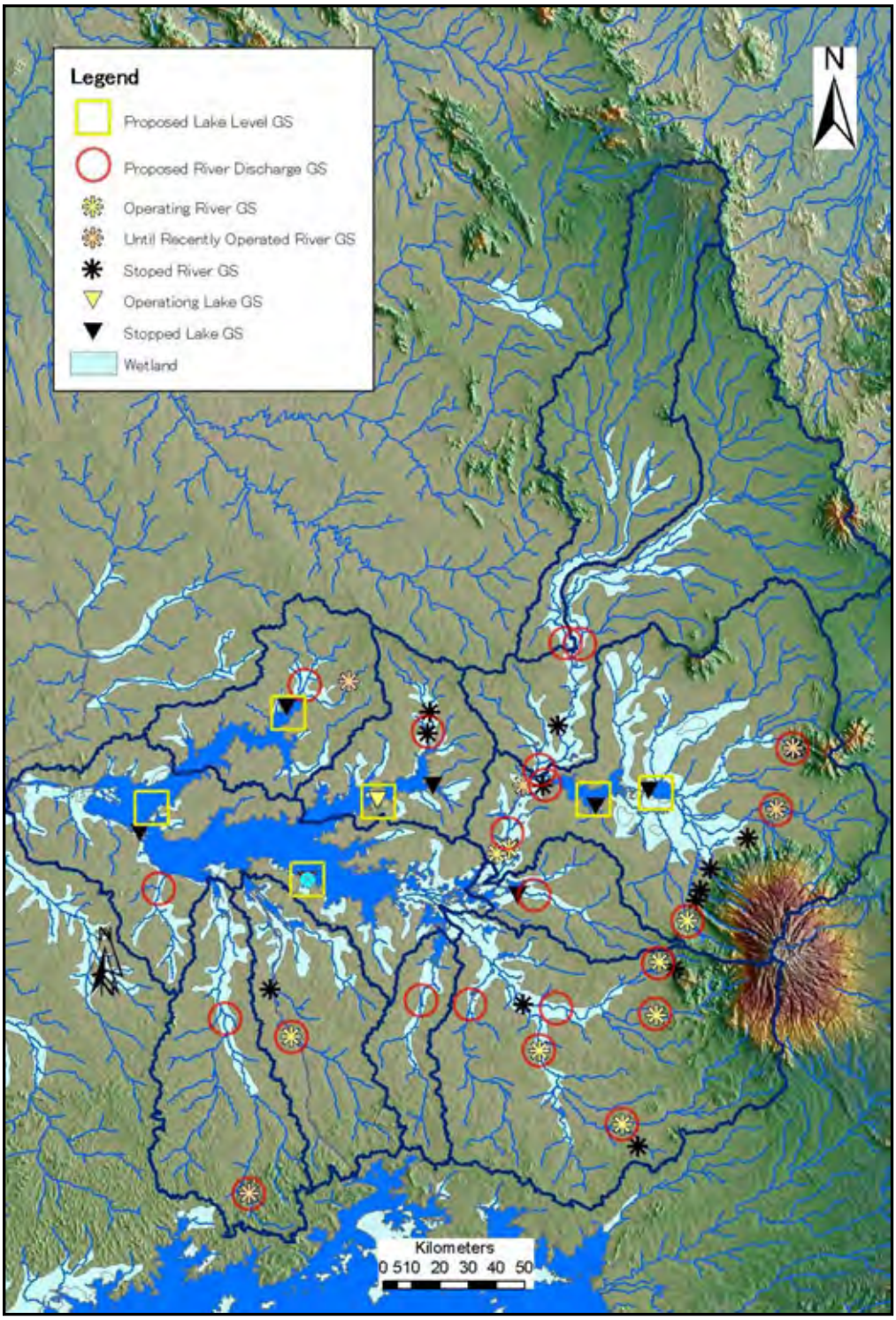


Figure 15-2 Surface Water Monitoring Plan

ii） Groundwater Monitoring Plan

Groundwater monitoring facilities are working only three in the Basin at present. To grasp the quantity and quality of groundwater, its monitoring is very important for groundwater development and management.

a) 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. (refer to 15.4.4(3))
- 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.

b) Groundwater Monitoring Plan

- Number of Stations and General Locations
- According to the above basic policy, the number of monitoring stations in each sub-basin and their general locations are planned in Table 15-6 and Figure 15-3. Total 35 stations: 16 new, 1 rehabilitated 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

Table 15-6 Groundwater Monitoring Wells

Sub-basin	Location	Classifi -cation	Note	Counting			
				New	Rehabilita -tion	Existing/ Transfer	Total
(1) Okok	Kaabong	N	Uppermost-stream of sub-basin	2	0	0	**2**
	Kotido	N	Middle-stream of sub-basin				
(2) Okere	Amuria	N	Near boundary of Lake Kyoga Basin, Middle-stream of sub-basin	1	1	0	**2**
	Moroto	R	Uppermost-stream of sub-basin				
(3) Awoja	Katakwi	N	Near boundary between (2) and (3), middle-stream of sub-basin	2	0	0	**2**
	Sironko	N	Up-stream of sub-basin				
(4) Akweng	Kaberamaido	N	Near boundary between (4) and (5)	1	0	1	**2**
	Soroti	E	ditto				
(5) Abalan	Agwata	N	Middle-stream of sub-basin	2	0	0	**2**
	Dokolo	N	ditto				
(6) Lwere	Kameke (JTB-11)	T	JICA test well	1	0	2	**3**
	Kameke (JTB-12)	T	ditto				
	Kumi	N	Near boundary between (3) and (6)				
(7) Kyoga Lakeside	Kidetok (JTB-17)	T	JICA test well	2	0	3	**5**
	Kidetok (JTB-18)	T	ditto				
	Kidetok (JTB-19)	T	ditto				
	Amolatar	N	Down-stream of sub-basin				
	Nakasongola	N	Up-stream of sub-basin				
(8) Mpologoma	Kibale (JTB-9)	T	JICA test well	1	0	6	**7**
	Kadama (JTB-13)	T	ditto				
	Kadama (JTB-14)	T	ditto				
	Kabweri (JTB-15)	T	ditto				
	Kabweri (JTB-16)	T	ditto				
	Busia	N	-				
	Pallisa	E	-				
(9) Lumbuye	Ikumbya (JTB-3)	T	JICA test well	1	0	3	**4**
	Ikumbya (JTB-4)	T	ditto				
	Naigobya (JTB-6)	T	ditto				
	Mayuge	N	Uppermost-stream of sub-basin				
(10) Victoria Nile	Lambala (JTB-7)	T	JICA test well	2	0	2	**4**
	Lambala (JTB-8)	T	ditto				
	Jinja	N	Near boundary of Lake Kyoga Basin, uppermost -stream of sub-basin				
	Kamuli	N	Middle-stream of sub-basin				
(11) Sezibwa	Kayunga	N	Middle-stream of sub-basin	1	0	1	**2**
	Mukono	E	Uppermost-stream of sub-basin				
N: New, R:Rhabilitation, T:Transfer, E: Existing				**16**	**1**	**18**	**35**

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.

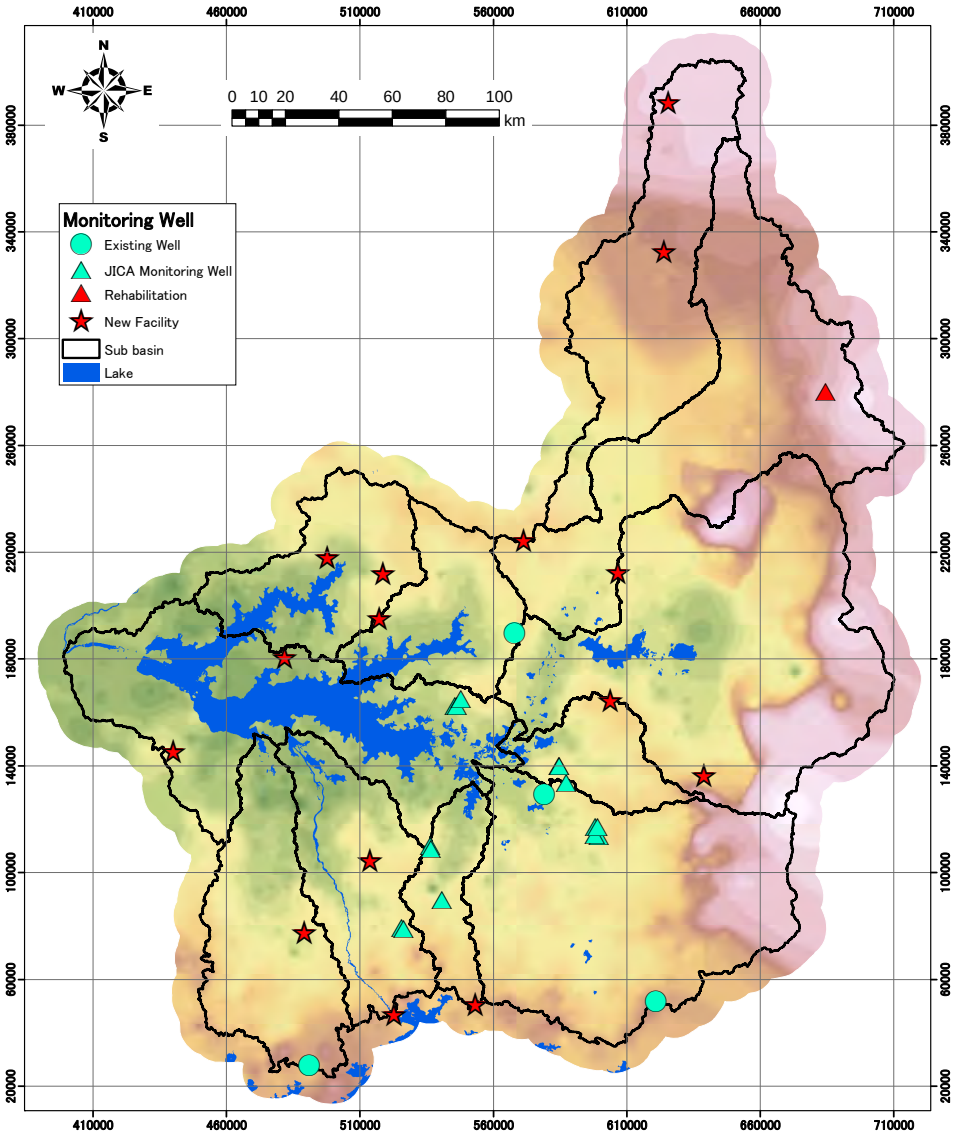


Figure 15-3 Proposed Groundwater Monitoring Location

iii) 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.

a) 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.

b) Rainfall Monitoring Plan

- Number of gauging stations and the locations

  Guideline numbers of rainfall monitoring stations are shown in Table 6-7 for each sub-basin. And their locations are roughly shown in Figure 15-4. As a result, the number of monitoring stations will be totally 62, and the breakout are 48 in Lka Kyoga Basin and 14 around the basin.

Table15-7 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**

- Data Processing

  Observation and data processing system should be realized in each district water office, and data collection and database system among DWD, IWRM 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.

