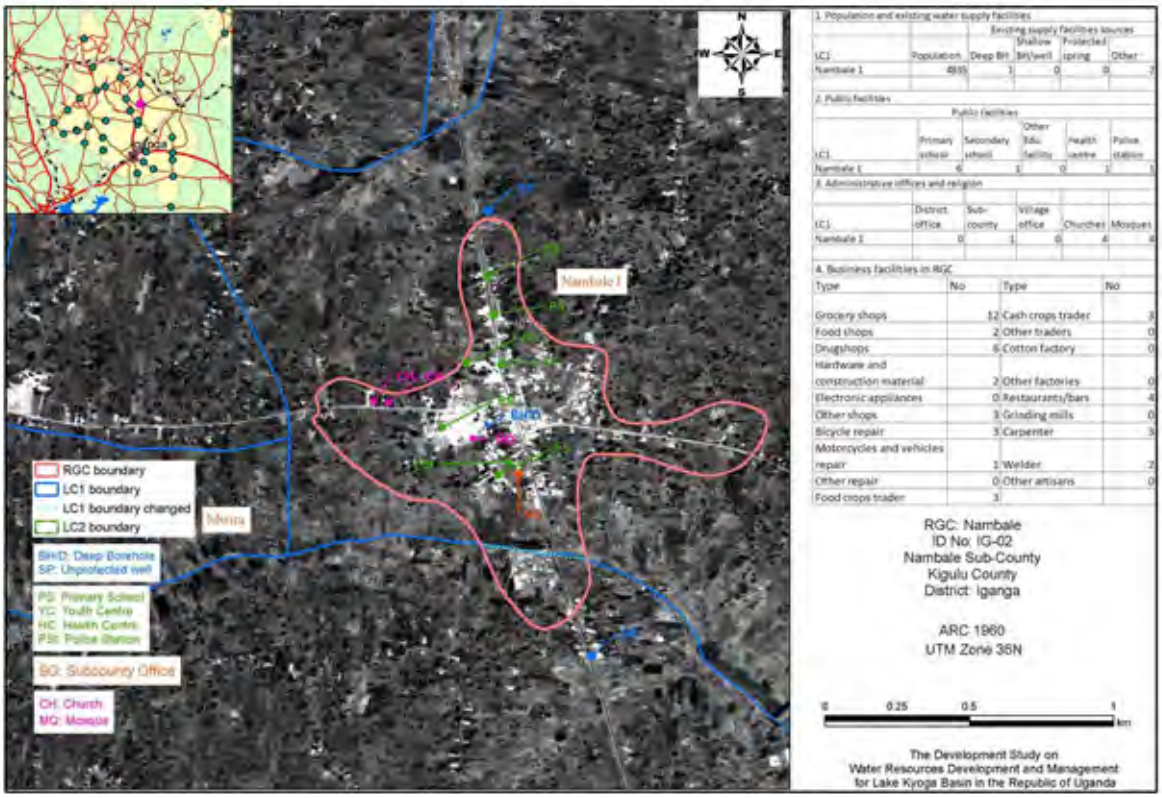


Figure 7-6 Example of RGC Survey Result Map

7.3 Rural Water Supply Master Plan

7.3.1 Present Situation of Rural Water Supply

(1) Administrative Units and Study Area

The Iganga, the Pallisa and the Soroti districts were selected as the priority districts for rural water supply master plan as discussed in Section 7.1, but the these selected districts were split up at the beginning of July 2010 as shown in Figure 7-7. The rural water supply master plan is to be prepared for the rural areas of sub-counties situated in the former district areas of the selected priority districts, but the new administrative boundaries and units are not considered.

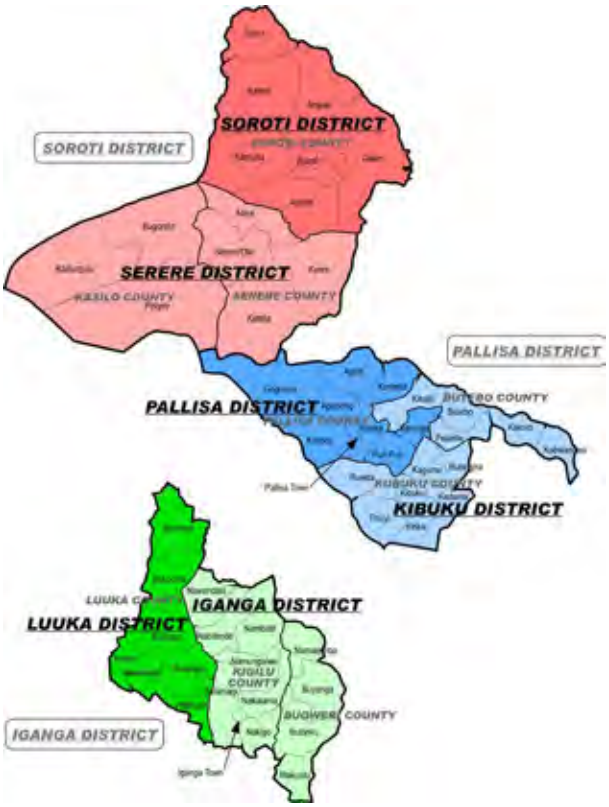


Figure 7-7 Former and Present Administrative Units

(2) Rural Water Supply

1) Water Source

The source of rural water supply in the priority districts is mainly groundwater, and deep and shallow wells with hand pump unit

are applied in the most of the village areas. In some areas water supply systems are connected to the transmissions of NWSC, and such systems are managed and maintained by NWSC though those areas are categorized in the rural areas. Such areas are excluded from the areas for this master plan study.

As shown in Table 7-6, there are 1,324, 927 and 1,143 point water sources such as deep and shallow wells and protected springs in the rural areas of the Iganga, the Pallisa and the Soroti districts, respectively according to the WATSUP data. The following Table presents the ratio of water sources in each priority district.

Table 7-6 Ratio of Water Sources in Priority Districts

(Unit: %)

District	Deep Groundwater	Spring Water	Shallow Groundwater	Rain Water
Iganga	62.0	11.2	26.7	0.1
Pallisa	70.6	18.6	10.7	0.1
Soroti	67.8	6.4	25.6	0.1

Dependence of water source on the groundwater in these districts such as deep and shallow wells and springs is considered to be as high as 99 % as shown in the above Table.

2) Population and Water Demand

The population of rural areas of each sub-county is tabulated below based on the population setting presented in SIP.

Table 7-7 Present Population of Rural Areas in Priority Districts (2010)

1. Iganga District		2. Pallisa District		3. Soroti District	
Sub-county	Population	Sub-county	Population	Sub-county	Population
Ikumbya	29,764	Gogonyo	22,640	Tuburu	21,743
Bukooma	37,626	Agule	27,599	Katine	26,658
Bulongo	29,532	Kameke	26,932	Arapai	38,195
Irongo	31,765	Apopong	23,590	Kamuda	34,556
Nawampiti	23,863	Kasodo	27,515	Soroti	17,649
Bukanga	43,530	Pallisa	13,809	Gweri	48,131
Waibuga	31,276	Putiputi	21,624	Asuret	37,310
Nawandala	29,707	Kamuge	19,036	Atiira	20,516
Nambale	40,701	Kibale	28,021	Olio	31,920
Nabitende	30,573	Butebo	24,527	Kyere	46,969
Namungalwe	36,414	Kakoro	17,936	Kateta	52,709
Nakalama	33,428	Kabuwangasi	19,328	Bugondo	34,026
Bulamagi	45,093	Petete	22,269	Kadungulu	25,839
Nakigo	22,919	Buseta	31,926	Pingire	48,895
Namalemba	19,250	Kibuku	14,911	Whole District	485,116
Buyanga	35,827	Tirinyi	16,786		
Ibulanku	49,567	Kirika	18,885		
Makuutu	27,022	Kadama	28,717		
Whole District	597,855	Kagumu	22,814		
		Bulangira	21,853		
		Whole District	450,719		

The present population to be covered by rural water supply are calculated to be 597,855, 450,719 and 485,116 for the whole district of the Iganga, the Pallisa and the Soroti districts, respectively. The present water demands are calculated as shown in Table 7-8 for each sub-county considering the present water consumption of 15 liter/day/capita applied in the estimates in SIP, and the annual water demands of the whole districts are 3.27 MCM, 2.47 MCM and 2.66 MCM for the Iganga, the Pallisa and the Soroti districts, respectively.

Table 7-8 Present Water Demand of Rural Areas in Priority Districts (2010)

(Unit: MCM)

1. Iganga District		2. Pallisa District		3. Soroti District	
Sub-county	Population	Sub-county	Population	Sub-county	Population
Ikumbya	0.16	Gogonyo	0.12	Tubur	0.12
Bukooma	0.21	Agule	0.15	Katine	0.15
Bulongo	0.16	Kameke	0.15	Arapai	0.21
Irongo	0.17	Apopong	0.13	Kamuda	0.19
Nawampiti	0.13	Kasodo	0.15	Soroti	0.10
Bukanga	0.24	Pallisa	0.08	Gweri	0.26
Waibuga	0.17	Putiputi	0.12	Asuret	0.20
Nawandala	0.16	Kamuge	0.10	Atiira	0.11
Nambale	0.22	Kibale	0.15	Olio	0.17
Nabitende	0.17	Butebo	0.13	Kyere	0.26
Namungalwe	0.20	Kakoro	0.10	Kateta	0.29
Nakalama	0.18	Kabuwangasi	0.11	Bugondo	0.19
Bulamagi	0.25	Petete	0.12	Kadungulu	0.14
Nakigo	0.13	Buseta	0.17	Pingire	0.27
Namalemba	0.11	Kibuku	0.08	Whole District	2.66
Buyanga	0.20	Tirinyi	0.09		
Ibulanku	0.27	Kirika	0.10		
Makuutu	0.15	Kadama	0.16		
Whole District	3.27	Kagumu	0.12		
		Bulangira	0.12		
		Whole District	2.47		

3) RGCs in Priority Districts

As shown in Table 7-9, there are 61 RGCs identified in the priority districts; 29, 17 and 15 numbers in the Iganga, the Pallisa and the Soroti districts, respectively, excluding the two(2) RGCs of which water supply facilities are provided and managed by NWSC; Trinyi and Kibuku. Out of these RGCs, four (4) RGCs in the Soroti district (Ocapa, Kyere, Kamod and Kadungulu) will have existing piped water supply systems, and then the remaining 57 RGCs considered to require water supply facilities.

Table 7-9 List RGCs for Master Planning

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

Note: The RGCs with "*" are those having the existing schemes, and then only the future extension of the schemes is considered in the master plan.

4) Coverage of Safe Water Supply

There are protected springs and deep and shallow boreholes with hand pump scattered in the rural areas of the priority districts, but in the RGC areas the population is increasing rapidly due to population inflow from the surrounding rural areas, worsening water supply situations in RGCs. The coverage of RGCs in the priority districts calculated based on the data collected through the WATSUP survey and RGC survey are presented in Figure 7-8, and the coverage of

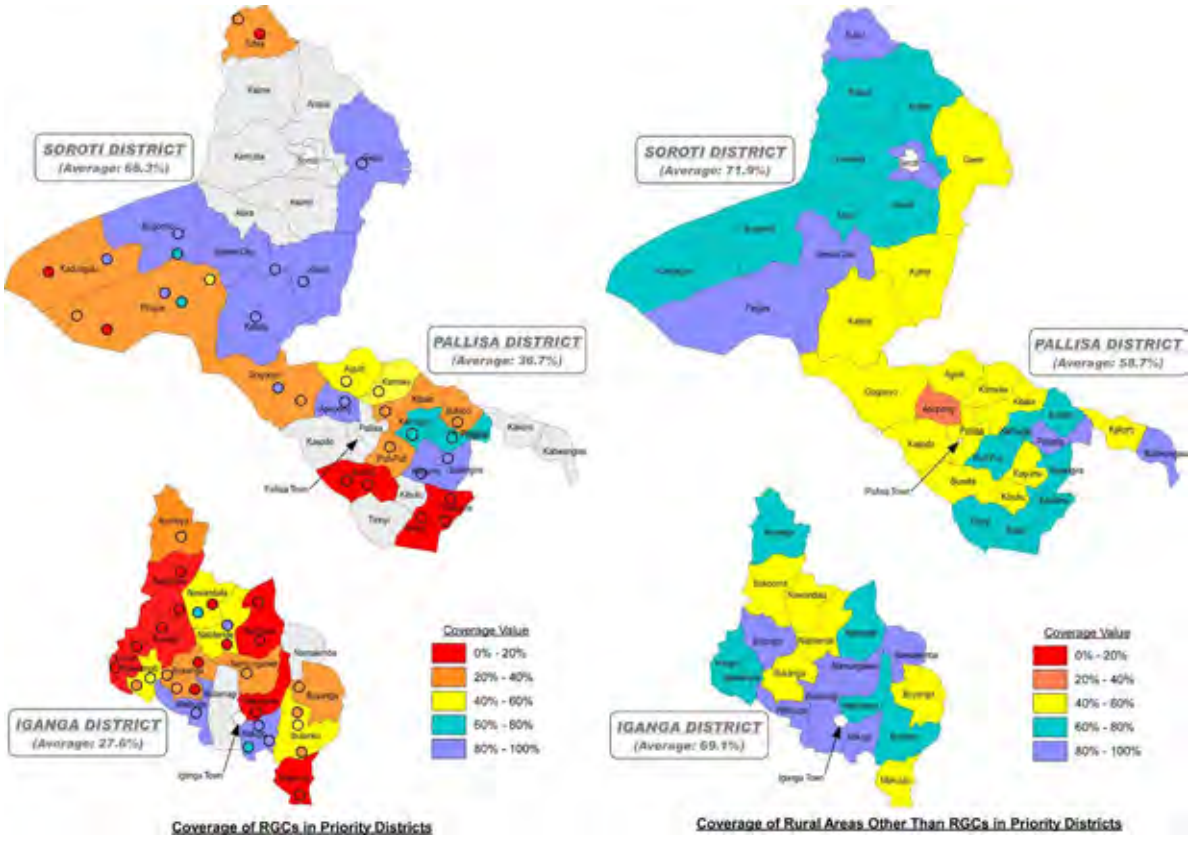


Figure 7-8 Coverage of RGCs and Other Rural Areas in Priority Districts

the whole RGCs in the priority districts are 27.1 %, 36.5 % and 60.1 % for the Iganga, the Pallisa and the Soroti districts, respectively. The coverage of the Soroti district is rather higher then the others because the coverage of the RGCs for which water supply systems are either on going or has determined to implement the construction are set at 100 %, but those for the other RGCs in the Soroti district is considered on almost same level as the Iganga and the Pallisa districts.

On the other hand, the coverage of the rural areas other than the RGC areas are 69.1 %, 58.7 % and 71.2 % for the Iganga, the Pallisa and the Soroti districts, and the coverage of RGCs are found to be quite lower comparing with these values. The sub-county-wise coverage vary widely from 38.1 % of Apopong sub-county of the Pallisa district to 100 % of the Tubur and the Soroti sub-counties of the Soroti district. However, the coverage of such areas that the population densities are so low as Tubur sub-county may not reflect the actual situations, and they may face the difficulties in fetching water due to long access distances, etc. Since it is difficult to grasp such situations from the processed data, these matters are not considered in master planning.

The coverage of each RGC is calculated based on the population and the type and number of the existing water supply facilities in RGC which are obtained in the RGC survey. Since the period of the RGC survey was limited, the RGC boundaries were set on the satellite images and the population was estimated with the simplified method, and the coverage was calculated dividing the served population by the existing facilities by the population. Therefore, it is important to confirm RGC population, type and number of existing water supply facilities, accumulation of commercial and business facilities as well as setting of RGC boundary through the more precise socio-economic survey in order to grasp the actual situation of water supply in RGC for establishing the water supply plan which meets the needs of the RGC population.

5) Hydrogeological Condition

Main geology of target districts is called the Basement Complex composed by granite or gneiss formed in Precambrian era. After the Precambrian era, this area didn't get large tectonic movement. Therefore, peneplain has formed by weathering and erosion. Characteristically, granite is easy to be weathered and has many fractures from near surface to several dozen meters in depth. Weathered granite forms sandy state near surface. Clay mineral called "Kaoline" derives from weathered granite. Since the topography is flat in this area, thick clay layer which has 20 to 30m thickness is formed occasionally. Since clay has very low hydraulic permeability., the recharge of groundwater from surface is very limited. Lowness of groundwater yield of wells in this area is caused by this thick clay layer. In the existing well data analysis, average well yield is very low, i.e. 2.5 m^3/h in Iganga and Soroti districts, and 1.9 m^3/h in Pallisa district.

