The enquiry was made through the questionnaire form designed previously as shown in Appendix B (Volume Three). The actual survey and analytical works were sub-contracted to a local consultant, Carl Bro Uganda Ltd.

The number of communities identified by the inventory survey was 282 in total instead of 300 in the original list. The major reasons for the difference are the following; Some communities were regrouped together in the recent consolidation of LCI's under the decentralisation policy. Also plural place names were sometimes given for a single community in the original list. Only one community name was adopted in the final list in such a case. The final list of communities in comparison with the original list is given in Appendix-1 at the end of this Volume.

3.4.2. Community Type and Target Communities

(1) Community type by population size

The community types are categorised by the population size and the existing water sources for the communities. The communities are grouped by four population sizes as below and summarised in Table 3.4.1.

(a) 200 or less
(b) 201 to 600
(c) 601 to 1,000 and
(d) 1,001 or above.

Table 3.4.1. Number of Communities by Population Size

District	≦200	201-600	601-1000	1001<	Total
Mpigi	3	60	26	7	96
Mubende	4	60	29	3	96
Kiboga	10	65	10	5	90
Total	17	185	65	15	282
%	6.1	65.6	23.0	5.3	100.0

From this table it can be seen that about two-thirds of the rural communities have a population of 201 to 600 people.

(2) Community by availability of safe water sources

Communities are also categorised on the basis of availability of safe water sources. A safe water source is here considered to be the boreholes, the wells with handpumps, the protected springs or the gravity fed systems. Numbers of villages are counted according to the number of such safe water sources. The results are indicated in Table 3.4.2.

As to the availability of boreholes only 9.2% of the surveyed communities have working boreholes. The same for wells with handpumps, protected springs and gravity fed systems are 3.2, 10.3% respectively. Combining the above four sources of safe water, the overall availability of safe water for the target communities in three Districts are 23%, 27% and 30% for Mpigi, Mubende and Kiboga Districts respectively. The average for all three districts is 26.6%.

Table 3.4.2. Number of Communities by Number of Safe Water Sources

Boreholes (working)						
No. of Boreholes	1	2	3	4 or more	Total	%
Mpigi	9	2	0	0	11	11
Mubende	8	1	0	0	9	9
Kiboga	5	1	0	0	6	6
Total	22	4	0	0	26	92
Well with Handpump (working)						
No. of Wells with Pumps	1	2	3	4 or more	Total	%
Mpigi	4	1	0	0	5	5
Mubende	2	1	0	0	3	3
Kiboga	1	0	0	0	1	1
Total	7	2	0	0	9	32
Protected Spring (working)						
No. of Protected Springs	1	2	3	4 or more	Total	%
Mpigi	5	0	0	1	6	6
Mubende	10	2	0	0	12	12
Kiboga	8	2	1	0	11	11
Total	23	4	1	1	29	10 3
Gravity Fed System (working)						
No. of Gravity Sys.	1	2	3	4 or more	Total	%
Mpigi	0	0	0	0	0	0
Mubende	2	0	0	0	2	2
Kiboga	4	3	1	1	9	10
Total	6	3	1	1	11	3.9
Total Safe Water Sources (working) (Boreholes, Wells with Handpumps, and Protected Springs and Gravity Fed Systems)						
No. of Water Sources	1	2	3	4 or more	Total	%
Mpigi	18	3	0	1	22	23
Mubende	22	4	0	0	26	27
Kiboga	18	6	2	1	27	30
Total	58	13	2	2	75	26.6

(3) **Trading Centres**

Two(2) trading centres from each district i.e., a total of 6 in the Study area were pointed out as being particularly populous and thus meriting special attention. As a result of the inventory survey the following data were found as to the population of each trading centre.

Table 3.4.3. Trading Centres and Population

Community		District	(1)	(2)	(3)
No.	Name		orig.pop	inv.pop	2005-pop
1216	Kasangati	Mpigi	2000	600	780
1419	Wakiso	//	2000	3000	3897
2119	Kasambya	Mubende	1500	800	1087
2201	Kassanda	//	1800	1700	2309
3109	Bukomero	Kiboga	3000	806	1072
3117	Ntwetwe	//	2000	524	697

Note: (1) orig.pop: No of population given in the original list.
(2) inv.pop: No. of population found by Inventory Survey.
(3) 2005-pop: No. of population projected in 2005.