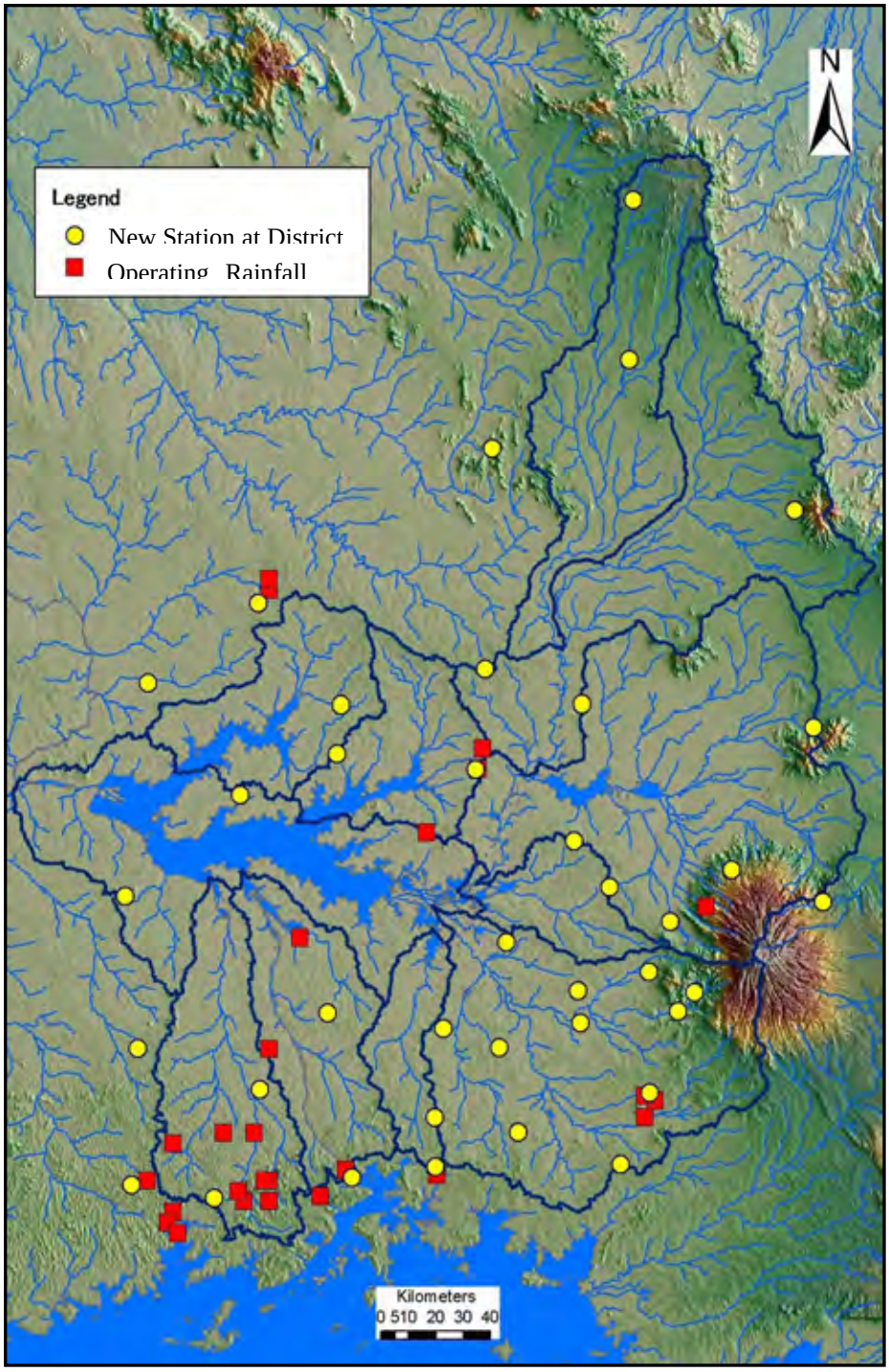


Figure 15-4 Rainfall Monitoring Plan

(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 as shown in Figure 8-1 is needed. 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 15-5. 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.

A. Typical Concept for IWRM as Catchment-wise Management

Major Eight River Basins

Merit:
(i) Water resources can be naturally or scientifically manageable.
(ii) Transboundary issues can be treated domestically and internationally.

Demerit:
(i) Statistical data made up administrative boundary-wise must be allocated basin-wise.
(ii)Water resources development plan formulated basin-wise may be re-arranged to administrative unit.

B. Administrative & Catchment Boundary-wise Concept

Four Water Resources Management Zones (WMZ)

Merit:
(i) It's easy to collect and make up statistic data for water resources development plan.
(ii) Social conditions can be more reflected to the plan.

Demerit
(i) It is difficult to evaluate water resources potential.
(ii) Transboundary issues are sat aside.

Figure 15-5 Two Concepts for Water Resources Development and Management

(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.

i) Amount of Water Usage

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 will collect data with assistance from Sub-basin Liaison Council and send them to DWRM.（refer to 15.4.5）

(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.

15.4.2 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 15-23)

(2) Control of Water Demand

The present water demand of 435.7MCM in 2008 grows up to 8441MCM in 2035 in the Lake Kyoga basin according to the demand estimation, and in some sub-basin the demand may exceed its potential water resource. 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.

i) Effective Water Use

It is desirable to utilize all of the water taken from the source without any losses, but the water volume utilized and applied is less than that taken from the source due to losses and leakage during transmission. The following measures are required to be taken as the provision against future increase of water demand in order to improve the effectiveness of water application for the sustainable utilization.

- 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.

ii) 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 balance 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.

iii) 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 medias 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 UXG/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 rise the tariff rates in order to improve the awareness of users on saving water.

(3) Water Supply Facility Plan

The facility plan for the rural water supply is discussed below based on the demand forecasting of SIP presented in Chapter 12 of this report.

i) Drinking Water Supply

a) Urban Water Supply

<u>Water Supply System for Large Towns and Peri-urban Areas</u>

The Soroti, Lira, Iganga, Mbale, Tororo, Jinja and Lugazi towans have the urban water supply systems managed by NWSC in the Lake Kyoga basin. Out of these towns, four (4) systems of i) Soroti town in the Awoja sub-basin, ii) Lira town in the Abalan sub-basin, iii) Mbale town in the Mpologoma sub-basin, and iv) Lira town in the Abalan sub -basin do not take the water of the Lake Victoria.

Only a part of the area served by the system of Lira is located in the Lake Kyoga basin, and most of the part is out of the basin. The water source of the Lira system is taken from the Lake

Kwania which is situated north of the Lake Kyoga, and the water lifted and treated at the water work beside the lake is transmitted with the transmission pipeline of about 45km to the service area of Lira. Since it uses the water of the Abalan sub-basin where the Lake Kwania is situated, it is considered as one of the facilities in the Lake Kyoga basin in the study.

As shown in Figure 15-6, 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.

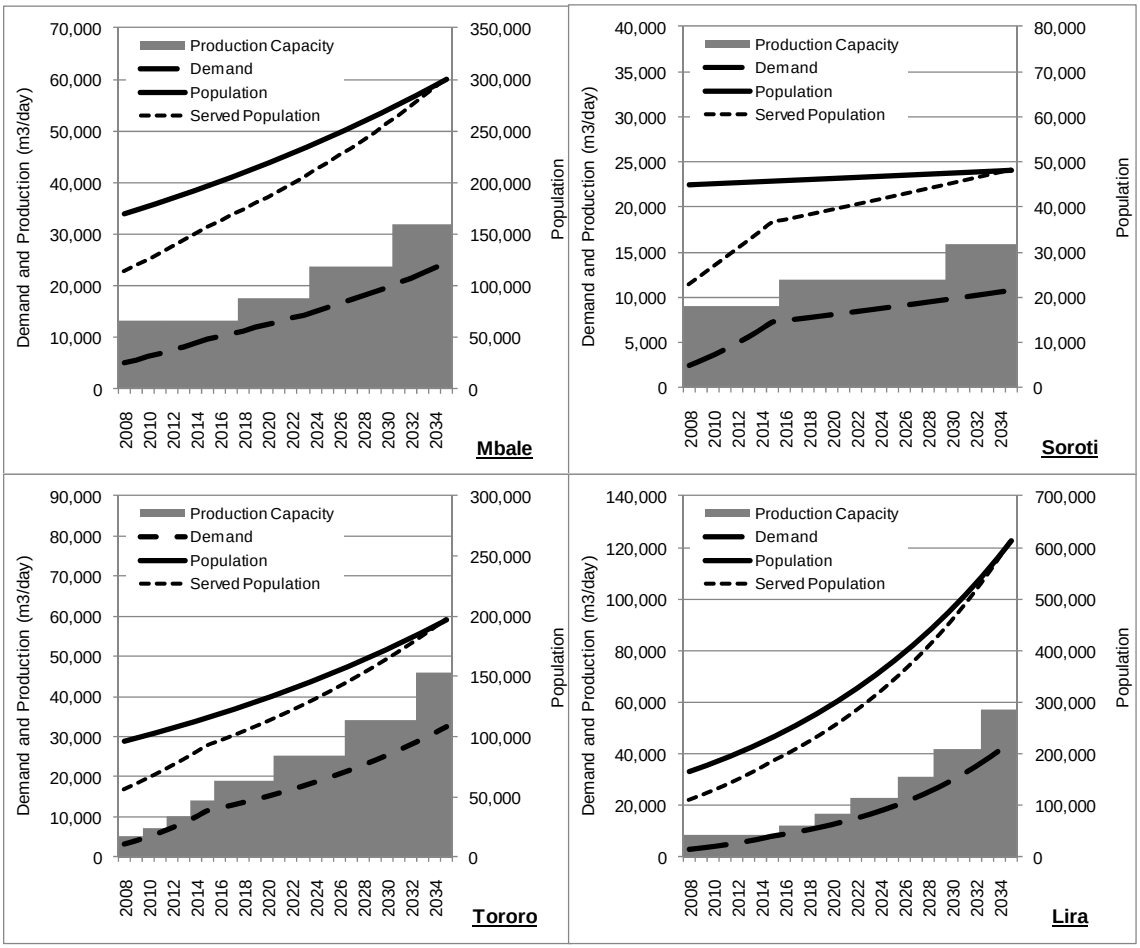


Figure 15-6 Expansion Plan of Urban Water Supply System for Large Towns and Peri-urban Areas (NWSC)

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 15-7. 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 15-8.

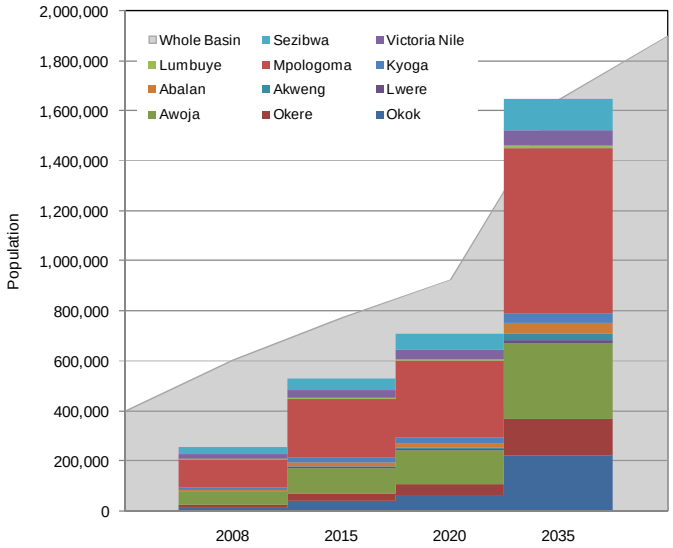


Figure 15-7 Population Served by Water Supply System for Small Towns by Sub-basin

Table 15-8 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%

b) 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.

- 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 present (2008) and the future (2035) technology mixes are summarized for the regions and the country in Table 15-9. Springs and shallow wells are not considered less reliable even if any protection is provided, and then the technology mix of these facilities are planned to be decreased from the present 27% and 25% to 2% and 11% for springs and shallow wells, respectively, though their construction will be continued in the future.

Table 15-9 Present and Future Technology Mix of SIP

Regions	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks
Mix Existing Technology Mix						
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

Since the rural population is still increased in the future, and population will concentrated into trading centers and commercial centers, they put the emphasis on the piped water system and the gravity flow scheme which are considered as those enabling effective water supply. The piped water system shares only 2% at present and it will be increase to 43% in the facilities to be constructed in the future. Gravity flow schemes are possible to be applied only in the areas around Mt. Elgon where the water resources such as stream flows and springs are considered abundant and elevations between water source area and the service areas are also enough to flow water by gravity. It is therefore difficult to apply the gravity flow system widely in the basin because the topographical limits, and it share in the technology to be constructed in the future is not increased remaining in the same level as the present. Deep wells will be constructed in the future and the number of wells will be increased but the share of deep wells will be same as the present. Rain water harvesting system is considered as the supplemental resources and its share in the facilities to be constructed is very few both in the present and the future.