Two types of aquifer are considered, which were the weathered granite before argillization and the fracture zone in the rock. Fractures occur not only vertical but also horizontal in granitic rocks. Many small hills of granite called "Inselberg" with more resistant rock masses, which formed through weathering process, are observed in this area. This inserberg is considered as good groundwater recharge area. Therefore, the important thing is to understand the distribution of exposed bedrock place and continuity of decomposed granite layer or fracture.

To grasp the hydrogeological situation of the priority districts, the well data which have hydrogeological informations such as static water levels and yields) were extracted and analyzed by comparing between the existing well data (NGWDB) and WATSUP data, since the accuracy of well positions are quite improved in WATSUP data. Figure 7-9 shows the well yield distribution of each district.

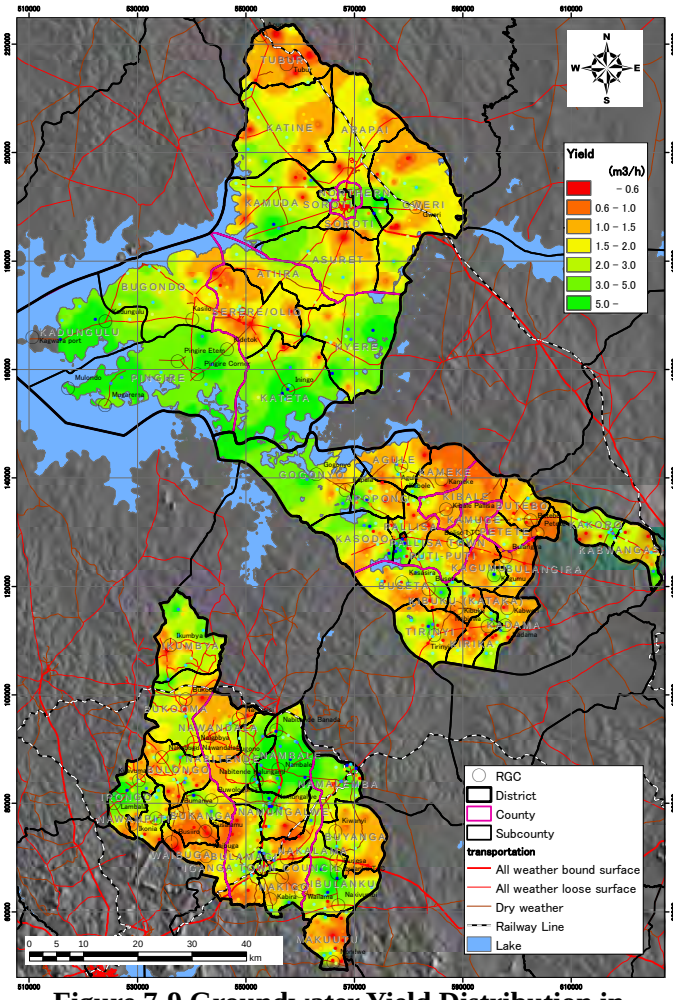


Figure 7-9 Groundwater Yield Distribution in the Priority Districts

In Iganga district, very low yield areas are in Waibuga subcounty, Bukanga subcounty, and the border area between Namungalwe and Nakalama subcounty. The oldest geologies in this area, i.e. Nyanzian formation and Granitoid, are distributed in Makuutu sobcounty. This sub-county has also very low yield. Nambale sub-county and Ibulanku sub-county are relatively high yield.

Pallisa district has low yield in whole area, i.e. most of sub-counties have below $2m^3/h$ yield. Especially, Bulangira, Agula, and Butebo sub-county have very low yield. But Kakoro sub-county, Trinyi sub-county, and the area along Lake Kyoga or Mpologoma river are relatively high yield.

Southern part of Soroti district, Kadungulu, Pingire, Kateta and Kyere sub-counties, are high yield area. But the northern part of Soroti district has low yield.

Additionally, test boreholes were drilled to confirm the hydrogeological condition in the priority

districts. The result is shown in Table 7-10. Maximum yield was 13.2 m^3/h at Kidetok RGC in Soroti district. On the other hand, 4 boreholes were dry. The average yield of test boreholes is 2.82m^3/h. This is the same level as existing data mentioned above. Additionally, if the yield 0.5 m^3/h or more is success borehole, the success rate is calculated 60%.

Table 7-10 Result of Test Borehole Drilling

RGC Name	Bore-hole No.	UTM-E (m)	UTM-N (m)	Drilled depth (m)	SWL (GL-m)	Safe yield (m^3/h)	Dynamic water level (m)	Trans-missivity (m^3/h/m)	Storage Co-efficient	Total Residue Solid (mg/L)
Nabitende	JTB-1	555211	93570	71.00	Dry	-	-	-	-	-
	JTB-2	556605	94312	101.00	Dry	-	-	-	-	-
Ikumbya	JTB-3	536283	110016	78.00	16.00	3.9	30.21	0.246	0.016	162
	JTB-4	536549	108910	83.00	13.19	1.2	32.62	0.058	$2.3x10^{-4}$	241
Naigobya	JTB-5	540745	90151	65.00	Dry	-	-	-	-	-
	JTB-6	540671	90044	45.00	6.80	3.65	19.21	0.842	$3.4x10^{-6}$	125
Lambala	JTB-7	525603	79395	65.00	7.13	0.32	20.55	-	-	703
	JTB-8	526207	78988	60.00	3.60	1.2	17.60	0.075	$4.5x10^{-4}$	177
Kibale	JTB-9	587203	133792	80.00	7.00	0.32	36.00	-	-	159
	JTB-10	587168	133833	60.00	Dry	-	-	-	-	-
Kameke	JTB-11	584511	139903	70.00	3.45	7.2	23.16	0.194	0.28	237
	JTB-12	584571	139941	70.00	3.36	1.8	32.32	0.061	0.008	177
Kadama	JTB-13	599409	113709	87.00	4.03	0.6	33.13	0.007	0.054	198
	JTB14	597907	114227	55.00	1.93	0.6	9.98	0.042	0.004	312
Kabweri	JTB-15	598108	117233	55.00	4.71	0.32	36.55	-	-	241
	JTB-16	599036	117098	55.00	5.02	1.5	17.83	0.102	0.002	713
Kidetok	JTB-17	545498	162649	80.00	8.64	7.2	22.69	0.186	0.433	529
	JTB-18	546246	162351	80.00	13.20	13.2	32.12	0.508	0.406	383
	JTB-19	547671	165028	87.00	12.42	1.8	37.26	0.025	0.051	180
Achuna	JTB-20	553725	220705	50.00	5.3	< 0.3	37.77			285

Probability density function against yield of each sub-county can be obtained from the calculation of average value and the standard deviation of the groundwater yield from statistic data of the existing boreholes. Success rate of well is considered on the cumulated curve of the function.

Success rate of the yield Y m^3/h was calculated by the following equation.

$$SuccessRate(Y) = \frac{1}{\sqrt{2\pi}} \int_Y^{\infty} \exp\left(-\frac{(x-\bar{x})^2}{2\sigma^2} \right) dx$$

Where, $\bar{x}$ is the average of the yield, σ is the standard deviation.

Figure 7-10 shows the success rate distribution of each subcounty in case of 1.0 m^3/h yield.

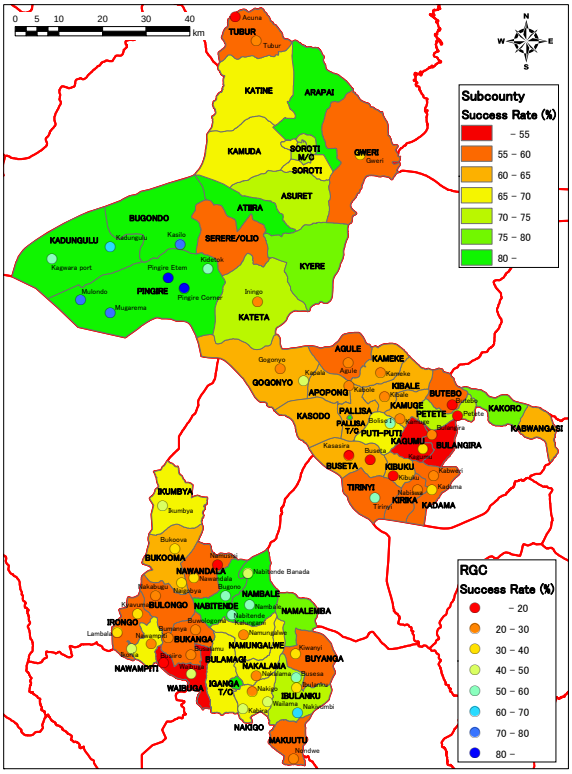


Figure 7-10 Success Rate of Wells by Subcounty

Water balance was considered between groundwater resource amaount and groundwater demand planned in this master

plan in 2035. Annual groundwater recharge amount is used as sustainable water resource amount. Annual groundwater recharge by sub-basin in Chapter 2 was used as groundwater resource amount, and it was re-distributed by subcounty. Water demand was calculated from population frame. Table 7-11 shows the result. Used groundwater amount is only 1% out of groundwater amount. Then, even in 2035, the groundwater amount is enough, but there is one

Table 7-11 Comparison between Water Demand and Available Groundwater Amount

District	County	Sub-county	Water Demand (Million m^3/year)								Exploitable Groundwater Resources (Million m^3)
			2010		2015		2020		2035		
			Demand	Ratio(%)	Demand	Ratio(%)	Demand	Ratio(%)	Demand	Ratio(%)	
Iganga	Buguweri	Buyanga	0.2	0.6	0.3	1.0	0.5	1.4	0.9	2.8	32.4
		Iublanku	0.3	1.0	0.4	1.6	0.6	2.4	1.3	4.8	26.2
		Makuutu	0.1	2.6	0.2	4.1	0.3	6.1	0.7	12.2	5.6
		Namalemba	0.1	0.5	0.2	0.8	0.2	1.1	0.5	2.2	22.0
	Kigulu	Bulamagi	0.2	0.8	0.4	1.3	0.6	1.8	1.1	3.7	31.1
		Nabitende	0.2	1.0	0.3	1.5	0.4	2.3	0.8	4.5	17.2
		Nakalama	0.2	1.4	0.3	2.2	0.4	3.3	0.8	6.5	13.1
		Nakigo	0.1	1.0	0.2	1.6	0.3	2.4	0.6	4.8	12.1
		Namabale	0.2	0.7	0.4	1.2	0.5	1.7	1.0	3.4	30.5
		Namungalwe	0.2	0.9	0.3	1.5	0.5	2.2	0.9	4.3	21.3
		Nawandala	0.2	0.6	0.3	1.0	0.4	1.5	0.8	3.0	25.3
	Luuka	Bukanga	0.2	1.5	0.4	2.4	0.6	3.5	1.1	7.0	15.8
		Bukooma	0.2	0.6	0.3	0.9	0.5	1.3	1.0	2.6	36.3
		Bulongo	0.2	0.8	0.3	1.3	0.4	1.9	0.7	3.8	19.5
		Ikumbya	0.2	0.4	0.3	0.7	0.4	1.0	0.8	2.0	38.4
		Irongo	0.2	1.3	0.3	2.1	0.4	3.1	0.8	6.1	13.2
		Nawampiti	0.1	1.1	0.2	1.7	0.3	2.5	0.6	4.9	12.4
		Waibuga	0.2	1.1	0.3	1.8	0.4	2.6	0.8	5.1	15.4
Total			3.3	0.8	5.2	1.3	7.6	2.0	15.1	3.9	387.8
Pallisa	Pallisa	Agule	0.2	0.5	0.2	0.8	0.4	1.3	0.7	2.5	28.2
		Apopong	0.1	0.6	0.2	1.0	0.3	1.5	0.6	3.0	20.4
		Gogonyo	0.1	0.2	0.2	0.3	0.3	0.5	0.6	0.9	62.8
		Kameke	0.1	0.6	0.2	0.9	0.3	1.3	0.7	2.6	26.8
		Kamuge	0.1	1.0	0.2	1.7	0.2	2.5	0.5	4.9	9.9
		Kasodo	0.2	0.5	0.2	0.8	0.4	1.2	0.7	2.4	29.4
		Pallisa	0.1	0.4	0.1	0.6	0.2	1.0	0.4	1.9	18.4
		Puti-Puti	0.1	0.7	0.2	1.1	0.3	1.6	0.6	3.2	17.6
	Butebo	Butebo	0.1	0.8	0.2	1.3	0.3	1.9	0.6	3.8	16.5
		Kabwangasi	0.1	0.7	0.2	1.2	0.2	1.7	0.5	3.4	14.5
		Kakoro	0.1	0.6	0.2	1.0	0.2	1.5	0.5	2.9	15.8
		Kibale	0.2	0.5	0.2	0.9	0.4	1.3	0.7	2.5	28.4
		Petete	0.1	1.2	0.2	1.9	0.3	2.8	0.6	5.5	10.4
	Kibuku	Bulangira	0.1	1.7	0.2	2.7	0.3	4.1	0.6	8.1	6.9
		Buseta	0.2	0.6	0.3	0.9	0.4	1.3	0.8	2.7	31.0
		Kadama	0.2	1.5	0.2	2.4	0.4	3.6	0.7	7.1	10.4
		Kagumu	0.1	1.3	0.2	2.0	0.3	3.0	0.6	6.0	9.8
		Kibuku	0.1	1.1	0.2	1.8	0.2	2.7	0.4	5.4	8.3
		Kirika	0.1	0.9	0.2	1.4	0.2	2.0	0.5	4.1	12.0
		Tirinyi	0.1	0.7	0.2	1.2	0.3	1.7	0.7	3.4	20.4
Total			2.5	0.6	4.0	1.0	6.0	1.5	12.0	3.0	397.9
Soroti	Soroti	Arapai	0.2	0.5	0.3	0.8	0.5	1.2	1.1	2.5	44.1
		Asuret	0.2	0.6	0.3	1.0	0.5	1.5	1.1	3.2	33.9
		Gweri	0.3	0.4	0.4	0.7	0.7	1.1	1.4	2.3	61.5
		Kamuda	0.2	0.5	0.3	0.8	0.5	1.2	1.0	2.5	40.0
		Katine	0.2	0.3	0.3	0.5	0.4	0.8	0.9	1.7	52.8
		Soroti	0.1	1.2	0.2	1.9	0.2	2.9	0.5	6.2	8.3
		Tubur	0.1	0.6	0.2	0.9	0.3	1.4	0.6	3.0	21.4
	Kasilo	Bugondo	0.2	0.5	0.3	0.8	0.5	1.3	1.0	2.8	35.8
		Kadungulu	0.1	0.4	0.2	0.6	0.3	0.9	0.8	2.0	37.6
		Pingire	0.3	0.3	0.4	0.5	0.7	0.8	1.4	1.7	83.5
	Serere	Atiira	0.1	0.6	0.2	1.0	0.3	1.5	0.6	3.3	18.1
		Kateta	0.3	0.4	0.5	0.6	0.7	0.9	1.5	2.0	75.4
		Kyere	0.3	0.5	0.4	0.9	0.6	1.3	1.4	2.8	48.3
		Serere/Olio	0.2	0.5	0.3	0.8	0.4	1.2	0.9	2.7	34.8
Total			2.7	0.5	4.3	0.7	6.6	1.1	14.3	2.4	595.3

subcounty which is exceeded 10% of usable groundwater amount.

7.3.2 Basic Conditions of Master Plan

(1) Target Years

The master plan is prepared based on the results of the WATSUP survey conducted by DWD and the RGC survey and both of them were carried out in 2010. The basic year is, therefore, set for 2010 and the final target year is set for 2035 with the reference milestone years of 2015 and 2020. The master plan is to be achieved with three (3) steps; the short, medium and long term plans for the target years of 2015, 2020 and 2035, respectively.

(2) Target of Master Plan

The target value of access to safe water in 2015 is set for 77 % in accordance with NDP and SIP. SIP further state the targets of safe water access 83 % and 100 % for 2020 and 2035, respectively. The target value of coverage is set as follows in the master plan.

Table 7-12 Target Value of Master Plan

Target Years	2015	2020	2035
Target Value of Coverage for each District	77 %	83 %	100 %

(3) Components of Master Plan

To improve the access to safe water, the water supply facilities have to be provided. The water supply facilities are planned for the RGC areas and the rural areas other than RGCs in this master plan as shown bellow.