The technology mix of rural water supply facilities in the Lake Kyoga basin is shown in Figure 15-8, and as same as those for the whole country, the share of springs and shallow wells is decreased, while piped water system is increased remarkably. The future technology mix including the existing facilities is presented in Table 15-10.

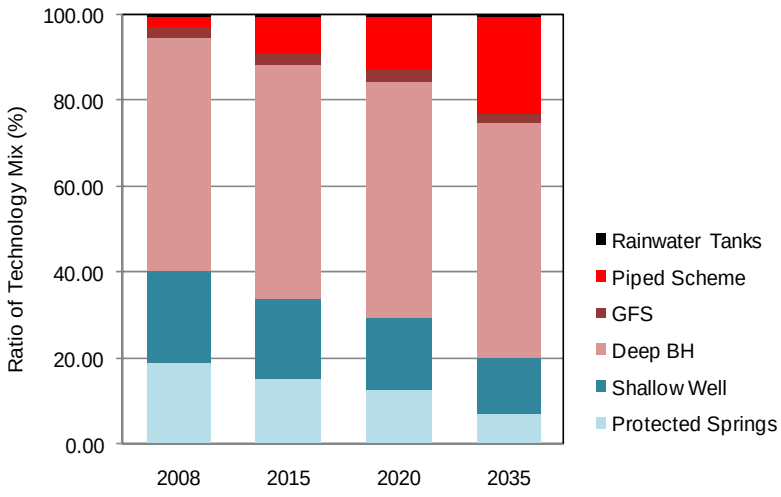


Figure 15-8 Present and Future Technology Mix

Table 15-10 Present and Future Technology Mix for Lake Kyoga Basin

year	Sub-basin	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks
2008	1. Okok	0.3	94.7	4.3	0.0	0.7	0.0
	2. Okere	3.8	78.9	15.5	1.0	0.7	0.1
	3. Awoja	30.3	39.6	15.5	10.6	3.8	0.1
	4. Lwere	25.1	42.7	27.7	1.6	2.9	0.0
	5. Akweng	12.2	65.0	20.4	0.1	2.3	0.1
	6. Abalan	20.3	44.4	33.8	0.3	1.3	0.0
	7. Kyoga Lakeside	0.7	78.2	16.4	0.0	4.7	0.0
	8. Mpologoma	23.1	55.5	12.6	4.5	4.3	0.0
	9. Lumbuye	5.4	67.9	26.4	0.4	0.0	0.0
	10. Victoria Nile	12.0	51.6	36.3	0.0	0.0	0.0
	11. Sezibwa	27.2	41.2	30.2	0.0	1.3	0.0
	Total	**19.1**	**54.2**	**21.3**	**2.9**	**2.6**	**0.0**
2015	1. Okok	0.3	90.3	4.0	0.1	5.3	0.0
	2. Okere	3.1	79.7	12.4	1.1	3.7	0.1
	3. Awoja	24.1	40.8	14.0	9.2	11.8	0.1
	4. Lwere	18.9	44.8	24.5	1.4	10.5	0.0
	5. Akweng	11.5	64.5	20.1	0.1	3.9	0.1
	6. Abalan	18.0	45.0	30.9	0.4	5.6	0.0
	7. Kyoga Lakeside	0.9	74.6	15.9	0.0	8.7	0.0
	8. Mpologoma	18.8	53.9	11.1	4.2	12.1	0.0
	9. Lumbuye	4.3	67.6	22.0	0.3	5.7	0.0
	10. Victoria Nile	9.1	54.3	31.7	0.0	4.9	0.0
	11. Sezibwa	22.6	38.6	29.3	0.1	9.4	0.0
	Total	**15.3**	**54.4**	**18.6**	**2.7**	**9.0**	**0.0**
2020	1. Okok	0.3	89.9	3.6	0.1	6.1	0.0
	2. Okere	2.5	79.8	10.8	1.1	5.9	0.1
	3. Awoja	19.9	41.8	12.8	8.8	16.7	0.1
	4. Lwere	15.5	46.6	22.2	1.3	14.3	0.1
	5. Akweng	9.4	64.0	18.6	0.1	7.8	0.1
	6. Abalan	15.0	45.1	28.1	0.5	11.3	0.1
	7. Kyoga Lakeside	0.8	73.8	14.9	0.0	10.5	0.0
	8. Mpologoma	15.6	54.3	10.0	4.1	16.0	0.0
	9. Lumbuye	3.5	68.4	19.3	0.3	8.5	0.0
	10. Victoria Nile	7.6	55.6	28.9	0.0	7.9	0.0
	11. Sezibwa	19.3	37.9	27.5	0.1	15.1	0.0
	Total	**12.6**	**55.0**	**16.9**	**2.6**	**12.8**	**0.0**
2035	1. Okok	0.2	88.0	2.9	0.1	8.8	0.0
	2. Okere	1.4	78.7	7.9	1.0	11.0	0.1
	3. Awoja	11.1	42.2	10.1	7.5	29.0	0.1
	4. Lwere	8.5	48.3	17.3	1.2	24.7	0.1
	5. Akweng	5.0	62.5	15.1	0.1	17.2	0.1
	6. Abalan	8.4	44.0	22.0	0.7	24.9	0.1
	7. Kyoga Lakeside	0.6	70.6	12.8	0.0	16.0	0.0
	8. Mpologoma	8.9	53.0	7.7	3.8	26.6	0.0
	9. Lumbuye	1.9	68.4	13.9	0.3	15.5	0.0
	10. Victoria Nile	4.5	56.9	22.6	0.0	16.0	0.0
	11. Sezibwa	11.8	34.7	22.7	0.3	30.6	0.0
	Total	**7.1**	**54.5**	**13.1**	**2.4**	**22.8**	**0.1**

Figure 15-9 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.

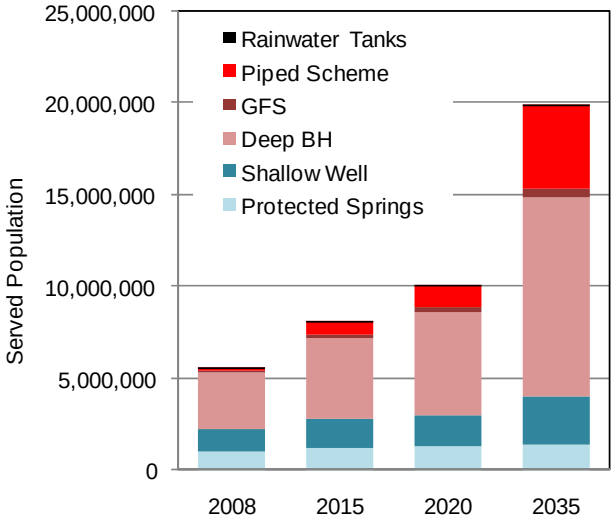


Figure 15-9 Present and Future Population Served by Each Technology in Lake Kyoga Basin

The coverage of rural water supply in each sub-basin is presented in Table 15-11, The present coverage is different among the sub-basins, but it is planned to increase to 77% in 2015 and 100% in 2035.

Table 15-11 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 numbers of facilities to be constructed in the future is presented for each technology and sub-basin in Table 15-12, and the number of whole facilities including the existing ones is also summarized in Table 15-13.

Table 15-12 Number of Facilities to be Constructed in Future from 2008 to 2035 in Lake Kyoga Basin

year	Sub-basin	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks
2008 - 2015	1. Okok	3	415	18	1	77	12
	2. Okere	10	346	25	11	84	15
	3. Awoja	196	509	128	147	672	132
	4. Lwere	43	253	90	10	274	28
	5. Akweng	9	75	21	0	46	14
	6. Abalan	27	106	40	5	109	36
	7. Kyoga Lakeside	10	400	88	0	186	21
	8. Mpologoma	437	1,423	226	202	1,522	151
	9. Lumbuye	18	350	71	3	174	8
	10. Victoria Nile	24	546	181	1	305	2
	11. Sezibwa	86	215	187	2	490	13
	Total	**864**	**4,637**	**1,075**	**382**	**3,940**	**432**
2015 - 2020	1. Okok	1	242	7	1	45	8
	2. Okere	3	316	22	8	102	19
	3. Awoja	44	417	74	128	658	117
	4. Lwere	10	213	52	9	238	26
	5. Akweng	5	187	37	1	147	35
	6. Abalan	8	127	45	5	198	35
	7. Kyoga Lakeside	3	302	47	0	150	22
	8. Mpologoma	72	1,129	116	149	1,292	106
	9. Lumbuye	3	293	38	2	154	7
	10. Victoria Nile	7	410	104	0	293	2
	11. Sezibwa	26	202	110	5	511	16
	Total	**181**	**3,839**	**651**	**307**	**3,787**	**392**
2020 - 2035	1. Okok	3	1,056	29	4	270	34
	2. Okere	13	1,578	113	37	618	98
	3. Awoja	181	2,010	351	597	3,857	575
	4. Lwere	44	1,001	246	40	1,406	132
	5. Akweng	25	1,061	206	4	892	198
	6. Abalan	39	628	231	23	1,130	164
	7. Kyoga Lakeside	11	1,329	208	0	857	108
	8. Mpologoma	264	5,031	511	665	7,344	480
	9. Lumbuye	9	1,344	168	8	882	34
	10. Victoria Nile	28	1,760	443	2	1,576	8
	11. Sezibwa	109	875	480	25	2,832	75
	Total	**725**	**17,672**	**2,985**	**1,405**	**21,665**	**1,907**

Table 15-13 Present and Future Number of Water Supply Facilities in Lake Kyoga Basin

year	Sub-basin	Protected Springs	Deep BH	Shallow Well	GFS	Piped Scheme	Rainwater Tanks
2008	1. Okok	1	272	12	0	4	12
	2. Okere	50	690	136	18	13	52
	3. Awoja	1,121	977	382	524	188	265
	4. Lwere	413	469	305	35	64	42
	5. Akweng	208	739	233	2	52	58
	6. Abalan	295	431	329	5	25	6
	7. Kyoga Lakeside	11	829	174	0	99	10
	8. Mpologoma	1,876	3,001	683	487	465	160
	9. Lumbuye	81	684	266	8	0	17
	10. Victoria Nile	401	1,148	807	1	0	5
	11. Sezibwa	899	910	667	0	58	61
	Total	**5,357**	**10,151**	**3,993**	**1,080**	**968**	**688**
2015	1. Okok	4	687	30	1	81	23
	2. Okere	60	1,036	161	29	97	68
	3. Awoja	1,317	1,486	510	671	861	397
	4. Lwere	457	722	394	45	338	70
	5. Akweng	217	814	254	2	97	72
	6. Abalan	322	536	369	10	134	42
	7. Kyoga Lakeside	21	1,229	262	0	285	31
	8. Mpologoma	2,313	4,424	909	689	1,987	311
	9. Lumbuye	99	1,034	337	11	174	25
	10. Victoria Nile	425	1,694	988	2	305	7
	11. Sezibwa	985	1,125	854	3	548	73
	Total	**6,221**	**14,788**	**5,068**	**1,461**	**4,908**	**1,120**
2020	1. Okok	5	929	37	2	126	31
	2. Okere	63	1,352	182	36	199	86
	3. Awoja	1,361	1,903	584	799	1,518	514
	4. Lwere	467	935	446	53	575	96
	5. Akweng	222	1,001	290	3	245	107
	6. Abalan	331	664	414	15	332	77
	7. Kyoga Lakeside	24	1,531	309	0	436	53
	8. Mpologoma	2,386	5,554	1,025	837	3,279	418
	9. Lumbuye	102	1,327	375	12	328	33
	10. Victoria Nile	432	2,104	1,092	2	598	9
	11. Sezibwa	1,011	1,327	963	8	1,059	90
	Total	**6,402**	**18,627**	**5,719**	**1,768**	**8,695**	**1,512**
2035	1. Okok	7	1,985	66	6	396	65
	2. Okere	76	2,930	295	73	817	184
	3. Awoja	1,542	3,913	935	1,396	5,375	1,088
	4. Lwere	511	1,935	693	93	1,982	228
	5. Akweng	246	2,062	497	8	1,137	305
	6. Abalan	370	1,292	645	38	1,462	241
	7. Kyoga Lakeside	35	2,860	518	0	1,293	161
	8. Mpologoma	2,650	10,585	1,535	1,503	10,623	898
	9. Lumbuye	111	2,671	542	20	1,210	67
	10. Victoria Nile	459	3,864	1,535	4	2,174	16
	11. Sezibwa	1,120	2,202	1,443	32	3,892	165
	Total	**7,127**	**36,299**	**8,704**	**3,173**	**30,359**	**3,419**

ii) 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.