- Piped water supply systems are provided to RGC areas, and their extension plans are also considered according to the population growth of the respective RGCs.
- The deep boreholes with hand pump are applied for the villages in rural areas other than RGCs, and it is necessary to repair non-functional water supply facilities as soon as possible. This repairing scheme is also considered as one of the master plan components. Since it is considered difficult for the village people to reserve the costs for depreciation of their borehole with hand pump in their management, the replacement of such facilities are required to be made by the government. The replacement of the existing water supply facilities is, therefore, considered in the master plan in order to keep the proper safe water access in rural areas.

(4) Water Sources

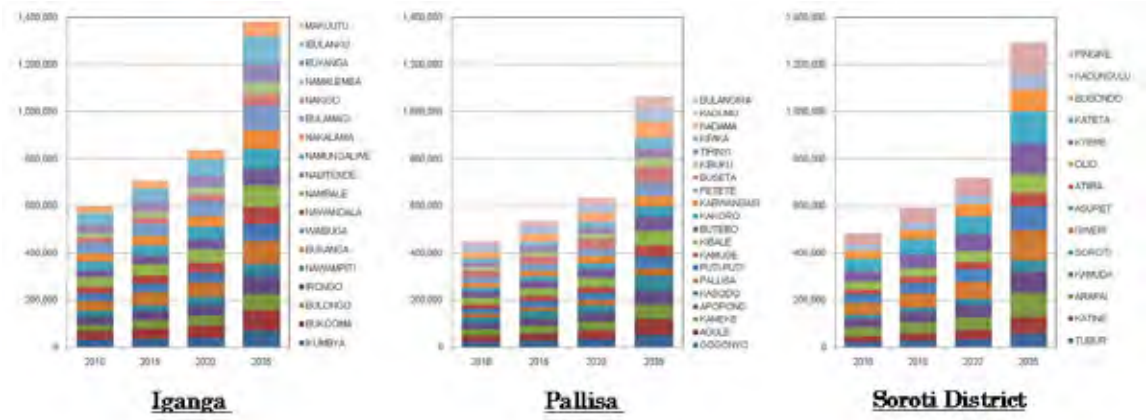
The groundwater is basically applied for the rural water supply because the surface water source is not used predominantly in the priority districts. However, in some villages located near the NWSC transmissions, water supply systems are connected to the transmission pipelines of NWSC. It is then considered in the master plan to adopt such connection to the NWSC transmissions as an alternative source in case that the groundwater potential is judged to be limited and there is no other groundwater sources even if it is considered to transmit water from nearby areas in the same district. As for the groundwater, it include shallow aquifer and spring water, too, but in this master

plan only the deep groundwater is considered because the shallow aquifer and spring water is not considered as the stable safe water even if protected.

7.3.3 Water Demand

(1) Population Frame

The future population is worked out in SIP until 2035 based on the census data of UBoS (2002). The rural population under the rural water supply controlled by DWD is calculated applying these SIP population data. The population of RGCs and village areas other than RGCs in each sub-county is calculated for the target years of 2015, 2020 and 2035 applying the population data of RGCs collected in the RGC survey. The population of the whole district and RGCs in the district are summarized in Figure 17-11.



District	2010	2015	2020	2035
Iganga	597,855	706,957	835,968	1,382,230
(RGC Pop.)	(88,867)	(105,084)	(124,251)	(205,458)
Pallisa	450,719	536,127	635,069	1,062,167
(RGC Pop.)	(45,744)	(54,407)	(64,454)	(107,801)
Soroti	485,116	590,218	718,090	1,293,240
(RGC Pop.)	(32,012)	(38,947)	(47,386)	(85,339)

Figure 7-11 Present and Future Rural Population of Priority Districts

The population of RGCs occupy 15 %, 10 % and 7 % of the whole population of the Iganga, the Pallisa and the Soroti districts, respectively. The population of these RGCs will increase as they grow by population concentration, and some of them will be transferred to urban water supply as the township in the future. In the other hand, new RGCs may be born by the population concentration to any new trading centers, etc. However, it is difficult to predict such future transformation of the rural population. Therefore, in this master plan, any new birth of RGC is not considered, and instead it is assumed that the present RGCs grow as they are even after the population thereof becoming over 5,000.

(2) Water Demand

The consumption per capita for the rural water supply is set as follows considering those applied in SIP.

Target Years	2010	2015	2020	2035
Consumption:	15 liter/day/capita	20 liter/day/capita	25 liter/day/capita	30 liter/day/capita

Based on the above consumption per capita and the projected future population, the future water demand is calculated as shown below.

Table 7-13 Future Rural Water Demands of Priority Districts

(m^3/day)

Priority District (Consumption)	2010 (15 lit./d./capita)	2015 (20 lit./d./capita)	2020 (25 lit./d./capita)	2035 (30 lit./d./capita)
Iganga District	8,968	14,139	20,899	41,467
Pallisa District	6,761	10,723	15,877	31,865
Soroti District	7,277	11,804	17,952	38,797

7.3.4 Water Supply Plan

The water supply facilities required for each term are planned for each sub-county considering the followings.

- Since the coverage of RGCs is found to be low comparing with the village areas other than RGCs, the water supply facilities are provided for RGCs with higher priority than the other areas and complete substantially in the short and the middle term plans. However, the RGCs having existing piped water supply facilities are put lower priority and their implementations are planned for the middle and the long term plans.
- Second priority is given to the village areas of which coverage values are lower, and much gains of coverage is considered. The population covered by one (1) borehole is set at 300 as applied in SIP in the calculation of coverage by boreholes with hand pump.
- The provision of water supply facilities are so determined that the coverage of the whole district achieves the target coverage set for each term.
- The repair of the non-functional facilities is planned to be conducted in the short and the middle terms.
- The replacement of the existing water supply facilities is planned considering the life period of 25 years in accordance with the setting in SIP; actually four (4) % of the existing boreholes have to be replaced every year.

The numbers of water supply facilities and the coverage values calculated for each term are summarized in Table 7-14, and the improvement of coverage in each sub-county is illustrated in Figure 7-12.

Table 7-14 Summary of Water Supply Facilities Proposed for Master Plan

Descriptions		2010 (Present)	2015 (Short Term Plan)	2020 (Middle Term Plan)	2035 (Long Term Plan)	Total
1. Iganga District						
(Coverage)						
RGC		27.1 %	95.6 %	100.0 %	100.0 %	-
Out of RGC		69.1 %	73.8 %	79.6 %	100.0 %	-
Whole District		63.0 %	77.1 %	82.6 %	100.0 %	-
(Required Water Supply Facilities)						
RGCs Areas	Construction	-	21 RGCs	5 RGCs	3 RGCs	29 RGCs
	Extension	-	-	21 RGCs	26 RGCs	-
Other Areas	Boreholes	-	306 nos.	406 nos.	2,035 nos.	2,747 nos.
	Repair	-	70 nos.	69 nos	-	139 nos.
	Replace	-	180 nos.	252 nos.	1,491 nos.	1,923 nos.
2. Pallisa District						
(Coverage)						
RGC		36.5 %	91.8 %	100.0 %	100.0 %	-
Out of RGC		58.7 %	75.2 %	81.1 %	100.0 %	-
Whole District		56.5 %	76.9 %	83.1 %	100.0 %	-
(Required Water Supply Facilities)						
RGCs Areas	Construction	-	11 RGCs	6 RGCs	-	17 RGCs
	Extension	-	-	11 RGCs	17 RGCs	-
Other Areas	Boreholes	-	390 nos.	361 nos	1,638 nos.	2,389 nos.
	Repair	-	47 nos.	47 nos.	-	94 nos.
	Replace	-	160 nos.	233 nos.	1,297 nos.	1,690 nos.
3. Soroti District						
(Coverage)						
RGC		60.1 %	97.2 %	100.0 %	100.0 %	-
Out of RGC		71.2 %	75.6 %	81.7 %	100.0 %	-
Whole District		70.4 %	77.0 %	82.9 %	100.0 %	-
(Required Water Supply Facilities)						
RGCs Areas	Construction	-	7 RGCs	3 RGCs	1 RGC	11 RGCs
	Extension	-	-4 RGCs	11 RGCs	14 RGCs	-
Other Areas	Boreholes	-	303 nos.	437 nos.	2,202 nos.	2,947 nos.
	Repair	-	84 nos.	84 nos.	-	168 nos.
	Replace	-	169 nos.	244 nos.	1,532 nos.	1,945 nos.

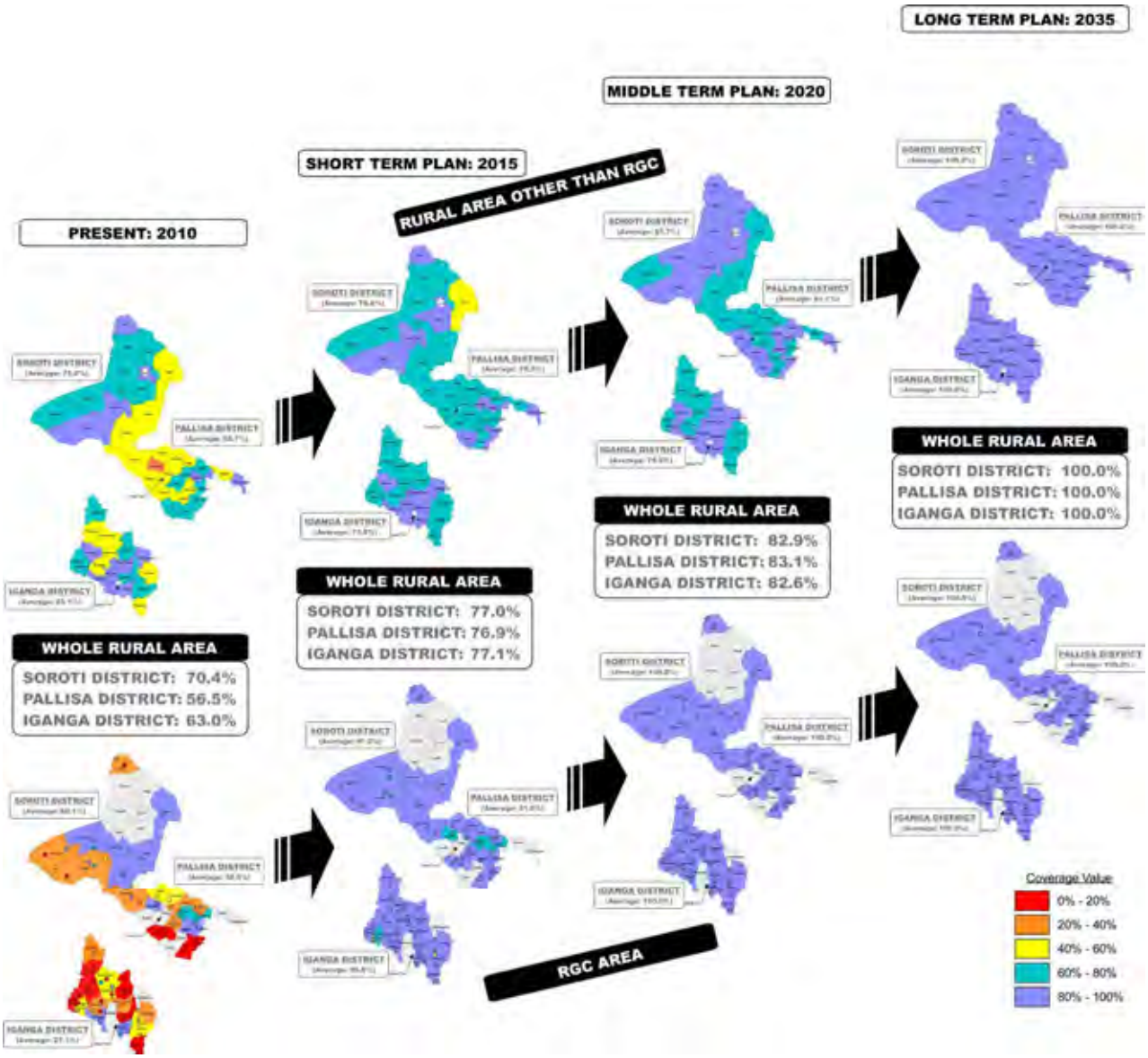


Figure 7-12 Improvement of Sub-county-wise Coverage in Priority Districts

The achievement of improving coverage of each priority district is set to fulfill the target of each term. The present coverage of the Iganga, the Pallisa and the Soroti districts are 63.0 %, 56.5 % and 70.4 %, respectively, and the master plan is so prepared that these coverage values of each district are set to reach 77 %, 83 % and 100 % in 2015 for the short term, 2020 for the middle term and 2035 for the long term, respectively.

The implementation term of water supply facilities for RGCs is tabulated in Table 7-15, and the locations and the implementation terms of such RGC facilities are illustrated in Figure 7-13. There are 57 RGCs in the priority districts excluding those having the existing facilities, and the water supply facilities of 39 RGCs which are given higher priorities due to lower coverage in each district are planned be provided in the short term (2015). The 39 RGCs for the short term plan consist of 21 RGCs for the Iganga district, 11 RGCs for the Pallisa district and 7 RGCs for the Soroti district. Since in some RGCs 100 % of coverage has been achieved by the existing facilities, 100 % of

coverage is substantially achieved for RGCs by the end of middle term plan. Then, the extension word of such RGC facilities and the construction of deep boreholes with hand pump are considered to be main work in the middle term plan.

Figure 7-13 Location and Implementation Term of RGC

Table 7-15 RGCs and Implementation Term

Short Term Plan (2015)	Middle Term Plan (2020)	Long Term Plan (2035)	Short Term Plan (2015)	Middle Term Plan (2020)	Long Term Plan (2035)
1. Iganga District (29 sites)			2. Pallisa District (17 site)		
Ikumbya Bukooma Naigobya Nakabugu Kyanvuma Lambala Nawampiti Buwologoma Bumanya Busiiro Busalamu Namusisi Nambale Nabitende B. Nabitende K. Namungalwe Kiwanyi Nakalama Busesa Nakivumbi Nondwe	Ikonia Nawandala Nakigo Kabira Ibulanku T/C	Waibuga Bugono Wailama	Kapala Agule Kameke Kibale Pallisa Butebo Boliso ITC Kasassira Buseta Nabisuwa Kabweri Kadama	Gogonyo Kabole Kamuge Petete Kigumu Bulangira	
			11 sites	6 sites	-
			3. Soroti District (11 sites)		
			Acuna Tubur Kagwara Port Kidetok Pingire Etem Mulondo Mugarema	Gweri Iningo Pingire Corner	Kasilo
21 sites	5 sites	3 sites	7 sites	3 sites	1 site
			39 sites	14 sites	4 sites

7.3.5 Water Supply Facilities

(1) Water Supply Facilities for Rural Areas Other than RGC

The deep boreholes with hand pump are predominantly applied in the rural areas in the priority districts, since the groundwater resources are considered the most promising source for safe water supply in the districts. In the master plan, the deep boreholes with hand pump as shown in Figure 7-14 are proposed to be applied for the rural areas other than RGCs.