According to the analysis result of water demand-supply balance in section 14.5 of Chapter 14, 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 15-10 and Table 15-14, 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.

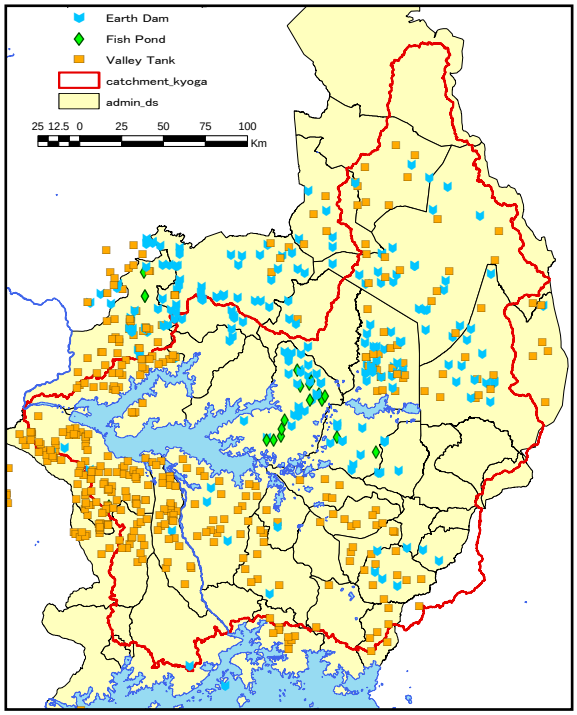


Figure 15-10 Distribution of Existing Surface Water Storage Facilities

Source: DWD Data (2009)

Table 15-14 Number and Volume of Surface Water Storage Facilities in each Sub-basin

Sub-basin	Earth Dam		Valley Dam		Fish Pond		Total	
	No.	Volume (m^3)	No.	Volume (m^3)	No.	Volume (m^3)	No.	Volume (m^3)
(1) Okok	7	2,253,900	12	203,800	0	0	19	2,457,700
(2) Okere	29	2,935,587	13	337,160	0		42	3,272,747
(3) Awoja	45	2,001,412	30	0	5	2,050	80	2,001,417
(4) Lwere	7	280,455	2	6,818	1	700	10	287,274
(5) Akweng	17	2,796,135	0	0	6	3,350	23	2,796,141
(6)Abalan	11	196,765	18	262,900	0	0	29	459,665
(7) Kyoga Lakeside Zone	3	455,000	85	477,319	4	6,482	92	932,323
(8) Mpologoma	7	31,362	34	111,679	0	0	41	143,041
(9) Lumbuye	2	38,636	11	82,997	0	0	13	121,633
(10) Victoria Nile	4	345,452	30	343,686	0	0	34	689,138
(11) Sezibwa	1	63,380	37	298,879	0	0	38	362,259
Total	133	11,398,084	272	2,125,238	16	12,582	421	13,523,338

iii) 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.

15.4.3 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

i) Deforestation Monitoring

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

ii) 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.

iii) 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.

iv) 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.

v) 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.

vi) 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.

vii) 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.

viii) 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 vii) to inhabitants.

(3) Flood Prevention Plan

i) 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.

Concrete plan for earth dam and valley tank is examined in water supply plan, however, because their main function is water use.

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

The roads in target area are unpaved except major roads and easily become impossible to pass by not so much rainfall due to poor road maintenance. In addition, most of roads which pass across the rivers don't have proper structure to be able to drain discharge in flood. In 2007 flood, even major roads were submerged and became impossible to pass in a long team.

Such 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.

iii) 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

i) 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 landuse and/or development as well as calling for attention by distribution and publicity of the hazard map to local government and inhabitants.

ii) 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.

iii) Relocation Planning

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

iv) 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.

v) Relocation Planning

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

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

i) 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.

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

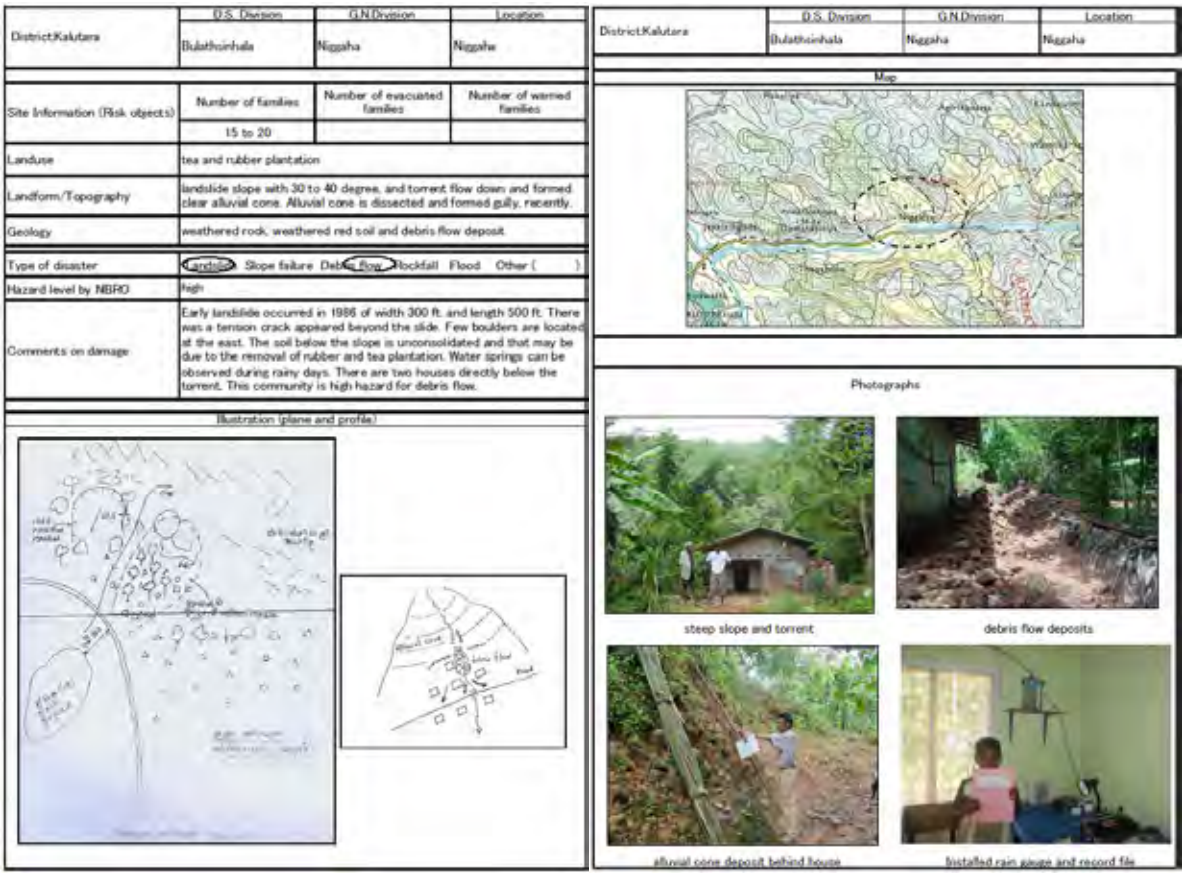
The system for collection, accumulation and sharing of disaster information is established. The information from relevant ministries/agencies, local governments and inhabitants are comprehensively gathered and compiled to a database on the initiative of DWRM of MWE. The information to be collected is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

Table 15-15 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.

The points to take notice for information collection are as follows:

- Past disaster information is also collected as much as possible. At least, a newly occurring disaster (natural phenomenon) shall be recorded without omission.
- Even if any damage doesn't arise, especially sediment phenomenon such as slope failure, debris flow and landslide shall be recorded as a natural phenomenon. Such a information is extremely valuable for analyses of sediment disaster mechanism like correlation with rainfall, geology and topography, and becomes basic data for setting criteria of issuing warning.
- Information on occurrence area (location) is collected as accurate as possible, for example, by using GPS and so on. Besides, especially as for sediment disaster, it is difficult to evaluate actual phenomenon (type of disaster) from the existing records so that understanding about phenomena and their names differs vastly by individuals at present. Therefore, it is necessary to familiarize the proper understanding about phenomena and their names so as for phenomena to be evaluated, classified and recorded properly. Preparation and distribution of a brochure and a poster for sediment disaster may be effective.
- Collected information is recorded as geographic data. The record as a GIS database is preferable. By recording as geographic data, it can be easily utilized for the above analyses of disaster mechanism and the preparation of hazard map in future. Information on affected area and damaged area is particularly valuable.



Source: "Comprehensive Study on Disaster Management in Sri Lanka"
Final Report, JICA, March 2009

Figure 15-11 Example of Disaster Record Sheet (Sediment Disaster)

iii) Preparation of Hazard Map and Risk Map

Hazard map and risk map are prepared based on the collected data.

A simple hazard map can be prepared by showing the past inundated area on a map in case of flood, and showing the past disasters (natural phenomena) occurrence area on a map in case of sediment disaster.

On the long-term basis, flood hazard map shall be prepared by showing the result of flood analysis/simulation carried out based on the collected various data, and sediment disaster hazard map shall be prepared by 1) investigating and grasping the characteristic of high-potential area of disaster occurrence from past disaster records and data of topographic and geological conditions of past disaster occurrence area, and 2) extracting and showing the area with the same characteristic as such a area.

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.

iv) Establishment of Early Warning System for Disasters

a) Early Warning System for Flood

"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.

Table 15-16 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.
Eadly 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

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.

"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.

b) 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. Outline of the system is shown in Table 15-16.

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.

v) 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

15.4.4 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 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 follows based on the results of water quality survey in this study, Japanese standards. The items of the standards for rivers are pH, SS, DO, BOD and Coliform groups, and for the lakes are Total Nitrogen (T-N) and Total Phosphorus (T-P) additionally as shown in Table 15-17.

- pH：index of acidity
- DO (dissolved oxygen)：index for appropriate environment for aquatic organism.
- SS：index for suspended solid.
- BOD：index for the pollution by human activity.
- Total Coliform：index for fecal pollution.
- T-N, T-P：index for eutrophication

Nitrogen and Phosphorus are useful to capture an eutrophication level and to take measures against blue-green algae, which are already confirmed in the Lake Victoria. Classification of standards is defined based on the current situation of water use including water for drinking, bathing, fish farming, irrigation and industry. In this plan, four types of class: AA, A, B and C, are adopted according to the current situation of water use as follows.

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

Furthermore, items of human health standard are listed in Table 15-19. Of this, 1,3-Dichloropropene, Thiram, Simazine and Thiobencarb are adopted for agrichemicals including weedicide and insecticide.

Table 15-17 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

(3) Water Quality Monitoring Plan

Water quality monitoring plan is set up as shown below.

- Monitoring Points: As shown in Table 15-18, 30 points set up by DWRM(refer to Figure 4-1 ad Table 4-3) 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 (refer to Table 15-4 to 6 and Figure 15-2 to 3) 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.