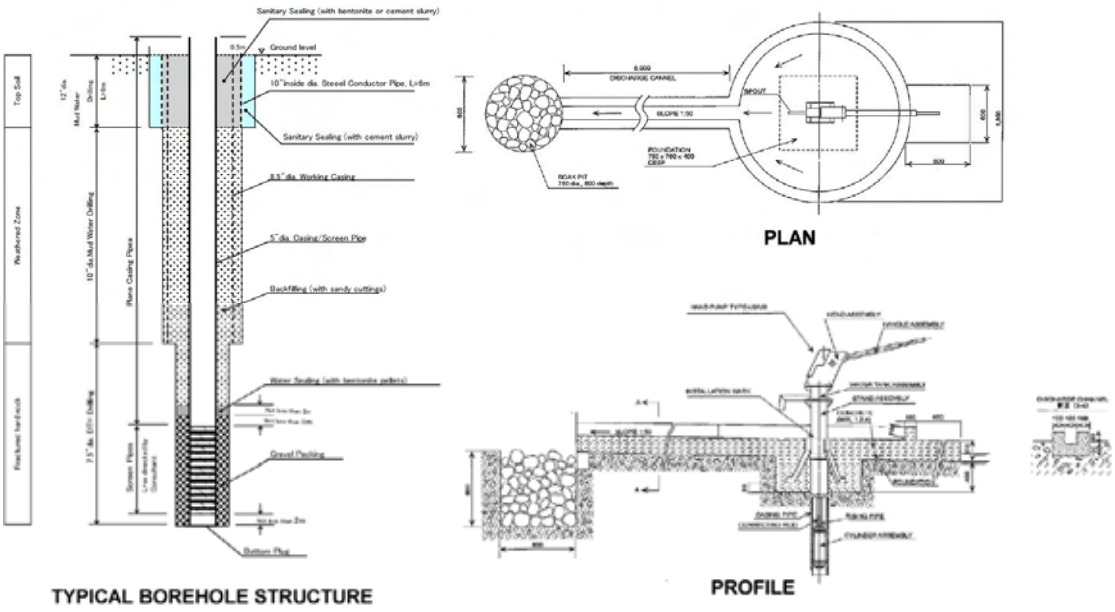


Figure 7-14 Typical Borehole Structure with Hand Pump for Rural Water Supply

(2) Water Supply Facilities for RGC Areas

1) Categories of RGCs

The RGCs are divided into four (4) categories in terms of population scale as follows:

Category	Population
- Category I:	<1,000
- Category II:	1,000 - 3,000
- Category III:	3,000 - 5,000
- Category IV:	5,000<

RGCs are defined as villages having a population between 500 and 5,000, but those villages of which population is out of this range are often called as RGCs due to their administration and commercial functions.

Preliminary design and cost estimate will be conducted for the RGCs selected for representing each category of RGC, and the construction costs for the other RGCs will be estimated based on the cost per capita calculated for each category of RGC. The selected nine (9) RGCs are listed in Table 7 16.

Since as shown in Figure 7-15, the number of RGCs categorized into Category II is the most, this category is sub-categorised into two (2) categories; Category II-1 and II-2. As the areas and topography of each RGC is different form RGC to RGC even in the same category, the RGCs representing the category are selected at least two (2) in each category. Considering the number of existing RGCs in each district, four (4), three (3) and two (2) representative RGCs are

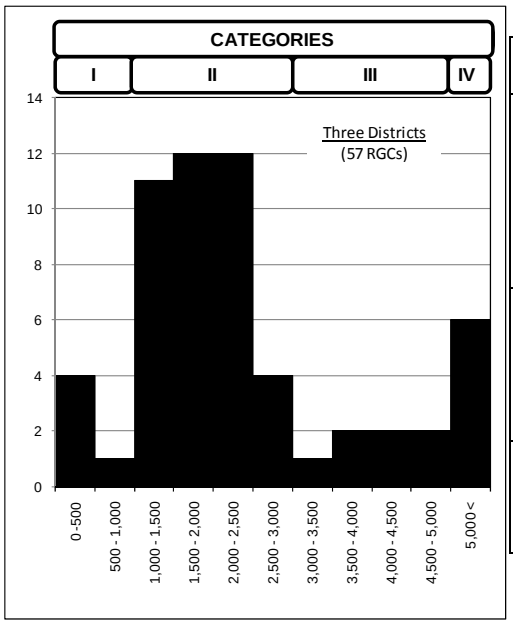


Figure 7-15 Distribution by Population Scale of RGCs

Table 7-16 RGCs Selected for Representing Categories

District and Sub-county	RGC	Population	Representing Category
Iganga District			
1 Ikumbya	Ikumbya	1,275	II-1
2 Bukooma	Naigobya	1,642	II-1
3 Nambale	Nambale	4,835	III
4 Namungalwe	Namungalwe	12,240	IV
Pallisa District			
5 Kameke	Kameke	2,600	II-2
6 Buseta	Buseta	2,392	II-2
7 Kadama	Kadama	10,858	IV
Soroti District			
8 Pingire	Kidetok	1,040	II-1
9 Kadungulu	Kagwara Port	3,120	III

Note: RGC Categories: II-1: Population 1,000 - 2,000
II-2: Population 2,000 - 3,000
III: Population 3,000 - 5,000
IV: Population 5,000 <
Category I is not considered since it is planned to be furnished point water source only for water supply.

allocated for the Iganga, the Pallisa and the Soroti districts, respectively. The selection of representative RGCs are conducted so that the population of the selected RGCs lean neither to larger nor to smaller side in the population range of each category. Since the RGCs of Category I is furnished with the point-water-source type of facility as mentioned later and the project cost of this type of facility is considered almost same, the RGCs representing Category I is not selected.

2) Types and Service Levels of Water Supply Facilities to be Applied

As shown in Table 7-17, the point water source with borehole is provided for the RGCs of Category I in accordance with "Long-term Strategy fro Investment Planning, Implementation and Operation & Maintenance of Water Supply and Sanitation in Rural Growth Centers (2005)". This system consists of a borehole, a motorized pumping unit, an on-site overhead storage tank and a water kiosk. The power system of the facilities for RGCs of Category I of which population are less than 1,000 are considered small comparing with those for the other categories, since their demands are also smaller. Though the construction and operation and maintenance costs of the power system is more expensive than the others, its difference is considered negligible even if the solar power system is adopted for the facilities of RGCs of Category I. Further, such small demand of RGCs of Category I is able to be supplied by the facilities of solar power generation even if its operational hour is as short as six (6) hours only. Therefore, the solar power generation system is applied for the power system of the water supply facilities for RGCs of Category I taking into account of advantages in operation and maintenance. Since the size and number of solar power modules are small, it is possible to set the modules on the elevated tank, resulting in advantages in security and light-harvesting. For

the safety measures in the operation and maintenance works on the elevated tank a redder will be provided to climbing up and down.

Table 7-17 Categories of RGCs and Water Supply Facilities to be Applied

	Category I	Category II	Category III	Category IV
1. Population	500 - 1,000	1,000 - 3,000	3,000 - 5,000	5,000 -
2. Consumption (liter/day/capita)	20 (2015), 25 (2020), 30 (2035)			
3. Type of Facilities	Point Water Source Power Source: Solar power	Piped Water Supply Facilities Electricity or diesel-generated power if commercial supply is not available. In case that NWSC transmission is available near the RGC and its groundwater potential is judged to be poor comparing with the estimated demand, the system may be proposed to be connected such transmission.		
4. Operation Hours	6 hr. (Operation hours of solar-powered pump: 6 hr)	12 hr.	12 hr.	18 hr.
5. Distribution	On site taps or water kiosk	Water Kiosks 1 water kiosk covers 450 persons. No house connection is considered.		Water kiosks and house connections (yard taps) 1 water kiosk covers 450 persons House connections are considered for 10 % of RGC population with 6 persons/connection

As for the RGCs of the other categories of which population is more than 1,000, the piped water supply system shown in Figure 7-16 is proposed be provided. The deep boreholes with submersible motor pump are applied at the water source, and the water is conveyed by the raw water transmission to the elevated water tank (reservoir). The water is distributed by the distribution pipelines to the water kiosks constructed in the service areas, and sold to the peoples in the area. Since the groundwater is used for water supply and any parameter of water quality is not found to be necessary for treatment, any treatment facility is not provided. Disinfection facility is not furnished because the water supply facilities are proposed to be disinfected in the course of the operation and maintenance by the operators of the facilities periodically.

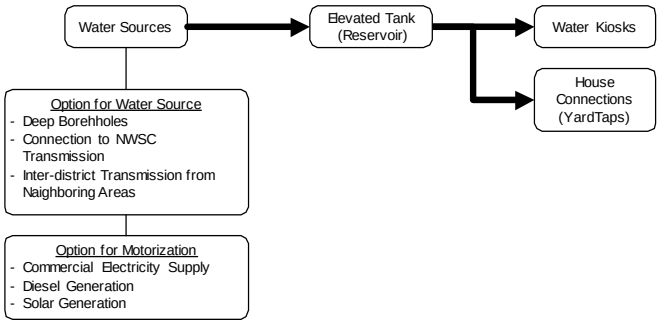


Figure 7-16 Flow Chart of Piped Water Supply System

i) Alternative Water Sources

Although the groundwater is used for the water supply for RGCs, there are some alternative water sources to be considered; the connection to NWSC transmission and the inter-district transmission from neighboring areas. These options are considered only in case that the groundwater potential is judged to be so limited in and around the RGC areas that it seems to be difficult to explore the required yields of boreholes to meet the water demand. As a result, the transmissions shown in Figure 7-17 are proposed considering the available groundwater potential

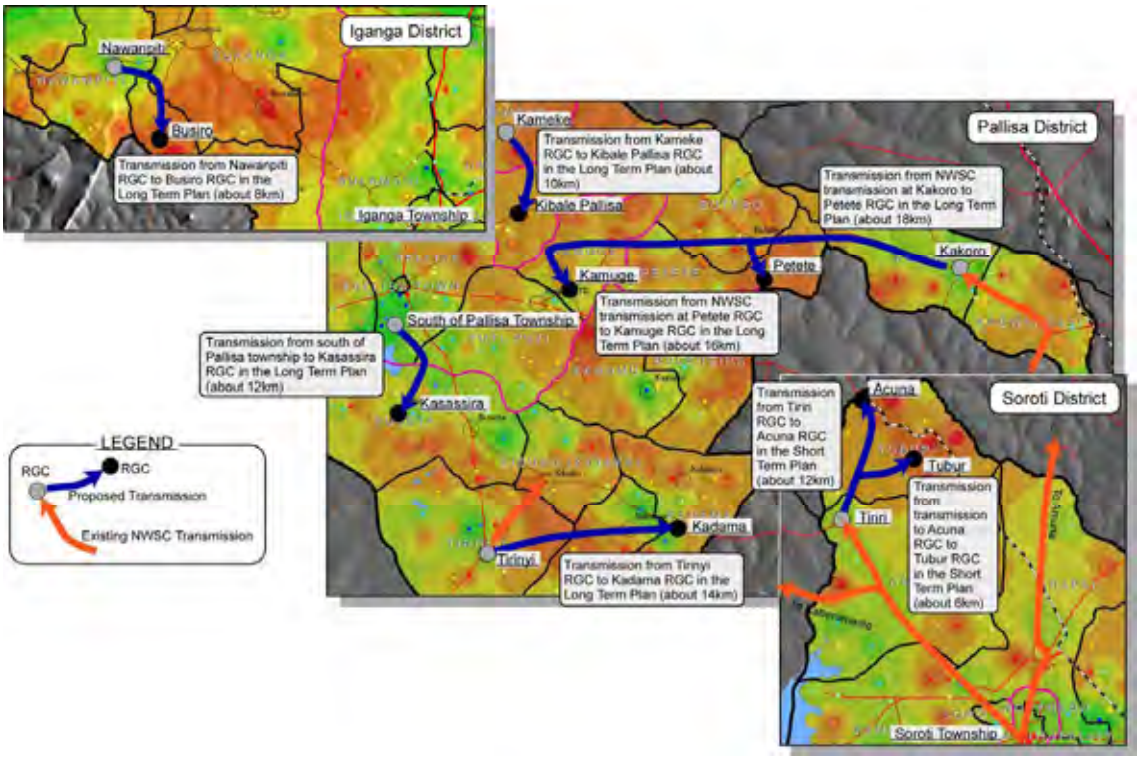


Figure 7-17 Proposed Plan of Transmission from NWSC and Other RGCs

ii) Alternatives for Power Source of Submersible Motor Pump of Boreholes

As for the power source of the submersible motor pumps of boreholes, there are three (3) alternatives such as commercial electricity supply, diesel generation and solar generation are considered. As shown in Table 7-18, where the commercial electricity supply is available, it is proposed to use it as much as possible from view of economic efficiency. However, where such electricity supply is not available, either diesel or solar generation has to be applied. The construction and the replacement costs for the solar power generation are higher than the other power systems. However, the operation and maintenance cost is considered lower than the diesel generation though it is higher than the commercial electricity supply. It does not need the payment for the power source such as electricity fees and fuel charge requiring only the regular inspection and maintenance, and then it is considered attractive to apply. As a result of fair and integrated evaluation in this project taking into account that the construction and the replacement of the water supply facilities are one of the obligation of the government the diesel generation system is seemed to be the most effective for the piped water supply system

for RGCs because its construction and replacement costs are lower than that of the diesel power generation. In addition, the operation hours of the solar generation is limited only in day time; the operation of six (6) hours is recommended in design the solar power generation in Uganda, which results in increasing the number of boreholes to be drilled in the areas where the groundwater potential is quite limited. Therefore, it is proposed to apply the diesel generation for the submersible motor pump of deep boreholes of piped water supply system considering the technical and economical view points discussed above. However, it is necessary to examine on the most appropriate power source to be applied before the implementation, since the price down of solar module due to recent rapid engineering innovation, necessity of environmental consideration, and rapid price escalation of fuel.

Table 7-18 Comparison of Power Sources for Piped Water Supply Systems

Descriptions	Commercial Electricity Supply	Diesel Generation	Solar Generation
	The piped water supply system serving population of 2,000 and the daily water demand of 40 m^3/day is considered for the comparison. The comparison is made for the costs relating to the intake facilities and elevated tank.		
Outline of Applied Facility	- Operation hour: 12 hr. - Submersible motor pump: 2 nos. - Transmission pipelines: 1,000 m - Elevated tank: 40 m3, H=12 m - Life period: 30 years		- Operation hour: 6 hr. - Submersible motor pump: 4 nos. - Transmission pipelines: 2,000 m - Elevated tank: 40 m3, H=12 m - Life period: 30 years
1. Construction	Construction cost for intake facility and elevated tank: 606,507,820 UGX	Construction cost for intake facility and elevated tank: 618,442,820 UGX	Construction cost for intake facility and elevated tank: 1,077,018,332 UGX
	A	B	C
2. Operation and Maintenance	Operation and Maintenance cost: 8,556,396 UGX Electricity fee is charged according to electricity consumption.	Operation and Maintenance cost: 16,373,500 UGX Fuel cost is expensive and spare parts are required for generator.	Operation and Maintenance cost:12,250,600 UGX No energy cost is required. Only regular maintenance is needed.
	A	C	B
3. Replacement	Replacement cost: 57,833,000 UGX No cost for replacement of power supply facility is required except pumping equipment (2 nos.).	Replacement cost: 93,638,000 UGX Diesel generator has to be replaced as well as pumping equipment (2 nos.).	Replacement cost: 226,514,000 UGX Solar modules and pumping equipment have to be replaced. Six (6) units of pumping equipment are required to be replaced.
	A	B	C
4. Overall Judgement	A	B	C

3) Term-wise Development

In the master plan, there are three (3) target years are set; the short term plan for 2015, the middle term plan for 2020 and the long term plan for 2035. The scales and capacities of the water supply facilities are planned so as to meet the demand of each target year. The term to the first target year of 2015 is five (5) years, and that to the second target year of 2020 is five years after the first target year. The period from the second target year to the final target of 2035 is 15 years. The capacity of the elevated tank and the size of main distribution pipelines are

considered difficult to expand to meet the demand of second target year after the construction in the short term plan. Therefore, these parts of the facilities are to be planned to meet the demand of the second target year of 2020 when they are constructed in the short term plan. The other parts of facilities such as water source facilities (deep boreholes), transmission pipelines to elevated tanks, water kiosks and yard taps are planned to be provided to meet to the demands of each target year. The sizes and capacities of the elevated tanks and the main distribution pipelines are planned to meet the demand of 2020, even when they are constructed in the short term plan. The project period from the initial year of 2010 to the last year of 2035 is 25 years, and the population gains about twice of the initial year and the consumption per capita is also set 30 liter/day/capita equivalent to 1.5 times of 15 liter/day/capita for the short term plan. Therefore, all the facilities from the water source to the water kiosks are planned additionally to be constructed to meet the demand of the long term plan (2035).

4) Results of Preliminary Design of Selected RGCs

The results of the preliminary design of the selected RGCs representing each category are presented on the photo map prepared in the RGC survey, of which example is shown in Figure 7-18.