Table 15-18 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	Total
1	**Okok**			1			1	1		2			**3**
2	**Okere**	2		2			4	2		2			**4**
3	**Awoja**	3		1			4	5	2	2			**9**
4	**Lwere**						0	1		2			**3**
5	**Akweng**					2	2	1	1	2		2	**6**
6	**Abalang**		1				1	1	1	3			**5**
7	**Kyoga Lakeside Zone**	1	1				2	1	2	5			**8**
8	**Mpologoma**	3		1	5		9	6		7	5		**18**
9	**Lumbuye**	1					1	1		4			**5**
10	**Victoria Nile**	1			3		4	1		4	3		**8**
11	**Sezibwa**	1		1			2	2		2			**4**
Total		12	2	6	8	2	30	22	6	35	8	2	**73**

- Implementation system: DWO supported by TSU under DWD have been carried out monitoring

of drinking water quality and DWRM have been monitored basically ambient water quality by them. Since DWRM don't have any subordinate organization corresponding to TSU in the Basin and their monitoring is not effective, WMZ office and WMZ-Lab should do and submit data to DWRM.

Table 15-19 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

(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. Therefore, 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.

i) 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 Table15-20. The standard class of each Sub-basin is defined not to deteriorate the current conditions.

Table 15-20 Adaptation of Ambient Standard Class to each Sub-basin

Source Type	Sub-basin	Item	pH	BOD5 (mg/l)	SS (mg/l)	Coliform Group (group/100ml)	Ambient standard Class
Lake	3 Awoja	Maximum	7.6	2.1	11	TNTC	AA
		Minimum	6.7	0.8	2	0	
		Average	7.3	1.5	5	–	
	5 Akweng	Maximum	8.4	3.2	30	TNTC	A
		Minimum	7.3	2.4	7	270	
		Average	7.9	2.8	19	–	
	7 Kyoga Lakeside Zone	Maximum	9.7	8.3	53	TNTC	B
		Minimum	5.1	0.9	2	0	
		Average	7.8	4.3	14	–	
	8 Mpologoma	Maximum	9.3	4.8	28	TNTC	A
		Minimum	6.0	1.8	8	0	
		Average	7.4	3.3	17	–	
River	1 Okok	Maximum	–	–	–	–	A
		Minimum	–	–	–	–	
		Average	–	–	–	–	
	2 Okere	Maximum	7.3	3.8	27	TNTC	A
		Minimum	6.1	0.4	2	10	
		Average	6.7	2.5	10	–	
	3 Awoja	Maximum	7.7	9.1	185	TNTC	B
		Minimum	5.8	0.3	0	6	
		Average	7.1	4.0	37	–	
	4 Lwere	Maximum	7.0	9.1	28	TNTC	B
		Minimum	6.0	1.0	3	0	
		Average	6.7	6.0	18	–	
	5 Akweng	Maximum	7.0	2.7	8,675	TNTC	A
		Minimum	6.0	2.3	7	0	
		Average	6.5	2.5	1781	–	
	6 Akweng	Maximum	–	–	–	–	A
		Minimum	–	–	–	–	
		Average	–	–	–	–	
	7 Kyoga Lakeside Zone	Maximum	6.2	8.0	38	TNTC	B
		Minimum	6.2	8.0	38	TNTC	
		Average	6.2	8.0	38	TNTC	
	8 Mpologoma	Maximum	9.8	19.0	1,601	TNTC	B
		Minimum	6.1	0.1	3	0	
		Average	7.1	5.1	136	–	
	9 Lumbuye	Maximum	7.1	8.0	37	TNTC	A
		Minimum	6.3	0.3	3	4	
		Average	6.8	3.7	13	–	
	10 Victoria Nile	Maximum	10.0	4.6	204	TNTC	AA
		Minimum	5.8	0.2	1	0	
		Average	7.3	1.8	26	–	
	11 Sezibwa	Maximum	9.1	12.0	23	TNTC	A
		Minimum	5.8	1.2	5	12	
		Average	7.2	4.7	14	–	

ii) Sewerage Treatment System Plan

a) Necessity of Sewerage Treatment System

As population increases in the Lake Kyoga Basin, the water supply facilities are also constructed to meet such increase of the population, which causes the increase of sewer flow resulting in increase of concern on declining water quality of waterborne in the Basin. A sewerage treatment system plan is formulated in this Basic Plan to maintain at least the current water quality level and protect deterioration of water pollution in the Basin.

In SIP, it is proposed to promote the use of Ecosan (Ecological Sanitation) toilets as well as cost saving pit latrines in the policy for rural sanitation aspect, it is considered that such sanitation measures will be preceded as expected.

On the other hand, more than 90% of the urban population uses pit-latrines in large towns and peri-urban areas other than those in central core areas where the population density is rather high. Although sewerage systems should be provided in such urban core areas where pit-latrines are not be able to be applied, its coverage is still low in these areas. In addition, the sewerage system should be expanded as such core areas expand.

b) Sewerage Treatment System

The following three (3) types of sewerage treatment system are used to be applied for the urban sewerage system.

- Activated sludge process: There are two (2) processes: standard activated sludge and oxidation ditch processes.
- Fixed membrane process: There are three (3) processes: conventional trickling filter, high-rate trickling filter and rotating bio-disc processes.
- Oxidation pond process: Stabilization pond process is applied usually.
- In Uganda as well as in the large towns in the Lake Kyoga Basin the stabilization pond process of the oxidation pond process is applied. The characteristics of this process are as follows:
- Variation of volume of sewer flowing in and its water quality either seasonal or normally may affects treatment effect, and pond scum flowing our may also concerned, but they have not been found in the operation of the existing treatment facilities. In case that the volume of sewer flowing in increases and any higher level of treatment process is needed, it is easy to install aeration facilities and cyclic water pump additionally to meet such future requirement.
- Operation and maintenance as well as repairing are considered easy and simple. Sludge in ponds has to be removed every five (5) years with solar drying. The sludge removed from ponds will be reused for agricultural farming as fertilizer nearby treatment facilities.
- Wide and large yards are generally required for constructing treatment facility of the stabilization pond process; for instance in case of the plant of average capacity of treatment from 500 - 1,000m^3/day 12,500 - 25,000m^2 of lands are required comparing with the other process of treatment.
- Electricity driven equipment is not required basically except for the electricity for lighting in the night and operation costs are then low.
- Since mosquitoes and odor of anaerobic ponds and sludge drying beds may cause claims of neighboring peoples, it is necessary to provide planting zones and to take measures for proper removal of stacked sludge.

The flow of the stabilization pond process is shown in Figure 15-12.

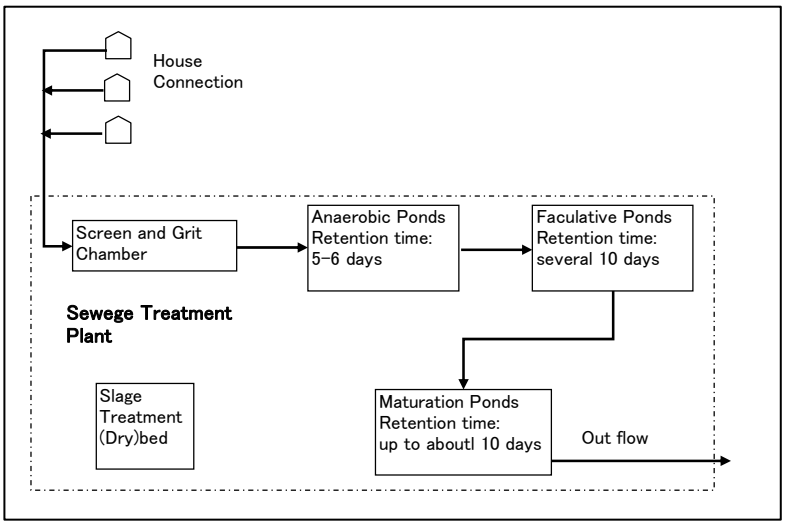


Figure 15-12 Flow Chart of Stabilization Pond Proces5

c) Scale of Sewerage System and Cost

Annual treatment volume of sewer water in each sub-basin and necessary number of systems based on the standard specification of stabilization pond type in Uganda as listed below to meet the water environmental standards are estimated in Table 15-21.

- 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 15-21 Necessary Number of Sewerage Systems

Year / Sub-basin	2015		2020		2035	
	Sewer Water Volume (m^3)	No.of System	Sewer Water Volume (m^3)	No.of System	Sewer Water Volume (m^3)	No.of System
1. Okok	79.5	1	239.9	2	1,452.7	8
2. Okere	39.7	1	144.1	1	793.2	4
3. Awoja	207.3	2	475.1	3	1,676.8	9
4. Lwere	51.6	1	85.7	1	204.9	2
5. Akweng	11.6	1	72.4	1	271.1	2
6. Abalan	0.0	0	0.0	0	258.1	2
7. Kyaga	124.9	1	160.3	1	292.8	2
8. Mpologoma	0.0	0	315.3	2	3,861.3	20
9. Lumbuye	187.7	1	277.5	2	740.8	4
10. Victoria Nile	1,140.9	6	1,416.8	8	2,515.2	13
11. Sezbwa	3,678.5	19	4,960.9	25	11,426.3	57
Total	5,521.7	33	8,147.9	46	23,493.2	123

Unit: 1,000m3/year

On the other hand, Table 15-22 showing an overall schedule of sewerage system construction in Lake Kyoga Basin 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.

Table 15-22 Overall 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**

e) Operation and Maintenance of Sewerage Treatment System

The activities of operation and maintenance cover all the process of sewerage treatment system properly from sewer colleting networks to treatment facilities and effluent from ponds. As itemized below, the operation and maintenance of the stabilization pond process do not include such activity that requires many numbers of staff.

Regular operation and maintenance manual which presents the following activities has to be prepared, and in accordance with the manual such operation and maintenance activities have to be performed including training of necessary technologies.

- Collection of sewerage fees
- Sewerage pipelines (cleaning of manholes and pipelines, installation of new connections)
- Sewerage treatment facilities (Monitoring of water quality flowing in and out the ponds)
- Measurement of the parameters such as BOD, SS (Suspended Solid), pH, ammonia, coliforms, etc. has to be carried out every three (3) months in accordance with the environmental standard. Based on the measured value of water quality, treatment process has to be adjusted.
- Removal of garbage and sediment sand from screen and grid chamber
- Removal of scum in the ponds and floating macrophytes from the surface of facultative and maturation ponds
- Repair of damage to the embankments and block protection
- Periodical cutting the grass on the pond embankment
- Disinfections against insects and mosquitoes
- Elimination of odor of dry betting

- Removal of sludge and sediments with the interval of 2 - 5 years
- Provision and check of fences and ditches to protect from castles and for security purposes

f) Approximate Cost of Sewerage Treatment System

Approximate cost of above-mentioned sewerage system as a standard type for Lake Kyoga Basin is estimated referring to same type of sewerage treatment systems in Uganda. According to the unit price from them, a unit construction cost per unit treated sewer water volume and unit O/M cost come to 600,000 UGX/m^3 and 6,000 UGX/m^3/day respectively. In view of this, the construction of one sewerage treatment system is 3.3 billion UGX (1.65 million USD) and its O/M cost is 1.2 billion UGX / year (0.6 million USD).

15.4.5 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 15-13.