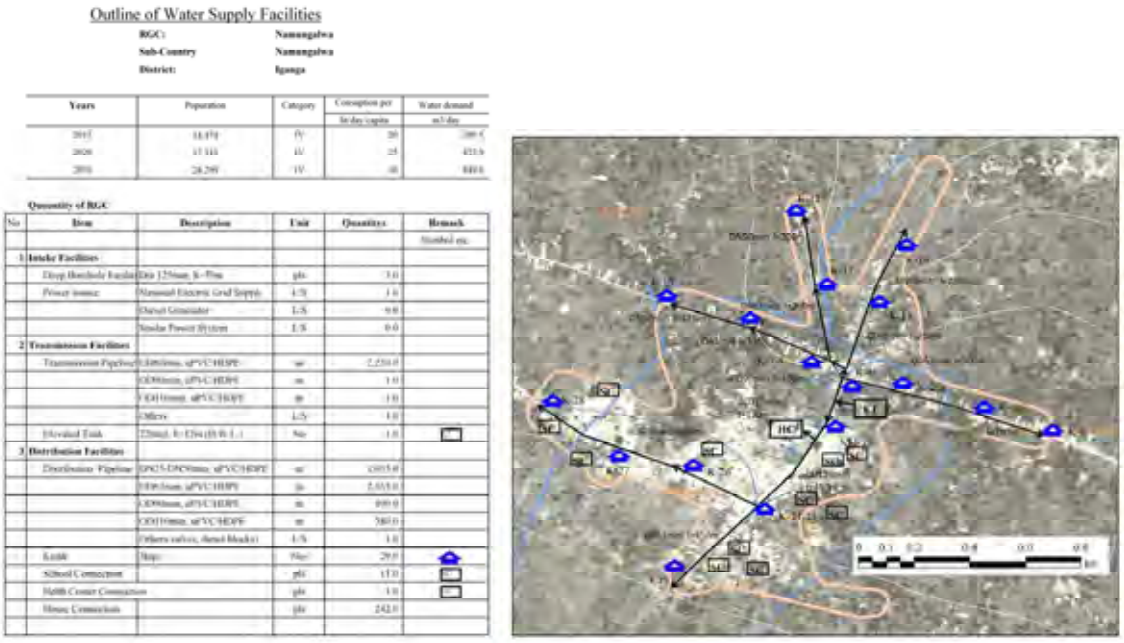


Figure 7-18 Example of Preliminary Design of Water Supply System for Selected RGC (Namungalwe RGC)

7.3.6 Management Plan of Water Supply Systems

(1) Present Situation of Operation and Maintenance of Rural Water Supply Systems

The water supply facilities in rural areas of Uganda are individual and are operated and maintained mainly WSCs which are formed by election of WUC and/or WUG. for each facility as shown in Table 7-19. Piped water supply systems of RGCs are managed by the water supply board to be

established for each system under the sub-county office.

Table 7-19 Water Supply System and O&M Organization

Area		Population	Type of Water Supply System	O&M Organization of the Facilities
Rural	Village	Less than 500	Point Water Source ・Borehole with hand pump ・Shallow well ・Protected spring ・Gravity flow scheme Tap ・Rain water tank	Water User Community or Water User Group (WUC*1or WUG*2): The whale community served by the individual point water facility
				Water and Sanitation Committee (WSC*3): WSC of about 6 people elected by the WUC
				Water User Association (WUA*4): In case of many WUC/WCG being served by one water source (like a GFS), the WSCs come together to form a WUA, who in turn can select/elect the Central Committee (like a WSC) to O&M the whole scheme.
	Rural Growth Center (RGC)	500 ～5,000	Point Water Source	Same the above
			Small scale of Water Supply System with pipeline and pumps.	Water Supply Board under Water Authority
Urban	Small Town	5,000～15,000	Water Supply System with pipeline and pumps	Town Board Water Supply Offce
				Private Operator under the Town Water Authority
	Large Town	More than 15,000	Large Scale Water Supply System	National Water and Sanitation Corporation (NWSC)

Note: *1 Water User Community *2 WUG: Water User Group
*3 WSC: Water and Sanitation Committee *4 WUA: Water User Association

In the priority districts, most of the rural water supply facilities are the boreholes with hand pump, the shallow wells or the protected springs, and managed by WSC on community based management (CBM). As for the piped water supply systems, there are three (3) piped water supply systems either being under constructed or having just been ready for initial operation in the Soroti district, and the operation by the hired private operators is planned for all of them according to the district water office.

The following issues are found in the operation and maintenance of the rural water supply facilities in the priority districts.

1) Point Water Source

According to the RGC survey, there are not many WSCs having the number of working members sufficient to the stipulated, and only 21 % of WSCs collect the water tariff in three (3) districts. The results of the WATSUP survey indicate that the functionalities are calculated to be 89.5 %, 89.9 % and 85.3 % for the Iganga, the Pallisa and the Soroti districts, respectively, and such abandoning of non-functional facilities are considered to be mainly caused by lack of fund for repairing and difficulty in collecting the fund necessary for spare parts. It is important to improve the collection rate of water charge and to reserve the fund necessary for purchasing spare parts in order to improve this situation. To reinforce the WSC organizations to enable these activities, it is necessary for the officer of the district water office in charge of community support to open up their activities to such communities, but their capacity is not sufficient in quantity and quality. The TSU of which offices are established in eight (8) locations in Uganda plays a role to support the district water offices, and it is possible to improve the capacity of water offices by reinforcing the support of TSU. Hand Pump Mechanics (HPMs) have to be

assigned either at least two (2) foe each sub-county or one (1) per 50 boreholes according to DWD. There are 19, 20 and 35 HPMs in the Iganga, the Pallisa and the Soroti districts, respectively at present, which are considered sufficient for the repair of the existing boreholes as a whole. However, 2,743, 2,389 and 2,947 of boreholes are planned to be drilled in the Iganga, the Pallisa and the Soroti districts, respectively till 2035 in the master plan, and for the short term plan 306, 390 and 303 boreholes are proposed for the Iganga, the Pallisa and the Soroti districts, respectively. It is necessary to train and increase the number of HPMs according to the increase of number of boreholes; 6, 8 and 6 HPMs are required to be trained in the Iganga, the Pallisa and the Soroti districts, respectively.

2) Piped Water Supply Scheme

In July 2010, three (3) priority districts are split up into six (6) new districts, and the district water offices are also split up. It is necessary to furnish the new water offices with accommodation, stationary, etc. as soon as possible in order to facilitate their function. The Technical Supporting Unit (TSU) also needed to increase the number of officers in charge of such new districts to provide the proper supporting services to such new districts. The former Iganga and Pallisa districts are under the support of TSU 4, and the former Soroti district is under TSU 3; both TSUs are required to assign the staff according to the number of increased districts. The reinforcement of human resources to these organizations is considered essential and urgent.

According to the records of the existing piped water supply systems, the fuel and electricity costs are considered to affect its income and expense balance to the extent that the operation of the system may interrupted due to shortage of operation fund. Especially in the systems of rather small RGCs of which operation is conducted by a private operator, the operation of facility tends to be interrupted due to the shortage of operation fund because the salary and profit may be reserved first. though the water charge collection is not performed well. As a result, such frequent interruptions may cause further difficulties in collecting water charges. The agreement with the private operators have to be renewed every two (2) years, and some of the operators left the electricity fee unpaid and withdrawn from the operation service resulting in the troubles in commencement of the operation service by the next operator. On the other hand, there are some systems operated directly by the water board under the sub-county without any deficit, and they take their efforts to reserve the operation fund for the expenses for fuel and electricity by saving salary of man powers for operation and maintenance. In case of the operation by the private operators, they tend to reserve their salary and profit first and the remaining fund is used for the operation. In the small scheme of which revenue from the water charge collection is not much, the operation costs are large comparing with the revenue by water charge collection, and the fund amount necessary for operation may not be reserved resulting in the interruption of the operation.

(2) Proposed Operation and Maintenance System

As for the operation and maintenance of the boreholes with hand pump for the rural areas other than RGC areas, the management by present WSC is proposed to be continued under the supports by the district water offices. However, since numbers of boreholes are planned to be drilled in these areas, it is required to increase the number of the staff for mobilization as well as HPMs. Each WSC is to consist of one (1) chairman, one (1) treasurer, two (2) caretakers, one (1) committee member and one (1) secretary in accordance with the guidelines.

The water supply facilities for RGCs are divided into four (4) categories in terms of their population as discussed the previous section; Category I for the population less than 1,000, Category II for the population from 1,000 to 3,000, Category III for the population from 3,000 to 5,000, and Category IV for the population more than 5,000. The simple system of point water source consisting of deep borehole with motorized submersible pump, small overhead tank, on-site water kiosk and solar modules is planned to be applied for the RGCs of Category I considering the easiness of operation and maintenance. Since the solar generation system is applied, they do not need to pay any fuel or electricity charges. Therefore, it is proposed to apply the same system of operation and maintenance as the borehole with hand pump.

On the other hand, as for the piped water supply systems are applied for the RGCs of Categories II - IV, which require the technical knowledge and the management know-how in the operation and maintenance, since the population scale of of RGCs (less than 5,000) is not as large as those for town water supply having the population of 20 - 30 thousand, the operation and maintenance is not considered effective, and hiring the private operators may causes higher risks as mentioned in the previous section. Since there are the water supply systems for the RGCs of which population are more than 1,500 operated by private operators, the private operator shall basically hired for the operation of the piped water supply system of this project. However, considering the risks mentioned above, it is proposed not to hire the private operator immediately at the initial stage of operation, and to adopt the operation and maintenance organization consisting of the water board and the technical staff as illustrated in Figure 7-19. The technical staff having the technical capacity to operate the water supply facilities of RGCs is proposed to be hired as required to minimize the man power expenses. Hiring the private operators are proposed to be introduced when the

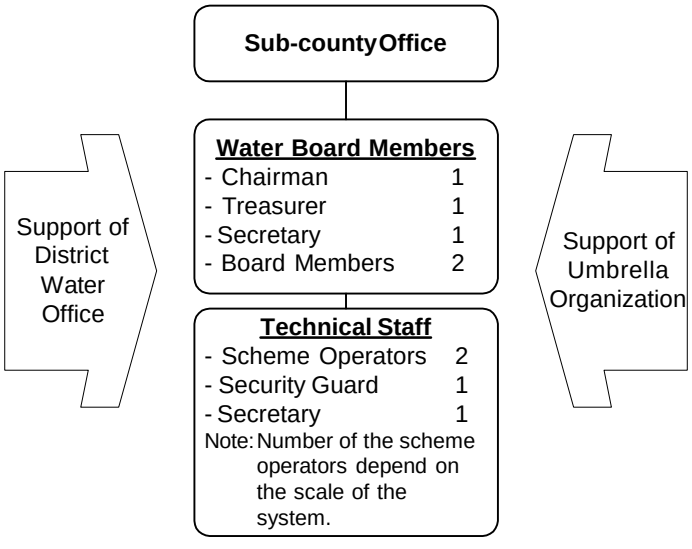


Figure 7-19 Proposed O & M Organization for RGCs of Categories II - IV

population is so increased that a certain level of water charge collection is achieved and the operation is stable and effective. It is also necessary to consider introducing the operation system to be conducted by one (1) private operator for some small systems at once.

(3) Capacity Building Plan

For smooth implementation of the master plan for the priority districts, the capacity building of the operation and maintenance organizations, monitoring to grasp the operation and maintenance situations, the workshops and trainings are proposed to be conducted at the times of construction and rehabilitation of facilities by the district water office under the support of TSU as shown in Table 7-20. The targets of the activities are water users, WSC members, members of Water Supply Boards, scheme operators and extension workers of sub-counties.

Table 7-20 Workshops and Trainings

Timing/ Activities	Detail of Activities	Targets	Documents	Remarks
(1) Before construction Workshops & Site explanation	1) Announcement to water users	- Water users	- Broad casting - Bulleting - Pamphlet	- By central & Local government
	2) Explanation of the Facilities (Capacity, Specification etc.)	- Water users - WSC members - Extension workers - Board members of the scheme - Scheme operators - Sub-County chief	- Planning documents	- DWO should be the chairman of the work shops. - Members of DWD, TSU should attend and lead/assisst the work shops. - The minutes should be made by DWO
	3) Explanation of O/M including Minor & Major repairs		- Document for maintenance including repairs	
	4) Decision of Water Tariff and collection method			
	5) Capacity building of WSC and Water Supply Board members i) Role and responsibility of each member ii) O/M procedure and records	- WSC members - Board members - Scheme operators - Extension Workers - Hand Pump Mechanics	- O/M manual	
(2) During and after construction Workshops & site trainings	1) Capacity building of WSC and Water Supply Board members i) Role and responsibility of each member ii) Confirmation of O/M procedure and records	- WSC members - Board members - Scheme operators - Extension Workers - Hand Pump Mechanics	- O/M manual - Handling instructions	
	2) O/M by the WSC members and scheme operators	- WSC members - Scheme operators - Hand Pump Mechanics	- O/M manual - Handling instructions	
	3) Training of Hand Pump Mechanics i) Inspection, repair ii) Records of inspection & repairs iii) Spare parts supplier	- Hand Pump Mechanics	- Documents & drawings from supplier	
	4) Monitoring i) Records on O/M ii) Updated lists on household iii) Daily inspection of pumps and facilities vi) Collection v) Record on spare parts purchased	- WSC members - Board members - Scheme operators	- Daily report - Inspection Report	

7.3.7 Project Cost Estimate

The project costs consist of construction costs for the contractors, costs for engineering services for detailed design and construction supervision, administration costs for the government administration and contingencies for price escalation and physical contingencies. The expenses for land acquisitions and compensations are not considered because the land for rural water supply facilities are constructed in the public lands and even if private lands are used such usage is agreed among the

community members. The value added tax (VAT) is considered in the equipment and material cost estimate. The estimated project costs are summarized in Table 7-21.

Table 7-21 Summary of Estimated Project Costs

(Unit: UGX)

Proposed Project Works		Short Term Plan (2010 - 2015)	Middle Term Plan (2015 - 2020)	Long Term Plan (2020 - 2035)
I. Iganga District	1. Construction of Boreholes with Hand Pump for the Areas Other than RGC	16,705,789,000	22,265,188,000	111,437,454,000
	2. Repair of Non-functional Water Supply Facilities for the Areas Other than RGC	77,649,000	77,961,000	-
	3. Replacement of Existing Boreholes with Hand Pump for the Areas Other than RGC	7,020,763,000	9,839,267,000	58,289,266,000
	4. Construction of New Piped Water Supply Facilities for RGC Areas	34,728,214,000	6,944,842,000	3,818,608,000
	5. Extension of Existing Piped Water Supply Facilities for RGC Areas	0	4,053,047,000	36,509,684,000
	Total for Iganga District	58,532,415,000	43,180,305,000	210,055,012,000
II. Pallisa District	1. Construction of Boreholes with Hand Pump for the Areas Other than RGC	21,654,908,000	20,017,847,000	90,624,471,000
	2. Repair of Non-functional Water Supply Facilities for the Areas Other than RGC	50,321,000	50,735,000	-
	3. Replacement of Existing Boreholes with Hand Pump for the Areas Other than RGC	6,254,891,000	9,108,279,000	50,687,144,000
	4. Construction of New Piped Water Supply Facilities for RGC Areas	17,752,767,000	8,791,179,000	0
	5. Extension of Existing Piped Water Supply Facilities for RGC Areas	0	2,911,999,000	26,272,041,000
	Total for Pallisa District	45,712,887,000	40,880,039,000	167,583,656,000
III. Soroti District	1. Construction of Boreholes with Hand Pump for the Areas Other than RGC	15,664,205,000	22,683,938,000	115,229,620,000
	2. Repair of Non-functional Water Supply Facilities for the Areas Other than RGC	92,364,000	93,189,000	-
	3. Replacement of Existing Boreholes with Hand Pump for the Areas Other than RGC	6,779,343,000	9,780,214,000	61,411,252,000
	4. Construction of New Piped Water Supply Facilities for RGC Areas	10,190,437,000	3,102,096,000	398,525,000
	5. Extension of Existing Piped Water Supply Facilities for RGC Areas	4,993,799,000	4,406,305,000	15,185,587,000
	Total for Soroti District	37,720,148,000	40,065,742,000	192,224,984,000

The above-tabulated costs are calculated in the manners explained below.

(1) Deep Boreholes with Hand Pump

The construction costs for the deep boreholes with hand pump are estimated including geophysical surveys, hydrogeological surveys, drilling boreholes, well development considering the success rate of drilling.

(2) Piped Water Supply Facilities

The piped water supply facilities are composed of deep boreholes, raw water transmissions, elevated tanks (reservoirs), distribution pipelines, and water kiosks and yard taps. The size and type of the boreholes and raw water transmissions (water source facilities) are determined mainly by the natural conditions such as topography and hydrogeology of the source areas, while those of the other facilities such as elevated tanks, distribution pipelines, and water kiosks and yard taps (water distribution facilities) are determined by the population scales of RGCs. Therefore, the cost

of construction and operation and maintenance of the water source facilities are calculated based on such natural conditions and those costs for the water distribution facilities are determined the RGC population multiplied by the costs per one (1) served population. As for the facility for Category I, it is calculated for one (1) unit and the same cost is applied for the other RGC.