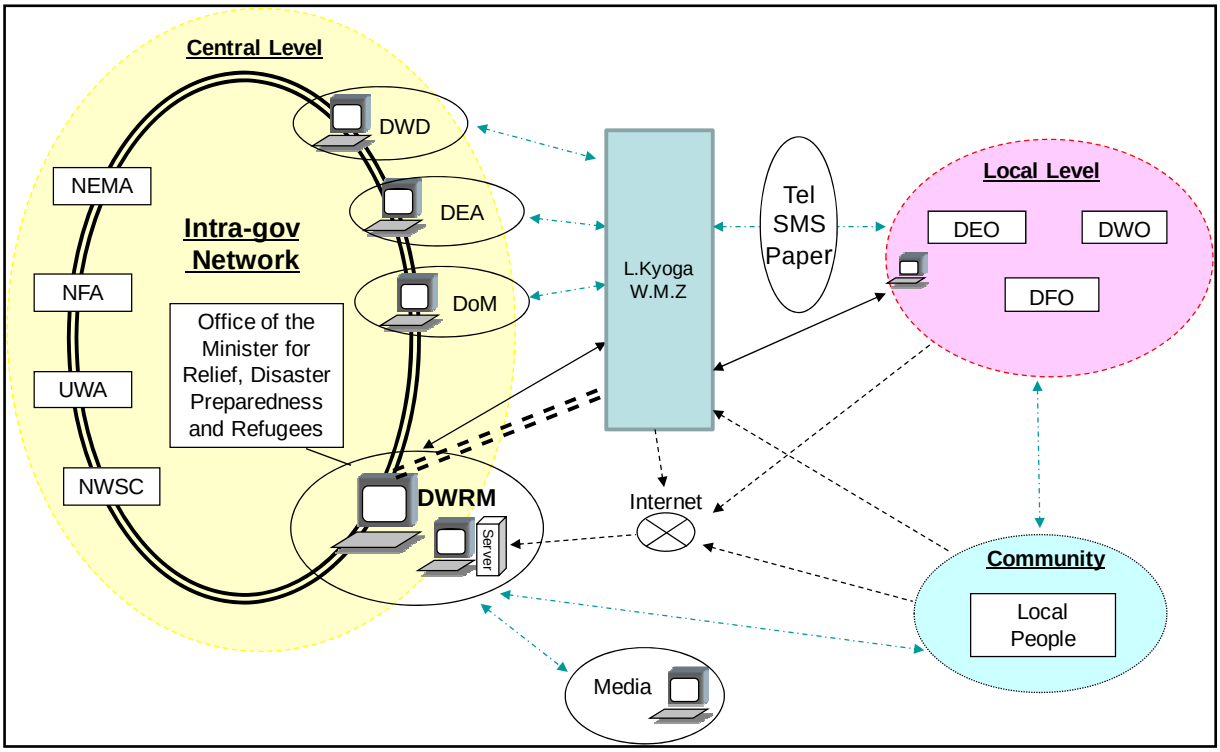


Figure 15-13 Outline of Information Sharing System

15.4.6 Total Schedule of the Basic Plan

Total schedule of the Basic Plan is shown in Table 15-23. 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 20235. 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

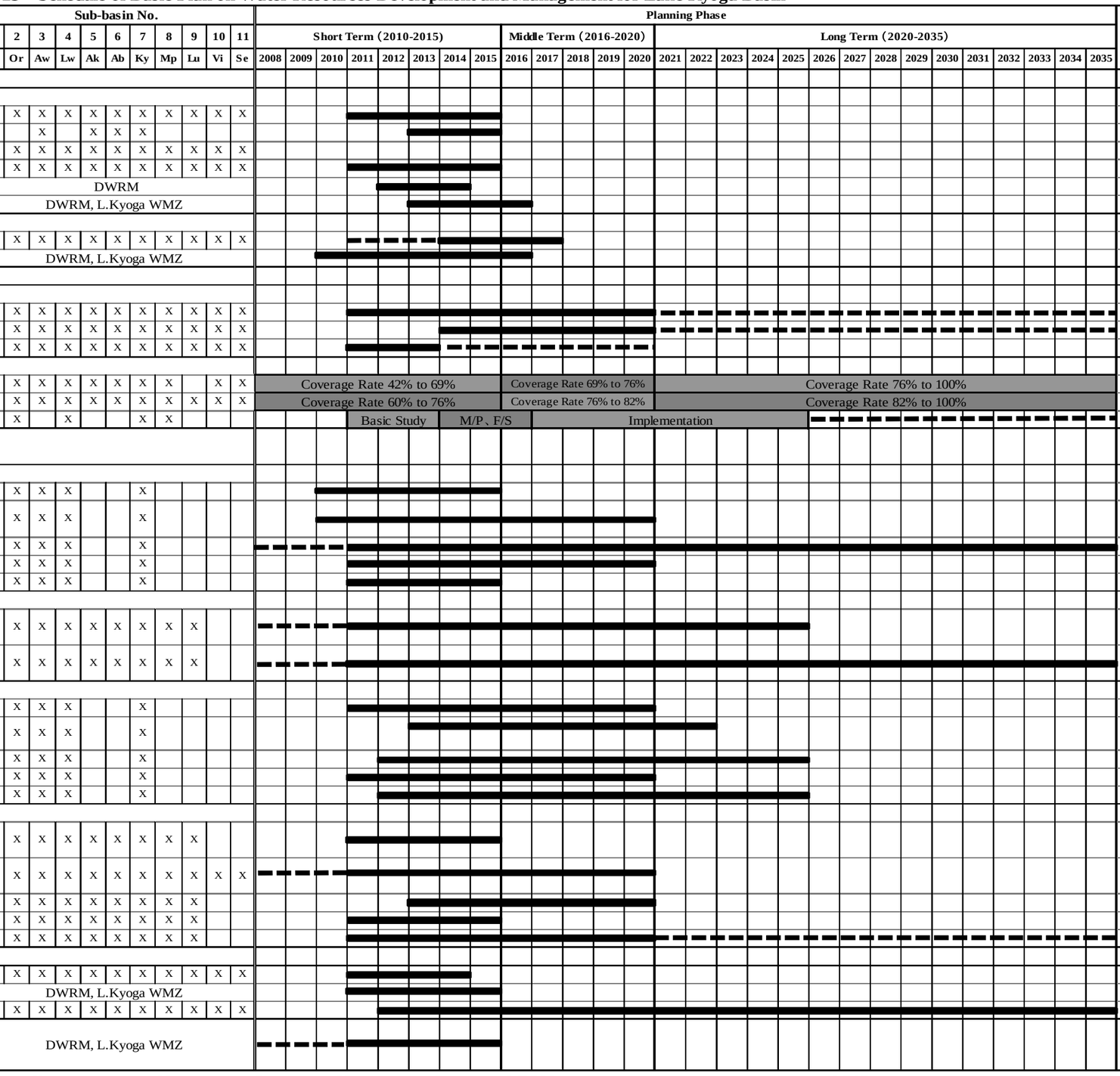
Setting up environmental conservation target and strengthening water quality monitoring system are planed in the short term but sewerage system as the structural measure belongs to the long term plan in consideration of its cost.

(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 15-13 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 15-23 Schedule of Basic Plan on Water Resources Development and Management for Lake Kyoga Basin

Item			year / Sub-basin No.	1	2	3	4	5	6	7	8	9	10	11	Responsible Organization
				Ok	Or	Aw	Lw	Ak	Ab	Ky	Mp	Lu	Vi	Se	
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	DWD, NWSC
		(2)	Rural Water Supply	X	X	X	X	X	X	X	X	X	X	X	DWD
		(3)	Agricultural Water Supply	X	X		X			X	X				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 DiasterPreparadness and Refugees

15.5 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 15-24, drinking water supply plan, particularly rural water supply features high on the evaluation list of priority.

15.6 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.

15.6.1 Outline Schedule

Construction and expansion of the water supply facilities in each district are planned to be implemented simultaneously from 2008 to 2035 in SIP to achieve respective targets of the improvement of coverage. 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.

15.6.2 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.

15.6.3 Result of Cost Estimation

The cost estimate is made based on the prices presented in SIP basically. In order to confirm the appropriateness of such prices, the construction costs of rural water supply facilities is calculated and the calculated results are compared those presented in SIP. The construction costs of each technology applied for rural water supply are shown in Table 15-25.

Table 15-24 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**
		-	-	-	-	-	-	-	In cooperation with the private sector, make available the benefits of new technologies, especially information and communications	**4 : high**
										3 : middle
										2 : low
										1: very low
										- : not applicable
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)

Table 15-25 Construction Costs of Each Technology for Rural Water Supply

Unit: UGX

Item	Facilities	Population Served	Const. Costs	Remarks
a) Protected Spring				
a-1	Middle Scale	400	2,527,470	20%
a-2	Small Scale	200	1,345,960	80%
Ave. Const. Cost per 200 persons			1,329,500	200 persons
Construction Cost per capita : kUGX 6.65 per capita				
b) Deep Well				
b-1	Deep Well (70m deep) w/HP	300	20,238,900	
Ave. Const. Cost per 300 persons			20,238,900	300 persons
Construction Cost per capita : kUGX 67.46				
c) Shallow Well				
c-1	Shallow borehole(30m deep) w/HP	300	11,485,100	20%
c-2	Dug well (8m deep) w/HP	300	4,065,700	80%
Ave. Const. Cost per 300 persons			5,549,600	300 persons
Construction Cost per capita : kUGX 18.49				
d) Piped Water System				
d-1	Small scale	2,000	457,120,400	10%
d-2	Middle scale	3,000	580,115,100	20%
d-3	Large scale	4,000	748,223,400	70%
Ave. Const. Cost per 3,600 persons			685,490,400	Ave. L=3,600m
Ave. Const. Cost per 150 persons covered by one kiosk			28,562,100	Ave. L=150m
Construction Cost per capita : kUGX 190.41				
e) Rain Water Harvesting				
e-1	Buildings (Pri. & Sec. Schools)	500	36,753,300	Reference
e-2	Common houses	3	1,836,700	
Ave. Const. Cost per one facility			1,837,700	
Construction Cost per capita : kUGX 612.68				
f) Gravity Flow Scheme (GFS)				
f-1	Type 1 (GI pipe, L=2,000m)	1,000	178,176,500	20%
f-2	Type 2 (GI pipe, L=1,000m and HDPE pipe, L=1,000m)	1,000	146,197,000	80%
Ave. Const. Cost per 1,000 persons			152,593,200	1,000
Ave. Const. Cost per 150 persons covered by one public tap			22,889,000	150
Construction Cost per capita : kUGX 148.76				

The results of the comparison of the above-calculated prices and those presented in SIP are shown in Table 15-26, and the prices calculated are almost same as those in SIP. The prices presented in SIP are then applied preferably in the Basic Plan.

The construction and operation and maintenance costs calculated as above for the urban and rural water supply facilities are presented in Table 15-27.

Table 15-26 Comparison of Calculated Prices and Those in SIP

Unit: kUGX

Water Supply Facilities	Construction Costs per Capita	
	Basic Plan	SIP (Relating Districts)
a) Protected Spring	6.65	6.35 - 7.41
b) Deep Well	67.46	60.14 - 78.07
c) Shallow Well	18.49	17.51 - 20.93
d) Piped Water System	190.41	148.41 - 227.26
e) Rain Water Harvesting	612.68	498.64 - 825.28
f) Gravity Flow Scheme (GFS)	148.76	142.71 - 177.51

Table 15-27 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

15.7 Evaluation of the Basic Plan on Water Resources Development Management

15.7.1 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 dealt 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.