The estimated costs for the piped water supply facilities of the selected RGCs are summarized for each Category of RGC as shown below.

Table 7-22 Project Cost for Selected RGCs Representing Categories

(Unit: UGX)

Category/RGC	Description	Short Term Plan (2015)	Middle Term Plan (2020)	Long Term Plan (2035)
1. Category II-1 (Population from 1,000 to 2,000)				
Ikumbya	Population	1,508	1,783	2,948
	Cost Proportional to Pop.	662,820,000	26,999,000	550,889,000
	Cost per Capita	439,536	15,142	186,869
	Cost for Intake Facility	392,691,000	5,635,000	383,663,000
	Total Cost	1,055,511,000	32,634,000	934,552,000
Naigobya	Population	1,942	2,296	3,797
	Cost Proportional to Pop.	717,875,000	26,999,000	567,587,000
	Cost per Capita	369,658	11,759	149,483
	Cost for Intake Facility	326,796,000	0	330,589,000
	Total Cost	1,044,671,000	26,999,000	898,176,000
Kidetok	Population	1,265	1,539	2,772
	Cost Proportional to Pop.	547,697,000	26,999,000	534,720,000
	Cost per Capita	432,962	17,543	192,900
	Cost for Intake Facility	268,672,000	0	254,229,000
	Total Cost	816,369,000	26,999,000	788,949,000
Average of Category II-1		414,052	14,815	176,417
2. Category II-2 (Population from 2,000 to 3,000)				
Kameke	Population	3,194	3,663	6,127
	Cost Proportional to Pop.	931,192,000	26,999,000	836,959,000
	Cost per Capita	291,544	7,371	136,602
	Cost for Intake Facility	689,793,000	0	346,811,000
	Total Cost	1,620,985,000	26,999,000	1,183,770,000
Buseta	Population	2,839	3,370	5,637
	Cost Proportional to Pop.	981,478,000	26,999,000	998,973,000
	Cost per Capita	345,713	8,012	177,217
	Cost for Intake Facility	723,115,000	0	365,019,000
	Total Cost	1,704,593,000	26,999,000	1,363,992,000
Average of Category II-2		318,629	7,692	156,910
3. Category III (Population from 3,000 to 5,000)				
Nambale	Population	5,715	6,760	11,178
	Cost Proportional to Pop.	1,272,064,000	73,518,000	994,709,000
	Cost per Capita	222,583	10,875	88,988
	Cost for Intake Facility	495,626,000	0	619,548,000
	Total Cost	1,731,690,000	73,518,000	1,614,257,000
Kagwara Port	Population	3,796	4,618	8,317
	Cost Proportional to Pop.	910,779,000	53,997,000	974,283,000
	Cost per Capita	239,931	11,693	117,144
	Cost for Intake Facility	731,232,000	716,790,000	6,831,000
	Total Cost	1,642,011,000	770,787,000	981,114,000
Average of Category III		231,257	11,284	103,066
4. Category IV (Population more than 5,000)				
Namungalwe	Population	14,474	17,115	28,299
	Cost Proportional to Pop.	2,600,433,000	212,516,000	2,115,378,000
	Cost per Capita	179,662	12,417	74,751
	Cost for Intake Facility	831,071,000	0	1,242,073,000
	Total Cost	3,431,504,000	212,516,000	3,357,451,000
Kadama	Population	12,888	15,298	25,587
	Cost Proportional to Pop.	2,300,620,000	180,925,000	1,923,539,000
	Cost per Capita	178,509	11,827	75,176
	Cost for Intake Facility	1,174,076,000	723,359,000	2,658,920,000
	Total Cost	3,474,696,000	904,284,000	4,582,459,000
Average of Category IV		179,086	12,122	74,964

Note: The cost proportional to population include the project cost of a elevated tank, distribution pipelines, kiosks and yard taps.

(3) Repair of Non-functional Facilities and Replacement of Existing Boreholes

The costs for repair of non-functional facilities are estimated based on the repairing cost per site estimated assuming a certain extent of repairing works; breach of cylinders and aprons for well facilities, and breach of water collection pipes and side walls for protected springs . The replacement of the existing boreholes with hand pump are possible only in case that there is no problem on existing ones, and their costs are estimated for the same specification as those of the boreholes with hand pump to be constructed, but it is assumed that the success rate of drilling borehole is 100 % since the replacement boreholes are usually drilled near the old ones.

(4) Operation and Maintenance Cost for Boreholes with Hand Pump and Piped Water Supply Facilities

The operation and maintenance cost of the planned piped water supply facilities for RGCs are composed of salary of operation staff, fuel cost for diesel generation and electricity charge, and spare parts, etc. The operation and maintenance cost for the piped water supply facilities for RGCs in each priority district are summarized in Table 7-23.

Table 7-23 Operation and Maintenance Cost for Piped Water Supply Facility

(Unit: UGX/year)

District	Items	Short Term Plan (2015)	Middle Term Plan (2020)	Long Term Plan (2035)
Iganga District	Man Power	1,008,119,000	1,337,622,000	2,104,343,000
	Energy	91,727,000	162,323,000	299,490,000
	Spar Parts, etc.	351,505,000	467,037,000	883,323,000
	Total	1,451,351,000	1,966,982,000	3,287,156,000
Pallisa District	Man Power	467,986,000	743,426,000	1,113,783,000
	Energy	23,849,000	59,623,000	123,787,000
	Spar Parts, etc.	177,527,000	297,358,000	560,077,000
	Total	669,362,000	1,100,407,000	1,797,647,000
Soroti District	Man Power	376,120,000	528,002,000	844,282,000
	Energy	47,808,000	137,919,000	291,471,000
	Spar Parts, etc.	153,817,000	236,449,000	405,534,000
	Total	577,745,000	902,370,000	1,541,287,000

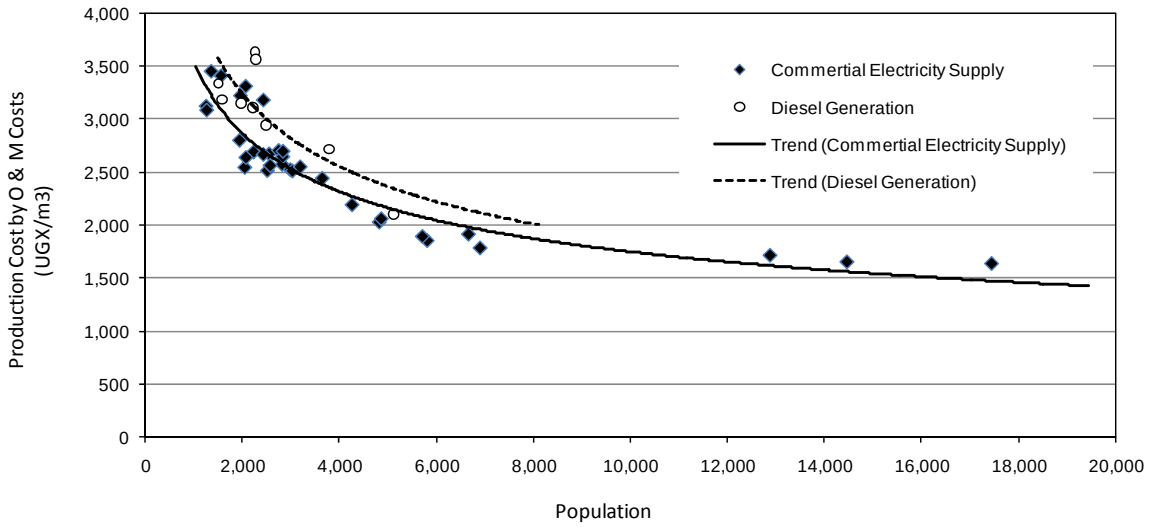


Figure 7-20 Operation and Maintenance Costs of Piped Water Supply Facilities and Population of RGC

Figure 7-20 illustrates the relation between the population and the operation and maintenance costs per unit production water (m^3) for the facilities for the 39 RGCs planned for the short term plan and the existing three (3) facilities in the Soroti district. The operation and maintenance cost for the facilities operated by diesel generation is higher than those by electricity supply for 10 - 20 %, and the operation and maintenance cost per one (1) m^3 of production tends to become lower when the population of RGC becomes larger. Considering the water charge from 1,500 to 2,500 UGX/m^3 charged in urban water supply in Uganda, the price levels of the facilities of RGCs are considered reasonable.

In the water supply facilities serving the population from 500 to 5,000, the less population served becomes, the more operation and maintenance cost increase sharply. The operation and

maintenance cost is considered as the production cost of water, and the water tariff is set based on this cost. Therefore, it is important to apply the operation system requiring as less expenses as possible in RGC management in case of the piped water supply facilities for small RGCs; direct management by water board instead of hiring private operator.

The operation and maintenance cost for the deep boreholes with hand pump is composed of spare parts cost, depreciation cost of hand pump unit and expenses for hand pump mechanics, and calculated to be 410,747 UGX/year. Supposing that the served population of 300 and the member of one (1) house hold of six (6), the amount of monthly collection per household is calculated to be 684 UGX/month. In the Ugandan community generally, 1,000 or 2,000 UGX/house hold of monthly collection is agreed among the members when their WUA is established before commencement of the construction, and the collection of the above-calculated amount is possible. However, such monthly collection of water charge has not been carried out and the broken hand

pumps are left without any repairing. Therefore, it is important for the district and sub-county water offices to support the communities to assure such water collection from the members.

It is important to increase the frequency to visit to the communities to grasp the situations of community activities and to reinforce dissemination to the communities. The easiest way to increase such frequency of visit is to increase the number of the officers of the water offices, but it may not be easy for the district offices to increase such number of their officers due to the limitation of budget allocation. Therefore, it is proposed to conduct such mobilization activities with cooperation with and exchanging information with the other ministries such as Ministry of Health and Ministry of Gender, Labour and Social Development both on district and sub-county levels, and to prepare the implementation organizations to conduct such activities with integrated formation with other sectors.

7.4 Economic and Financial Evaluation of Master Plan

7.4.1 Evaluation Method

The economic and financial evaluation was executed by the cost benefit analysis on construction and O/M (operation and maintenance) stage in the master plan from economical and financial point of view. The cost benefit analysis is a technique to measure the cost-effectiveness and/or cost-benefits ratio and to evaluate the validity of the project execution.

Three indices: Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit by Cost (B/C), which was useful to understand cost-effectiveness intuitively, were applied to evaluate the master plan.

7.4.2 Economic Evaluation of Total Master Plan

(1) Evaluation Procedure

The master plan was evaluated by NPV, B/C and IRR. FIRR（Financial Internal Rate of Return）could not be calculated because of the current economic conditions of Uganda, income conditions in the rural area of the districts and no other gaining from the projects except water charge. Therefore, the master plan was evaluated by EIRR（Economic Internal Rate of Return） based on a calculation of benefit to the Ugandan people economy from the plan.

(2) Cost and Benefit

Items of cost and benefit are as shown in Table 7-24.

Table 7-24 Cost and Benefit

Cost	Construction cost	Construction cost for water supply system
	Operation and maintenance cost	Operation and maintenance cost for water supply system
	Increment of water charge	Expense increases by upgrading to new water supply system
Benefit	Reduction of water collection time	Reduction time will contribute to income
	Reduction of waterborn diseases	To save medical expense and avoid lost of working hours. They will contribute to income.

(3) Calculation Result and Evaluation

Calculation and evaluation result shows as Table 7-25. According to the economic evaluation, the rural water supply master plan was well-evaluated its adequacy, effectiveness, availability and efficiency and confirmed large positive impacts to Uganda. However, the impossibility of FIRR indicates that the profitability and sustainability of the projects is very week because the revenue from only water charge cannot cover both construction cost and O/M cost. However, the impossibility of FIRR indicates that the profitability and sustainability of the projects.

Table 7-25 Calculation and Evaluation Result

Items	Result	Evaluation criteria	Evaluation
B/C	2.6	B/C>1.0	Good
NPV	+493,974millionUGX	NPV>0	Good
EIRR	107%	EIRR>10.0%	Good

Under this circumstance, it is necessary that the construction cost depends on any grant from donor countries including Japan and O/M cost is covered by water charge from the beneficiary and fiscal expenditure of Ugandan Government.

7.4.3 Financial Evaluation of O&M Stage

(1) Evaluation Procedure

FIRR is used for financial evaluation as revenue is expected from water charges with the master plan. The project is evaluated by three cases as follows.

- **Case1** : Entire Area of Master Plan
- **Case2** : Outside RGC (Water Supply System Type: Deep Borehole with Handpump)
- **Case3** : Inside RGC (Water Supply System Type: (i) Deep Borehole with Submersible Pump and Transmission Pipe Line or (ii) Deep Borehole with Submersible Pump and Storage Tank)

(2) Cost and Revenue

Cost and revenue are as follows.

- **Cost**: operation and maintenance cost of the water supply system
- **Revenue**: water charges

(3) Calculation Result and Evaluation of Entire Master Plan (Case1)

Table 7-26 shows the result of the financial evaluation of the entire rural water supply project. Although B/C is almost 1.0 and FIRR is close to the hurdle rate of 10%, the revenue from water charges is not enough to support the O&M of the water supply without funding from the national and local government. The estimated amount of a necessary obligation price witch present value at the first project year is approximately 3 billion UGX. Since the water resource situation is quite different inside and outside the RGC, financial evaluation was also performed separately described below.

Table 7-26 Calculation and Evaluation Result (1)
(Case-1: Entire Master Plan)

Items	Result	Evaluation criteria	Evaluation
B/C	0.95	B/C>1.0	NG
NPV	-2,789 million UGX	NPV>0	NG
FIRR	8.30%	FIRR>10.0%	NG

(4) Calculation Result and Evaluation of Outside RGC (Case2)

Table 7-27 shows the result of the financial evaluation outside the RGC. The water charge of UGX 1,013/person/year and UGX185/m^3, estimated from the survey of 375 households, was used for the evaluation.

In order to fund the O&M of the water resources, UGX 1,440 /year/person needs to be collected. Or, it is necessary to improve the collection rate of the water charge plus 12%. An amount of willingness to pay for water charge given by the socio-economic survey in the Study is average 2,914 UGX/person/year. Therefore, the management of such water system could be well-functioned by setting up the water charge collection system, and explaining the importance of the water charge payment.

Table 7-27 Calculation and Evaluation Result (2)
(Case-2: Outside RGC)

Items	Result	Evaluation criteria	Evaluation
B/C	0.72	B/C>1.0	NG
NPV	-4,802million UGX	NPV>0	NG
FIRR	-.-%	FIRR>10.0%	NG

(5) Calculation Result and Evaluation of Inside RGC (Case3)

On the other hand, sustained O&M supported by high B/C, NPV, and FIRR is expected inside RGC as shown in Table 7-28. This is based on the water charge of about UGX 2,025/person/year used by DWD in small towns, RGC, and large gravity schemes. A system to collect water charge without delinquency is needed to maintain the expected revenue.

Table 7-28 Calculation and Evaluation Result (3)
(Case-3: Inside RGC)

Items	Result	Evaluation criteria	Evaluation
B/C	1.05	B/C>1.0	Good
NPV	2,013millionUGX	NPV>0	Good
FIRR	11.30%	FIRR>10.0%	Good

7.5 Initial Environmental Evaluation

The effects on the social, natural, and living environment (pollution) of water supply facilities have been assessed. Table 7-28 summarizes the result of the assessment, and the items rated B or C in the table are described below.

7.5.1 Construction Period

(1) Living environment (pollution)

Problems such as air and water pollution, noise, and vibration because of the construction machinery for well drilling, building construction, and pipe installation are expected. However, the impacts will be limited due to the small scale of the construction.

(2) Natural Environment

Some impacts on the local ecosystem around the construction site are possible. The impacts can be relaxed by properly selecting the target sites based on the survey on the local endangered species. There are designated wetlands under the Ramsar convention in the Pallisa and Soroti districts. In case construction such as installation of water pipes cannot be avoided in those areas, extra cares are needed. For example, water pipes should be routed in a way that does not affect the local water flow, construction areas can be made as small as possible to protect the local animals, and measures to prevent drainage of turbid water to sensitive areas can be taken. In past construction projects in Uganda, water pipes were installed with care to the local traffic were completely buried after installation to minimize the impact on the local traffic.

In addition, high-rise water tanks can harm the landscape of the construction area. On the other hand those tanks can also appeal the existence of RGC. Facilities should be planned and designed with opinions of the local communities in consideration.

(3) Social Environment

Relocation of houses and cultural heritages may be needed depending on the location of facilities to be constructed. Therefore, careful survey is essential during the planning phase to confirm the existence of cultural heritages and intention of the local communities. On the other hand, facility construction provides job opportunities to the local industry and people. Such opportunities are particularly valuable for local communities without much monetary income.

7.5.2 Operation Period

(1) Living Environment (pollution)

The exhaust of diesel power generators will not cause any significant air pollution because the amount of exhaust is very limited. Land subsidence caused by pumping out the groundwater will not be of a big concern either because the groundwater will mainly be consumed for drinking which does not demand a large quantity and the groundwater is a shallow one provided by rainfall.

(2) Natural environment

Operation of the facility can lower the water level of other wells because of the consumption of the groundwater. In such a case, extending the water supply lines to those areas is one possible measure.

(3) Social Environment

Differentials between those who benefit from a new water supply facility and those who do not will initially be a problem. However, the Ugandan government is planning to raise the rural water supply rate to 100% by 2035. Therefore, the differentials will eventually vanish.

There are many different tribes in Uganda. Though not confirmed in this survey, unfair treatment of different tribes must be avoided. Potential discrimination of tribes need to be considered for planning new facilities.

Installation of new water supplies, which are the basic social infrastructure, will provide safe and stable water sources to local communities including poor ones. This will improve the social environment situation by preventing many diseases that stem from unsafe water such as diarrhea of infant supply and reducing the workload of women and children who daily retrieve water.

7.5.3 Conclusion

The impacts on the environment caused by construction and operation of the rural water supplies described in the master plan were assessed using a checklist as shown in Table 7-29. Air and water pollution, and noise generated during construction will not be of a big concern and will only occur during the construction. Effects on the local ecosystem and cultural heritages in and

around the construction sites can be avoided by conducting surveys on them and planning facility construction around the survey results.

Installation of new water supplies as basic social infrastructure will improve the health conditions of local communities and workload of women and children who daily carry water. On the other hand, those new water sources can cause differentials between those who benefit from them and those who do not. The differentials can be minimized by careful planning after consultation with local communities. In addition, the differentials will eventually diminish with installation of more facilities supported by the national plan of improving the rural water supply rate to 100%.

Table 7-29 Result of Scoping (Water Supply Facilities: Level 2 Class)

	No.	Likely Impacts	Rating *1			Description
			D	C	O	
Pollution	1	Air pollution	–	C-	C-	Slight impacts from construction machinery and pumps.
	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-	Very slight impacts are expected from groundwater pump up.
	6	Offensive odor	–	–	-	No impact is expected.
	7	Waste	–	C-	-	Proper disposal of waste soil excavated during construction is required.
	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	Groundwater	–	-	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, management, and 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 people	–	–	B+	Improvements of health conditions are expected.
	25	Equality of benefits and losses and equality in the development process	–	–	C+/-	Differentials between those who benefit and those who do not are expected.
	26	Gender	–	–	B	Workload of women who daily carry water will be relaxed.
	27	Children's rights	–	–	B+	Workload of children who daily carry water will be relaxed.
	28	Cultural heritage	–	C-	-	Depending on location, some impact is expected.
	29	Local conflicts of interest	–	–	C-	Differentials between those who benefit and those who do not are expected.
	30	Water usage and water rights	–	–	B+	Safe water will be available
	31	Infectious diseases such as HIV/AIDS	–	–	B+	Disease prevention by safe water is expected.
	32	Working conditions and 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 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 8
Selection of Priority Project

CHAPTER 8 SELECTION OF PRIORITY PROJECT

8.1 Basic Concept of Selection

The following works are proposed to be implemented in the short term plan (2015) of the master plan.

Table 8-1 Works Proposed for Short Term Plan

Priority Districts	Construction of Boreholes with Hand Pump (nos.)	Repair of Non-functional Water Supply Facilities (nos.)	Replacement of Existing Water Supply Facilities (nos.)	Construction of Piped Water Supply Facilities for RGCs (sites)
Iganga	306	70	180	21
Pallisa	390	47	160	11
Soroti	303	84	169	11
Total	999	201	509	43

To achieve effectively the target values of coverage of each district set at 77 % in 2015, it is necessary to put emphasis on the works to be implemented urgently. Since the present coverage values of RGCs are considered quite low comparing with the other rural areas; 27.1 % (areas other than RGC: 69.1 %), 36.5 % (areas other than RGC: 58.7 %) and 60.1 % (areas other than RGC: 71.2 %) for the Iganga, the Pallisa and the Soroti districts, respectively as discussed in Chapter 7, the most effective way to improve the coverage values of each district is considered to push up such low coverage values of RGCs to the levels above average values of the whole district. Further, the concentration of population to such rural centers as RGCs and townships will be accelerated in the near future, and it is urgent to reinforce the basic infrastructures such as water supply facilities to avoid worsening the water supply situations. In SIP the government of Uganda intends to put emphases on the construction of piped water supply schemes.

In addition, the construction of piped water supply schemes requires generally much expenditures comparing with the construction of point water sources like boreholes with hand pump. The construction of such facilities is divided into some fiscal years because of the budgetary limits requiring long construction period. Therefore, the assistance of the donors partners is indispensable in order to realize the implementation of the works proposed in the master plan as intended.

In the context discussed above, it is considered better and proposed to select the priority schemes among those for the piped water supply schemes for RGCs. The construction and replacement of the borehole facilities are considered possible by the own efforts of the Ugandan government, since their construction costs are low and it is possible for NGOs to assist the government.

8.2 Prioritization of Project Works

It is necessary to prioritize the proposed water supply schemes for RGC before selecting the priority projects among them. In this prioritization, various kinds of parameters are considered as follows:

Table 8-2 Parameters Applied for Prioritization

Descriptions	Applied Parameters	Remarks
i) Urgency of implementation	The coverage of safe water supply	The lower coverage is considered as the more urgent implementation.
ii) Importance of target RGC	The numbers of the existing public and administrative facilities and the business facilities in RGCs	The larger number of administrative and commercial facilities is considered as the more important RGC.
iii) Natural conditions such as exploitable groundwater potential and difficulty in such exploitation of groundwater	The expected yield at the RGC site and its success rate	The higher success rates and the larger yields are considered as the easier in construction.
iv) Impact of implementation	The population of RGCs	The larger population is considered as the wider impact of implementation.
v) Efficiency of water supply facility to be implemented	The population served by one (1) borehole	The larger population served by one (1) borehole is considered as the more effective project.
vi) Easiness in implementation	The availability of electricity supply in RGCs	The RGC having electricity supply service is considered as easier in construction of facilities.
vii) Continuity of assistance if it is implemented by any assistance	The yields observed at the test boreholes	It is considered as the continuous assistance to the respective RGC to provide the water supply facility to the RGC having the successful boreholes as a result of test drilling.

The values of each parameter are scored as shown in Figure 8-1. The point scoring is made in proportion by setting the maximum value as the maximum or minimum points RGC by RGC for each parameter. The maximum point is set at five (5) for all the parameters except for the population. The parameter of the population is considered important, since the population affects remarkably to the effectiveness of the operation and maintenance at the management stage as well as to the impact of the project implementation, and the maximum point is set at 10 considering these affects. The total scores are worked out for each RGC, and each RGC is ranked according to the total scores as shown in Table 8-3. Ranking is put on the respective RGC among those in each priority district as well as among whole of the RGCs.

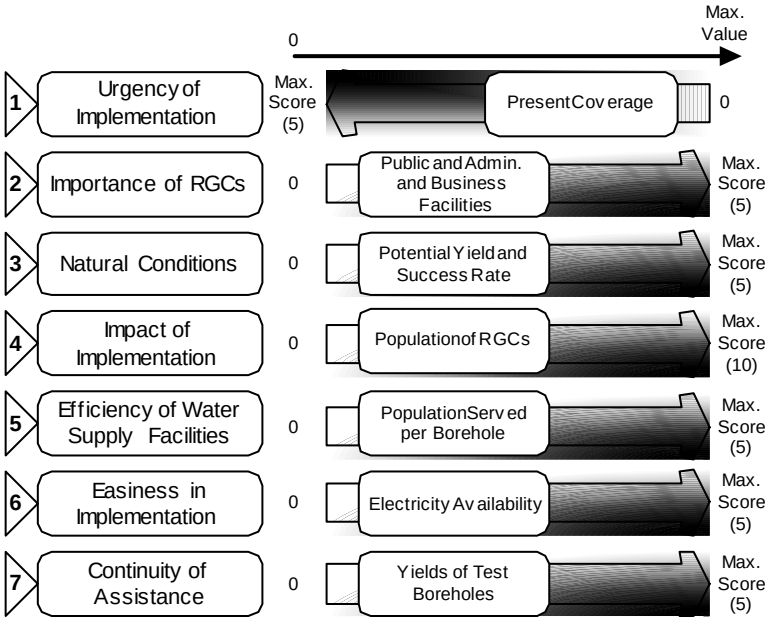


Figure 8-1 Scoring for Prioritization

8.3 Selection of Priority Project

The results of the prioritization of the implementation of piped water supply schemes are presented in Table 8-4. There are 39 RGCs for the implementation of the short term plan, and then they are divided into three (3) groups; the first, the second and the third priority gropes. The first priority group to be implemented most urgently consists of 13 schemes; seven (7), three (3) and three (3) schemes in the Iganga, the Pallisa and the Soroti districts, respectively. The second and the third prioritized groups of the projects will be those consisting of 13 schemes as indicated in the table.

The location of the selected RGCs for the first prioritized group are shown in Figure 8-2.

Table 8-3 Results of Prioritization of Piped Water Supply Systems

Priority Group	Iganga District				Pallisa District				Soroti District			
	Rank	RGC	Score	Population	Rank	RGC	Score	Population	Rank	RGC	Score	Population
First Priority Group	1	Nabitende B.	36.0	17,459	3	Kadama	32.4	12,888	2	Kidetok	32.5	1,265
	4	Namungalwe	32.0	14,474	10	Kasassira	22.2	6,666	5	Tubur	26.6	2,433
	6	Nambale	25.1	5,717	13	Kameke	20.8	3,194	7	Acuna	24.6	2,069
	8	Nakabugu	22.8	5,814	15	Kapala	18.9	2,574	19	Mugarema	18.1	5,125
	9	Nakalama	22.3	6,905	18	Buseta	18.1	2,839	25	Kagwara P.	17.3	3,796
	11	Lambala	21.6	2,515	21	Kibale P.	17.8	2,833	35	Mulondo	12.8	2,214
	12	Naigobya	21.3	1,942	23	Nabisuwa	17.4	2,074	36	Pingire Etem	12.6	1,582
Second Priority Group	14	Busesa	19.7	4,825	24	Kabweri	17.3	1,562				
	16	Kyanvuma	18.7	2,050	28	Butebo	15.6	1,358				
	17	Nakivumbi	18.2	2,750	30	Agule	15.0	2,988				
	20	Nondwe	17.9	4,264	33	Boliso ITC	13.0	1,253				
	22	Nabitende K.	17.6	2,822								
	26	Bukooma	17.1	2,533								
Third Priority Group	27	Kiwanyi	16.3	3,033								
	29	Namusisi	15.4	1,960								
	31	Ikumbya	14.3	1,508								
	32	Busiiro	13.1	2,231								
	34	Busalamu	13.0	1,972								
	37	Buwologoma	10.8	2,262								
	38	Bumanya	10.3	2,280								
	39	Nawampiti	9.1	2,485								

Table 8-4 Prioritization of RGCs of Short Term Plan for Urgent Implementation

	RGC	Urgency		Importance						Natural Condition				Impact		Effeiciency		Easiness in Implementation		Continuity of Asisstance			Total Score	Rank	
				Public and Administration Facility				Business Facilities		Potential Yield		Success Rate		Population		Pop. Served per BH		Electricity Availability		Test Borehole					
		Coverage (%)	Score	Schools, Etc.	Admin. Facility	Total	Score		Score	(m3/hr)	Score	(%)	Score	(2015)	Score	(2015)	Score		Score	(Nos.)	Yield (m3/hr)	Score		Respective District	Priority Districts
	I. Iganga District																								
1	Ikumbya	23.5	3.0	3	7	10	2.5	107	0.6	4.2	2.1	20	1.0	1,508	0.9	1,508	1.3	NA	0	2	3.90	3.0	14.3	16	31
2	Bukooma	14.0	3.8	5	6	11	2.8	61	0.3	3.3	1.7	20	1.0	2,533	1.5	1,266	1.1	A	5	-	-	0.0	17.1	13	26
3	Naigobya	18.3	3.4	7	4	11	2.8	70	0.4	4.8	2.4	35	1.8	1,942	1.1	1,942	1.7	A	5	2	3.65	2.8	21.3	7	12
4	Nakabugu	12.2	3.9	11	4	15	3.8	171	1.0	3.8	1.9	29	1.5	5,814	3.3	2,907	2.5	A	5	-	-	0.0	22.8	4	8
5	Kyanvuma	17.3	3.5	4	5	9	2.3	139	0.8	5.1	2.6	34	1.7	2,050	1.2	2,050	1.8	A	5	-	-	0.0	18.7	9	16
6	Lambala	0.0	5.0	4	4	8	2.0	84	0.5	6.2	3.1	31	1.6	2,515	1.4	2,515	2.2	A	5	2	1.20	0.9	21.6	6	11
7	Nawampiti	38.1	1.7	0	0	0	0.0	82	0.5	4.2	2.1	25	1.3	2,485	1.4	2,485	2.1	NA	0	-	-	0.0	9.1	21	39
8	Buwologoma	15.7	3.6	2	3	5	1.3	117	0.7	3.7	1.9	22	1.1	2,262	1.3	1,131	1.0	NA	0	-	-	0.0	10.8	19	37
9	Bumanya	36.3	1.9	3	8	11	2.8	98	0.6	2.9	1.5	29	1.5	2,280	1.3	1,140	1.0	NA	0	-	-	0.0	10.3	20	38
10	Busiiro	31.8	2.2	3	2	5	1.3	46	0.3	2.2	1.1	20	1.0	2,231	1.3	1,116	1.0	A	5	-	-	0.0	13.1	17	32
11	Busalamu	18.0	3.4	6	6	12	3.0	136	0.8	3.3	1.7	26	1.3	1,972	1.1	1,972	1.7	NA	0	-	-	0.0	13.0	18	34
12	Namusisi	18.1	3.4	4	4	8	2.0	76	0.4	3.2	1.6	20	1.0	1,960	1.1	980	0.8	A	5	-	-	0.0	15.4	15	29
13	Nambale	6.2	4.5	9	9	18	4.5	44	0.3	4.7	2.4	56	2.8	5,717	3.3	2,859	2.5	A	5	-	-	0.0	25.1	3	6
14	Nabitende B.	16.3	3.6	7	11	18	4.5	383	2.2	7.2	3.6	42	2.1	17,459	10.0	5,820	5.0	A	5	2	0.00	0.0	36.0	1	1
15	Nabitende K.	12.6	3.9	1	2	3	0.8	91	0.5	3.5	1.8	56	2.8	2,822	1.6	1,411	1.2	A	5	-	-	0.0	17.6	12	22
16	Namungalwe	22.9	3.0	11	8	19	4.8	274	1.6	8.0	4.0	25	1.3	14,474	8.3	4,825	4.1	A	5	-	-	0.0	32.0	2	4
17	Kiwanyi	35.1	2.0	9	6	15	3.8	68	0.4	2.0	1.0	31	1.6	3,033	1.7	1,011	0.9	A	5	-	-	0.0	16.3	14	27
18	Nakalama	17.1	3.5	6	5	11	2.8	123	0.7	3.9	2.0	30	1.5	6,905	4.0	3,453	3.0	A	5	-	-	0.0	22.3	5	9
19	Busesa	36.8	1.8	6	6	12	3.0	160	0.9	5.2	2.6	30	1.5	4,825	2.8	2,412	2.1	A	5	-	-	0.0	19.7	8	14
20	Nakivumbi	34.4	2.0	6	5	11	2.8	267	1.5	4.2	2.1	40	2.0	2,750	1.6	1,375	1.2	A	5	-	-	0.0	18.2	10	17
21	Nondwe	8.3	4.3	4	5	9	2.3	39	0.2	2.8	1.4	21	1.1	4,264	2.4	1,421	1.2	A	5	-	-	0.0	17.9	11	20
	II. Pallisa District																								
1	Kapala	27.7	2.6	10	10	20	5.0	136	0.8	3.20	1.6	30	1.5	2,574	1.5	1,084	0.9	A	5	-	-	0.0	18.9	4	15
2	Agule	55.6	0.2	8	5	13	3.3	130	0.7	3.30	1.7	28	1.4	2,988	1.7	1,259	1.1	A	5	-	-	0.0	15.0	10	30
3	Kameke	46.2	1.0	6	5	11	2.8	53	0.3	3.90	2.0	27	1.4	3,194	1.8	1,300	1.1	A	5	2	7.20	5.5	20.8	3	13
4	Kibale Pallisa	37.7	1.7	6	14	20	5.0	119	0.7	2.40	1.2	26	1.3	2,833	1.6	1,193	1.0	A	5	2	0.32	0.2	17.8	6	21
5	Butebo	26.2	2.7	3	3	6	1.5	432	2.5	2.30	1.2	20	1.0	1,358	0.8	1,144	1.0	A	5	-	-	0.0	15.6	9	28
6	Boliso ITC	28.4	2.5	1	2	3	0.8	73	0.4	2.40	1.2	30	1.5	1,253	0.7	1,056	0.9	A	5	-	-	0.0	13.0	11	33
7	Kasassira	10.7	4.1	5	5	10	2.5	409	2.3	3.70	1.9	20	1.0	6,666	3.8	1,872	1.6	A	5	-	-	0.0	22.2	2	10
8	Buseta	12.5	3.9	6	6	12	3.0	132	0.8	3.60	1.8	20	1.0	2,839	1.6	1,196	1.0	A	5	-	-	0.0	18.1	5	18
9	Nabisuwa	17.2	3.5	4	9	13	3.3	30	0.2	3.50	1.8	20	1.0	2,074	1.2	1,747	1.5	A	5	-	-	0.0	17.4	7	23
10	Kabweri	0.0	5.0	2	4	6	1.5	105	0.6	2.60	1.3	26	1.3	1,562	0.9	658	0.6	A	5	2	1.50	1.1	17.3	8	24
11	Kadama	8.3	4.3	8	12	20	5.0	874	5.0	3.90	2.0	20	1.0	12,888	7.4	2,714	2.3	A	5	2	0.60	0.5	32.4	1	3
	III. Soroti District																								
1	Acuna	35.3	1.9	2	2	4	1.0	66	0.4	10.00	5.0	100	5.0	2,069	1.2	NWSC	5.0	A	5	1	0.30	0.1	24.6	3	7
2	Tubur	15.0	3.7	3	2	5	1.3	50	0.3	10.00	5.0	100	5.0	2,433	1.4	NWSC	5.0	A	5	-	-	0.0	26.6	2	5
3	Kagwara Port	9.6	4.2	2	4	6	1.5	48	0.3	7.00	3.5	60	3.0	3,796	2.2	3,120	2.7	NA	0	-	-	0.0	17.3	5	25
4	Kidetok	57.7	0.0	4	12	16	4.0	100	0.6	7.00	3.5	56	2.8	1,265	0.7	1,040	0.9	A	5	3	13.20	15.0	32.5	1	2
5	Pingire Etem	23.1	3.0	4	2	6	1.5	55	0.3	2.90	1.5	86	4.3	1,582	0.9	1,300	1.1	NA	0	-	-	0.0	12.6	7	36
6	Mulondo	33.0	2.1	2	4	6	1.5	56	0.3	4.10	2.1	80	4.0	2,214	1.3	1,820	1.6	NA	0	-	-	0.0	12.8	6	35
7	Mugarema	0.0	5.0	0	4	4	1.0	40	0.2	6.60	3.3	40	2.0	5,125	2.9	4,212	3.6	NA	0	-	-	0.0	18.1	4	19