15.7.2 Economical and Financial Evaluation

(1) Economical Evaluation

i) Economical Condition of Uganda

The real economic growth rate of Uganda has fluctuated as shown in Figure 15-14 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 15-15 indicates the

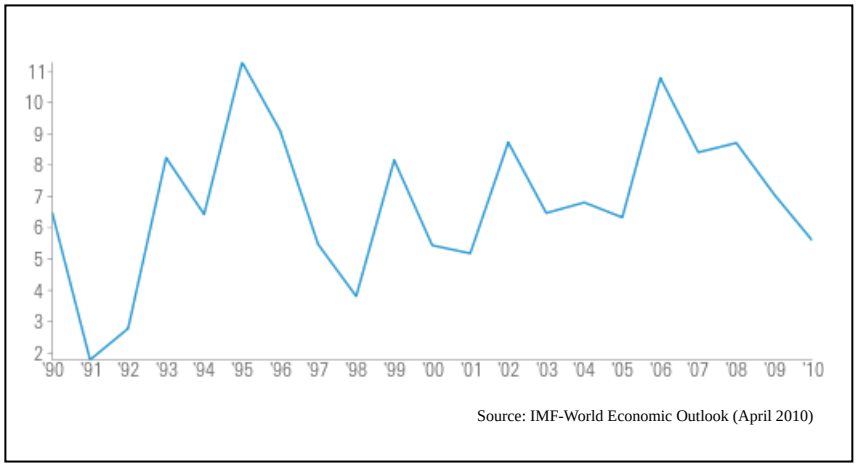


Figure 15-14 Transition of Real Economic Growth Rate (%)

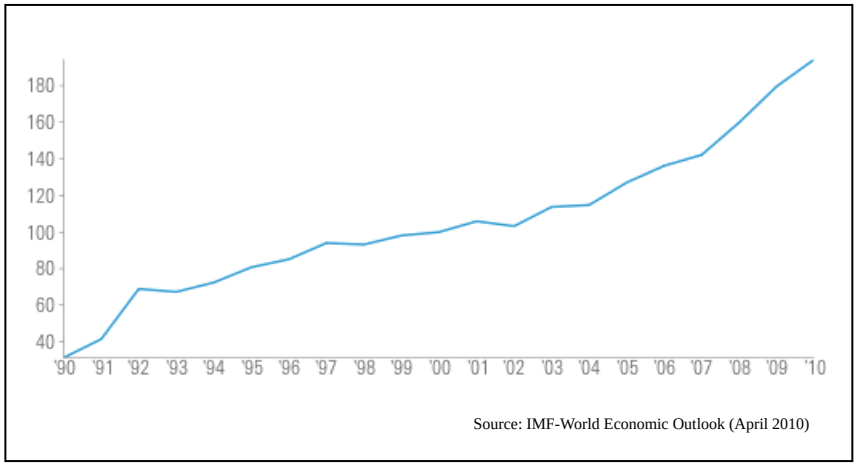


Figure 15-15 Transition of Inflation Rate (%)

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. The value of 2009/09: 14.1% was much bigger than the government target: 5%.

ii) Economic Evaluation of Rural Water Supply 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 Phase-I of the Study. 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 15-28. Since the EIRR value is larger than Discount rate, the implantation of this rural water supply plan is reasonable.

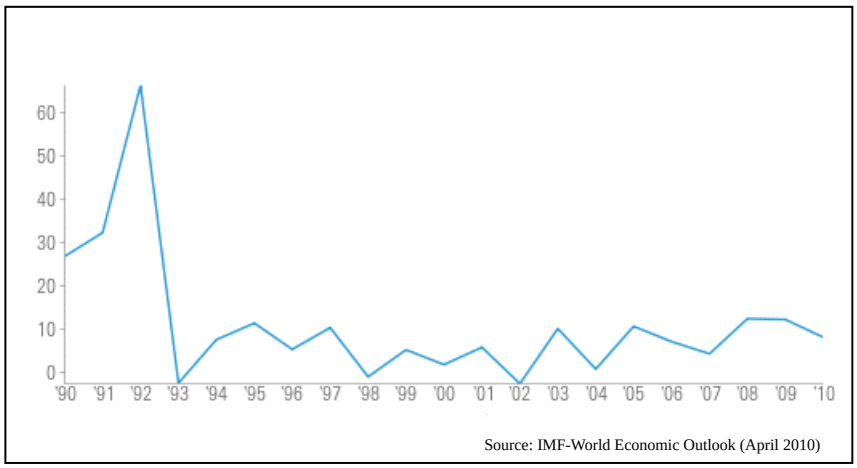


Figure 15-16 Transition of Year on Year of Inflation Rate

Table 15-28 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%

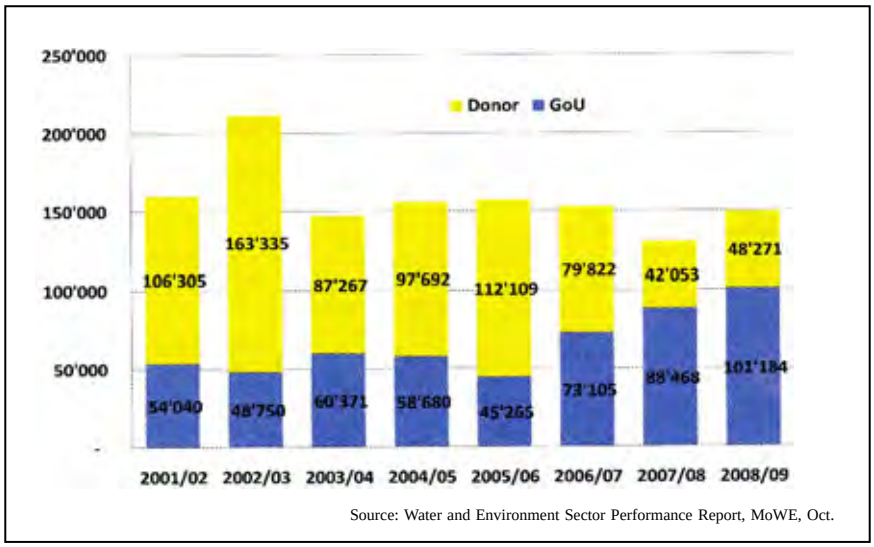
Aftertime, the master plan and feasibility plan study is needed for the final judgement of economic validity on each project.

(2) Financial Evaluation

i) 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 15-17. 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.



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

Figure 15-17 Transition of Budget for Water and Sanitation Sector

ii) 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.

15.7.3 Environmental and Social Considerations

The Basic Plan aims to realize "safe and stable drinking water supply", "conservation of good water environment" and "mitigation of flood and debris disaster" and to provide positive impacts into natural and social environment. However, the plan includes structural countermeasure: namely, construction of water supply and sewerage treatment facilities, for that reason there are some possibility to generate slightly negative environmental impacts: temporally water, noise and dust pollution, during their construction works. In addition, poor people in scattered villages or the northern part of the Basin with low water resources potential might not receive benefit and socioeconomic gap would widen depending on execution method of water supply plan and mitigation plan against flood or debris flow.

Therefore, preventive or mitigation measure to these negative impacts, environmental monitoring and activity for "environmental and social considerations" during the implementation of the

construction project should be reviewed adequately in forthcoming master plan or feasibility study stage.

CHAPTER 16 MASTER PLAN OF RURAL WATER SUPPLY

16.1 Selection of Priority Districts for Rural Water Supply Master Plan

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 WRDM, 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.

16.1.1 Potential Water Source

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

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.

As discussed above the groundwater is considered as the most predominant water source for the rural water supply in the Basin except those situated around Mt. Elgon. These districts have abundant resources of spring/stream water, and gravity flow systems of these spring/stream water are most prevailingly applied for water supply. Out of the 38 districts in the Basin, in the 27 districts the groundwater of deep aquifers is found to be the most predominant water source. The gravity flow systems of spring/stream water are predominant in the six (6) districts near Mt. Elgon such as Bududa, Bukewa, Kapchorwa, Manafwa, Mbale and Sironko, as shown in Table 9-4 in Chapter 9. In these districts, the elevation gaps between the intake facilities (water source) and the service areas are

enough to transmit the water by gravity due to the sloped topography. The other schemes of spring and rainwater harvesting are also often applied because of low investment costs of these facilities, but the shares of such systems are considered less in the Basin.

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.

16.1.2 Districts to be Considered for the Selection

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 16-1 shows the area where access is restricted by the JICA Uganda office regulations for safety. As shown in the figure, five (5) districts in Karamoja (Kaabong, Kotido, Abim, Moroto, and Nakapiripirit) and four (4) districts north of the Kyoga lake (Amolatar, Apac, Dokolo, and Lira). Among these nine (9) districts, two (2) are in the 21 candidate districts described above. The these two (2) districts are excluded due to security reason; the Amolatar and the Dokolo districts. Then the 19 districts remain as shown in Table 16-1.

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, 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.

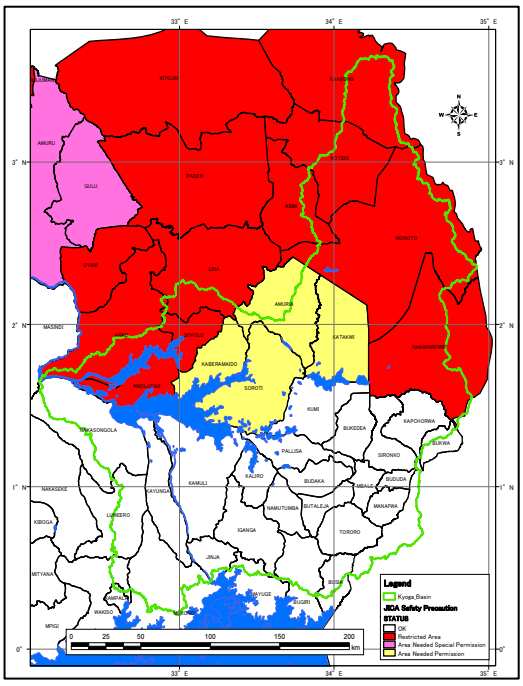


Figure 16-1 Districts to Which Entrance is Limited by JICA

Table 16-1 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

16.1.3 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

i) Poverty Ratio

Safe water supply is listed as one of the important targets for the poverty eradication in PEAP. Higher poverty ratio suggests that more urgent provision of safe water is needed. The districts with a high poverty ratio should be given high priority for the selection. Table 16-2 shows the county-wise poverty ratios in Uganda obtained from Nature, Distribution and Evolution of Poverty and Inequity in Uganda, 1992 - 2002 (UBOS and ILRI 2007). The original data for this table is of 2002 with the old district setting of the time. Therefore, the sub-county data were rearranged for the new (June 2009) district setting in order to create the table.

Table 16-2 Poverty Ratio of District, Sub-county and District's Average

Area	Region/District	County	No of poor 1992	Percent poor 1992	No of Poor in 2002 (person)	Ratio of Poor in 2002 (%)
Eastern District	**BUDAKA**	Budaka	64,116	65	66,819	**48.9**
	BUGIRI	Bukooli	145,229	64.8	202,507	**50.9**
	BUKUWA	Kongasis	15,404	51.5	15,102	**30.6**
	BUKUDEA	Bukedea	59,363	81.7	69,270	**56.2**
	BUDUDA	Manjiya	46,552	59.5	40,577	**32.9**
	BUSIA	Samia-Bugwe	86,217	64.7	97,034	**50.4**
	BUTALEJA	Bunyole	68,127	66.4	81,253	**51.3**
	IGANGA	Luuka	80,567	62.6	80,383	43.3
		Bugweri	48,639	63.8	50,163	42.3
		Kigulu	82,166	63.4	85,267	43.7
		Total			215,813	**43.2**
	JINJA	Kagoma	52,163	43.5	59,244	35.2
		Butembe	27,291	32.1	24,994	19.6
		Total			84,238	**28.5**
	KABERAMAIDO	Kalaki	31,516	80.2	40,108	58.4
		Kaberamaido	29,770	85.7	35,932	59.4
		Total			76,040	**58.9**
	KALIRO	Bulamogi	70,789	70.8	87,971	**56.8**
	KAMULI	Budiope	91,485	72.2	82,765	**56.2**
		Bugabula	101,700	69.7	96,133	44
		Buzaaya	62,486	67.9	53,731	40.5
		Total			232,629	**46.7**
	KAPCHORWA	Kween	21,221	59.1	19,650	**28.9**
	KUMI	Ngora	46,453	81.9	60,311	59.6
		Kumi	72,245	83.7	87,331	56.1
		Total			147,642	**57.5**
	MANAFUWA	Bubulo	102,280	58.1	96,148	**36.3**
	MAYUGE	Bunya	129,921	62.8	141,169	**45.0**
	MBALE	Bungokho	96,770	53.6	78,561	**30.2**
	NAMUTUNBA	Busiki	79,374	66.5	91,571	**55.3**
	PALLISA	Kibuku	61,108	68	65,614	51.1
		Butebo	37,631	60.3	50,409	53.5
		Pallisa	55,531	57.2	83,194	59.3
		Total			199,217	**54.9**
	SIRONKO	Bulambuli	35,964	56.1	31,943	32.9
		Budadiri	76,865	53.9	55,451	31.7
		Total			87,394	**32.1**
	SOROTI	Soroti	55,419	79.4	97,618	64.3
		Serere	44,580	76.8	65,376	62.4
		Kasilo	21,743	76.3	47,447	66.1
		Total			210,441	**64.1**
	TORORO	Kisoko (West)	100,293	64.3	101,730	48.9
		Tororo	45,821	50.7	60,142	44.4
		Total			161,872	**47.1**

Area	Region/District	County	No of poor 1992	Percent poor 1992	No of Poor in 2002 (person)	Ratio of Poor in 2002 (%)
Northern District	**AMOLATAR**	Kioga	44,196	66.3	44,952	**46.6**
	APAC	Kole	80,204	70.6	96,922	58.4
		Kwania	54,904	66.1	62,177	48.2
		Maruzi	46,408	65.7	51,767	46.1
		Koboko	47,201	82.6	53,881	54.7
		Madi-Okollo	46,943	67.8	58,715	63.0
		Yumra	37,054	59.1	48,158	53.6
		Teregо	53,385	54.8	77,185	49.2
		Ayivu	58,759	53.7	89,325	56.5
		Aringa	74,318	75.9	148,811	62.9
		Maracha	61,482	58	74,233	51.3
		Total			806,126	**58.2**
	DOKOLO	Dokolo	58,564	69.9	67,483	**51.8**
	LIRA	Moroto	79,320	71.4	101,839	61.6
		Erute	106,017	65.9	115,981	55.4
		Otuke	32,407	76	42,155	67.4
		Total			259,975	**59.5**
	ABIM	Labwor	27,131	88.3	39,914	**74.1**
	AMURIA	Amuria	31,462	71.1	68,643	57.4
		Kapelebyong	16,152	77.9	34,594	56.3
		Total			103,237	**57.0**
	KAABONGO	Dodoth	70,356	91.1	327,140	**94.6**
	KATAKWI	Usuk	54,501	78.3	69,661	**62.0**
	KOTIDO	Jie	42,263	93.1	120,361	**89.8**
	MOROTO	Bokora	30,421	83.8	101,048	89.8
		Matheniko	42,907	91.3	60,950	86.9
		Total			161,998	**88.7**
	NAKAPIRIPIRIT	Pian	20,442	84.9	35,312	87.7
		Kadam (Chekwii)	31,262	84.1	45,130	88.8
		Total			80,442	**88.3**
Central District	**KAYUNGA**	Bbaale	42,367	51.7	39,735	36.7
		Ntenjeru (Kinkiiji)	60,846	48.7	58,268	35.3
		Total			98,003	**35.9**
	LUWERO	Wabusana	64,984	61.6	45,506	33.3
		Nakaseke	48,088	53.3	40,360	29.8
		Katikamu	59,901	50.4	41,139	28.4
		Total			127,005	**30.5**
	MUKONO	Buyikwe	92,727	49	66,772	27.8
		Mukono	69,723	42	39,370	18.9
		Nakifuma	69,614	55.7	47,373	28.5
		Tingey	22,604	52.4	19,204	29.3
		Total			172,719	**25.4**
	NAKASONGOLA	Buruli	52,864	59.3	29,319	**24.4**
	WAKISO	Kyadondo	79,328	39.8	47,715	**10.2**

Source:"Nature,Distribution and Evolution of Poverty and Inquality in Uganda, 1992-2002" (UBOS and ILRI 2007)

ii) Waiting Time at Water Source in Dry seasons

Figure 16-2 shows average waiting time at water sources in dry seasons of the districts in the Basin obtained from the investigation by Ministry of Finance, Planning and Economic Development with 17,608 target households of the country. Some of the districts have been divided after the investigation. However, since sub-county level data is not available, it is assumed that the new districts have the same values as the original ones. In general, districts with long waiting time have higher needs for water supply facilities. Therefore, such districts have been considered to be given high priority for the selection.

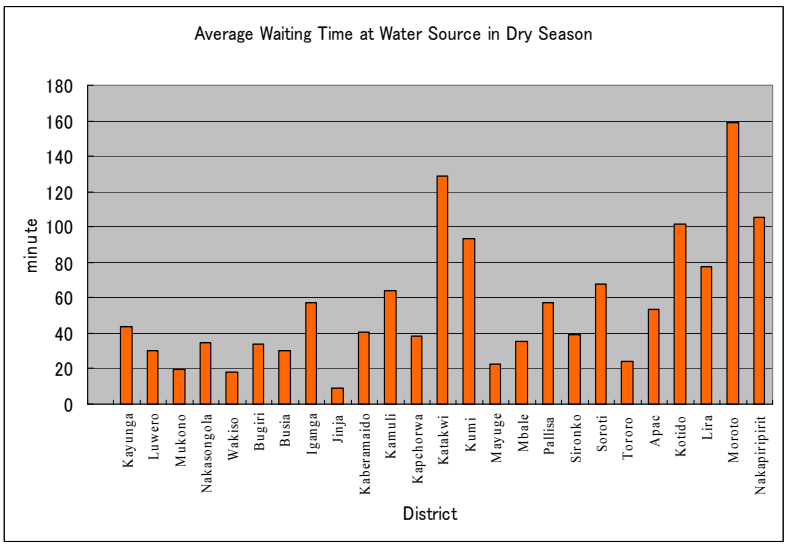


Figure 16-2 Waiting Time at Water Source in Dry Season

Data Source: "Gender Disaggregated Data for Water and Sanitation Sector" (MFPED Jan.2008)

iii) Rural Water Supply Coverage

Data shown in Table 9-6 in Chapter 9 was used to evaluate the water coverage rate of each district. The districts with lower water supply coverage considered to be given higher priority for the selection.

iv) Rural Water Supply Equity

Even for districts with the same water supply coverage, those with lower water supply equity tend to have higher needs of water sources. An indicator of equity in access to safe water is defined as the mean sub-county deviation from the district average in persons per water point as shown in Figure 9-8 in Chapter 9. The districts with high values in the figure are considered to be given high priority for the selection.

v) Functionality

The functionality is a ratio of the number of the functioning water supply facilities against the whole number of the facilities, and is considered to indicate the extent of mobilization for the community based management of facilities. The districts with higher functionality are generally considered to be more mobilized and smoother in facilitating the communities therein. Therefore, such districts with higher functionality are considered to be given higher priority in the selection.

(2) Natural Condition

Although groundwater sources have been predominantly used for the rural water supply due to various advantages in the Basin, there are certain difficulties in exploitation of groundwater resources. To minimize such difficulties it is required to find more advantageous areas for exploitation. The following five (5) hydrogeological parameters are adopted as those for natural conditions to indicate the advantages in developing groundwater of each district; drilling depths, static water levels, water yields, water qualities (TDS), and relative water recharges.

i) 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.

ii) 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.

iii) 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.

iv) 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.

v) Water Quality

Total Dissolved Solids (TDS) is one of the important measures of groundwater quality. It affects productivity of drinking water, and domestic animals. Therefore, the 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.

16.1.4 Evaluation Methods

Each parameter of the social and the natural conditions is linearly scaled to the range of 0 to 100 corresponding the lowest to the highest values. High values represent high priority for the selection. This operation is expressed in the following formula. Case 1 is for such data that a high value corresponds to higher priority for the selection. For example, poverty ratio of the social conditions and water yield of the natural conditions belong to Case 1. Case 2 is for the opposite cases where a high value corresponds to a low priority for selection such as water supply coverage rate of the social conditions and TDS of the natural conditions.

Case-1: $y = \frac{100}{Mm - Mx} \times (x - Mx)$

Case-2: $y = \frac{(x - Mm) \times 100}{Mx - Mm}$

$TP = \sum_{n=1}^{VI} y_n$

Mx : Maximum Value
Mm : Minimum Value
y : Evaluation Value
x : Data Value
TP : Total Evaluation Point
n : Index No.

16.1.5 Evaluation Result

(1) Social Conditions

Table 16-3 shows the social conditions of the 17 candidate districts evaluated based on the five (5) parameters (poverty ratio, waiting time at water sources in dry seasons, rural water supply coverage, rural water supply equity, functionality of water supply facilities). As shown in the table, Soroti, Katawaki, Budaka, Pallisa, Kumi and Kaliro emerge as the top six (6) priority districts in the descending order in terms of the social conditions.

(2) Natural Conditions (Hydrogeological Conditions)

The results are shown in Table 16-4. As shown in the table, Soroti, Iganga, Tororo, Sironko, and Namutunba are considered as the districts advantageous in groundwater development.

Table 16-3 Evaluation of Priority District by Social Condition

District Name	Social Condition Evaluation										Total Point	Ranking
	Poverty Condition		Waiting Time in Dry Season		Rural Water Supply Coverage							
	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"

Table 16-4 Evaluation of Priority District by Natural Condition

District Name	Natural Condition Evaluation (Hydrogeological Evaluation)										Total Point	Ranking
	Adopted Indices and Evluation Points											
	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**

(3) Results of Selection of Priority Districts

Figure 16-3 shows a scatter plot of the social and natural condition scores. 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).

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 priority districts. The locations of them are shown in Figure 16-4.

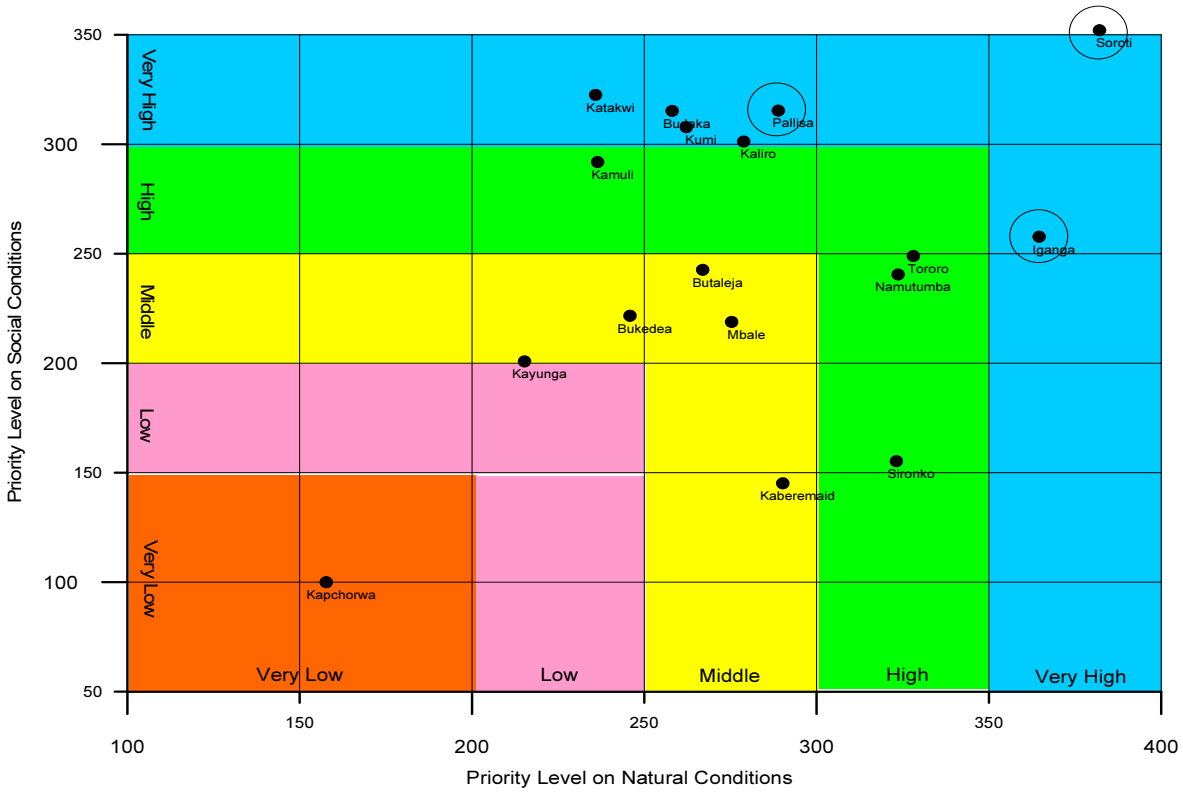


Figure 16-3 Selection of Priority District for Master Plan of Rural Water Supply