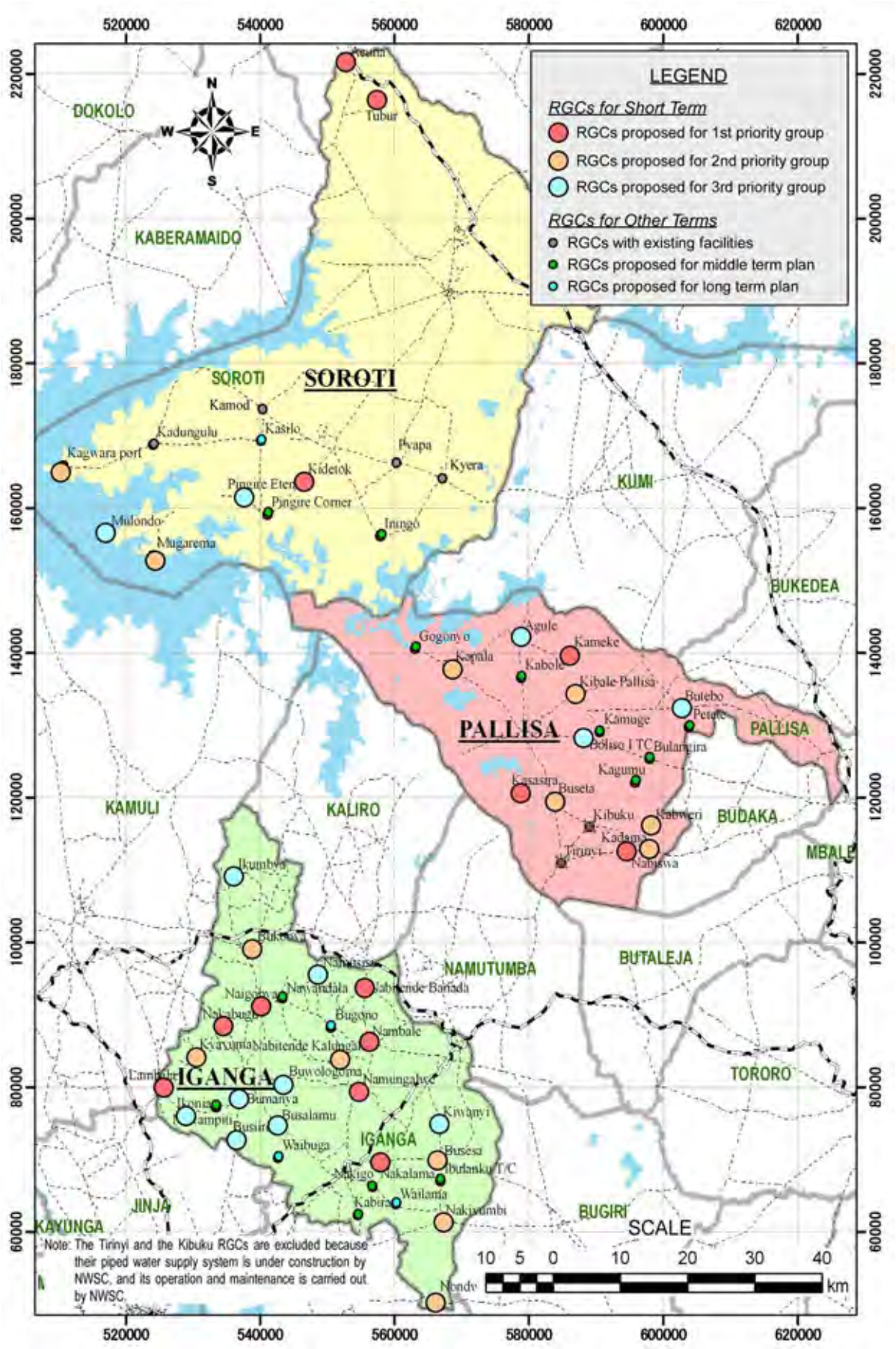


Figure 8-2 Location of Priority Projects

Chapter 9
Conclusion and Recommendations

CHAPTER 9 CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

Based on the wide-range data corrected for water resource development and management and the survey results obtained from the study over two years since March 2009, "The Basic Plan on Water Resources Development and Management" covering the Lake Kyoga basin based on the IWRM concept and "Rural Water Supply Master Plan" targeting three priority districts has been established. The conclusion of the study is summarized below.

(1) Water Resources Potential Evaluation

The ground water and surface water of the entire Lake Kyoga Basin was evaluated based on the survey results of this study. One of the key results is the estimated total available water resource of 556.1 MCM/year and 650.5 MCM/year in 1/10 and 1/3 drought years, respectively. This estimate with 1/10 drought year implies water resource shortage to occur by 2020.

(2) Major Issues on Water Resources Development and Management

Eleven major issues on water resources development and management found in the study 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 access to the surface water due to the Nile Water Agreement
- Climate change
- Lack of water supply and demand balance
- Insufficient rural water supply coverage
- Inadequate stakeholders collaboration for water resources development and management
- Lack of ambient water quality standards for conservation of water environment
- Lack of flood and sediment disaster mitigation
- Insufficient man power and organizing ability
- Insufficient community participation

(3) Water Balance of Supply and Demand in Each Sub-basin

The water supply and demand of each sub-basin in the Lake Kyoga basin was evaluated. Five sub-basins: Okok, Okere, Lwere, Kyoga Lakeside, and Mpologoma, will face shortage of agricultural water in near future. Mpologoma sub-basin was found in the worst condition of agricultural water shortage among the sub-basins.

(4) Formulation of the Basic Plan on Water Resources Development and Management

The Basic Plan on the Water Resources and Management for Lake Kyoga Basin consists of four items: i) Comprehensive Water Resources Management, ii) Effective, Stable and Equitable Water Supply, iii) Prevention of Flood and Sediments Disaster to Protect Lives and Properties, and iv) Conservation

of Water Environment. It was formulated for the short term to 2015, middle term to 2020, and long term to 2035.

(5) Priority Evaluation of the Basic Plan

Rural water supply was selected as the top priority item by comprehensive evaluation of the relative contribution of each item in the Basic Plan to the eight millennium development goals.

(6) Evaluation of the Basic Plan

There are no technical difficulties for implementation of the structual and non-structual measures in the Basic Plan. In terms of the economic evaluation, the validity of the rural water supply project has been confirmed based on the 12.7% EIRR which is larger than the discount rate of 10%. However, external funding is essential for implementation of basic infrastructures such as water supplies given the current financial situation of Uganda. The results of the social environment evaluation pose no unavoidable negative factors that affect forestation as well as construction of facilities such as water supply, storage, and filtration facilities.

(7) Selection of the Priority Districts for the Rural Water Supply Master Plan

Three priority districts, Soroti, Pallisa, and Iganga, were selected by evaluating five indices on both the natural and social condition for the Rural Water Supply Master Plan, which is the top priority project of the Basic Plan.

(8) Formulation of the Rural Water Master Plan

The Rural Water Master Plan for the three priority districts was formulated. It was concluded that implementation of piped water system for the Rural Growth Centre (RGC) would be very effective for drastic improvement of the rural water supply coverage as that of RGCs is considerably (10% to 40%) lower than the sub-county average and also the average of non-RGC rural areas according to the results of RGC survey and WATSUP.

(9) Evaluation of the Rural Water Supply Master Plan

The master will provide economical benefits to Uganda. However, external funding to support construction of facilities is inevitable given the financial situation of the country. Even for operating and maintaining the existing water supply facilities, the water charge collection rate of 75% must be achieved for wells with a hand pump, and roughly UGX 2,000/m^3 water charge must be collected without delinquency for the piped water supply syste in RGCs. In terms of the social environment, there are slight potential impacts, but they are avoidable.

(10) Selection of the Priority Projects

In order to meet the short-term goal of 77% rural water coverage by 2015, target RGCs of the priority projects were selected in the following manner. The total scores of the following items for every (61) RGCs in the three districts in the basin were used for the initial selection of 39 RGCs.

- Coverage rate of safe water supply
- The number of the existing public, administrative, and business facilities
- Expected water yield at the RGC site and its success rate
- Population
- Population served per each borehole
- Availability of electricity
- Yields observed at test boreholes

The selected RGCs were further classified into three priority groups. The following 13 RGCs belong to the first priority group.

- Soroti District：Kidetok, Tubur, and Acuna
- Pallisa District：Kadama, Kasassira, and Kameke
- Iganga District：Nabitende B., Namungalwe, Nambale, Nakabugu, Nakalama, Lambala, and Naigobya

9.2 Recommendations

Most of the recommendations on the water resources development and management of the Lake Kyoga basin, which are the main purpose of the study, are reflected in the Basic Plan. The recommendations mainly focus on water supply rather than sanitation, agriculture, power generation, or biodiversity though they are based on the concept of IWRM. Further expansion of this study by Uganda or DWRM is strongly recommended to address those areas to formulate the Integrated Water Resources Management Plan (IWRMP) hereafter. The main recommendations of the study are described below.

(1) Improvement of the Water Resources Monitoring System

In addition to its amount, the accuracy and continuity of the fundamental data, such as meteorological, hydrological, and hydrogeological, data are essential for Integrated Water Resources Management (IWRM). The current monitoring system needs to be significantly improved in this respect.

(2) More Human Resources and Capacity Development

More human resources and their capacity development (C/D) are needed for more efficient water resources development and management in the Lake Kyoga basin.

(3) Arbitration of Conflicts between Water Resources Stakeholders

Conflicts between water resources stakeholders are expected along with their development. Arbitration of such conflicts by basin or sub-basin lead by the Water Resources Management Zone Office) WRMZO and the Sub-basin Liaison Council is needed.

(4) Improvement of the Rural Water Coverage

New facilities are needed to improve the plateau of the rural water supply coverage. However, appropriate O/M of the existing facilities should not be neglected.

(5) Establishment of the O/M System for Water Supply Facilities

Collection of water charges without delinquency is the most important requirement for independent operation and maintenance of the water supply facilities by Uganda as explained in the financial evaluation in the Rural Water Supply Master Plan. Though maintainable O/M systems have been sought in Uganda, establishment of a feasible and efficient O/M system without delay is desired.

(6) Public Awareness of Water Saving

The analysis of water supply and demand shows rapid increase of water demand expected in near future in the Lake Kyoga basin. Therefore, public awareness of water saving is important to cope with the increasing demand.

(7) Acquisition of Funding Sources for the Rural Water Supply Master Plan

Roughly UGX 340 million/year is needed just to execute the Rural Water Supply Master Plan which is only for three out of about 80 districts in Uganda. Given the annual budget of UGX 1,500 million/year for the water related sector of Uganda, this amount is considerably large. Therefore, acquisition of funding sources needs to be seriously considered.

(8) Early Start of the Priority Projects and Acquisition of Groundwater Resources

The priority projects for the 13 selected RGCs should be started as soon as possible to improve the water coverage rate of the rural water supply. More detailed groundwater exploitation survey is necessary to acquire withdrawal volume for implementation of the projects.

(9) Water Supply Facilities for Rural Areas outside RGC

Water supply facilities, mainly deep wells with a hand pump, need be constructed in the rural areas outside RGC. Roughly 200 wells need to be installed every year in the three districts. A framework to accommodate that needs to be soon established. In addition, delinquency of water charges needs to be reduced for the level-1 operation and maintenance of the wells including the existing ones.

(10) Acquirement of Agricultural Water

Shortage of crop water is of a concern in five sub-basins, Mpologoma in particular. Planning and construction of flood water storages, valley tank and pond for example, as supplemental water storage should be carried out immediately.

(11) Dealing with Flood and Sediments Disasters

Destruction of the natural environment around the Mt. Elgon, along with the climate change, appears to have increased flooding and sediment disasters in the area. A basic survey to grasp the condition of the natural environment should be started soon.

(12) Environmental and Social Consideration

The water supply projects for the RGCs in the districts will go through the stages of F/S, basic design, detailed design, and implementation by turns. At the F/S stage, DWD needs to prepare application documents for NEMA based on "The Guideline for Environmental Impact Assessment in Uganda (1997)". Though will be eventually resolved, some differentials between those who benefit from new water supply facilities and those who do not may initially emerge. Therefore, an appropriate explanation of the project to the local communities is needed to avoid unnecessary conflicts.

(13) Population Control

The rapid population increase in Uganda, which ranks the third place in the world, is one of the main the causes of the rapid rise of the water demand and destruction of the natural environment around Mt. Elgon. Water supply planning and implementation with the population growth in consideration is of course important, but that with population control would be more effective.

(14) Expansion of the Study to Other Basins

Expansion of the water resources operation and management plan of this Study to other seven districts is strongly recommended.