The population of these trading centres with the exception of Wakiso and Kassanda is more or less the average size. Although Wakiso and Kassanda have a rather high population, further analysis showed that these could also be treated in the same manner as other communities. (Refer to Chapter Four)

(4) **African Development Bank (AfDB) Programmed Communities**

Mpigi and Mityana Towns fall under the Small Towns Project of DWD and are awaiting funds from the AfDB. Thus these towns are excluded from the present Study.

Table 3.4.4. AfDB Projected Towns

Community		District	(1)	(2)	(3)
No.	Name		orig.pop	inv.pop	2005-pop
1502	Mpigi	Mpigi	500	8191	10640
2308/9	Mityana	Mubende	-	950	1291

Note: (1) orig.pop: No of population given in the original list.
(2) inv.pop: No. of population found by Inventory Survey.
(3) 2005-pop: No. of population projected in 2005.

(5) **Communities with Test Borehole**

During the present Study period 5 communities received test boreholes which were turned into services boreholes with handpumps. The following Table 3.4.5. indicates the names and population of these communities

Table 3.4.5. Communities with Test Boreholes

Community		District	(1)	(2)	(3)
No.	Name		orig.pop	inv.pop	2005-pop
1217	Seeta	Mpigi	-	300	390
1218	Magere	Mpigi	-	400	520
2409	Bekina	Mubende	-	800	1087
3145	Ssinde	Kiboga	226	280	372
3146	Kawaawa	Kiboga	312	320	425

Note: (1) orig.pop: No of population given in the original list.
(2) inv.pop: No. of population found by Inventory Survey.
(3) 2005-pop: No. of population projected in 2005.

By constructing these boreholes water need for 4 communities was satisfied. But Bekina (No. 2409) with its population of 1087 forecast for 2005 could not be satisfied with only one borehole, which covers only 430 people. The remaining population of 657 (=1087-430) are still to be counted for supply of new facilities.

(6) **Target Communities**

In due consideration of the above paragraphs the communities and their population to be excluded from the planning are summarised in Table 3.4.6.

Table 3.4.6. Communities and Population By District Excluded from Planning

Community		District	Population 2005
No.	Name		
1217	Seeta	Mpigi	390
1218	Magere	//	520
1502	Mpigi	//	10640
Mpigi subtotal		3 comm.	11550
2409	Bekina*	Mubende	430*
2308/9	Mityana	//	1291
Mubende subtotal		1 comm.*	1721
3145	Ssinde	Kiboga	372
3146	Kawaawa	//	425
Kiboga Subtotal		2 comm.	797
(Grand Total)		6 comm.	14068

Note*: One test botchole was constructed in Bekina (No.2409) which supplies water to 430 people. Out of total population of 1087 (year 2005) still 657(=1087-430) are to be given water sources. Therefore, Bekina is not excluded as a community but only the number of population is reduced by 430.

The target communities and population are thus calculated by subtracting the communities and population given in Table 3.4.6.

The result is shown in Table 3.4.7.

Table 3.4.7. No. of Target Communities and Population by District

	No. of Communities	Population in 2005
Total MPIGI DISTRICT	96	87650
Mpigi excluded	3	11550
Mpigi balance(Target)	93	76100
Total MUBENDE DISTRICT	96	72723
Mubende excluded	1	1721
Mubende balance (Target)	95	71002
Total KIBOGA DISTRICT	90	58488
Kiboga excluded	2	797
Kiboga balance (Target)	88	57691
Grand Total (3 Districts)	282	218861
Grand Total excluded	6	14068
Grand Total balance (Target)	276	204793

3.4.3. Socioeconomy

(1) Categories in Population Size

As a result of Inventory Survey this time, the target communities may be categorized as (1) the population size of 200 and below with share rate of 6.2 %, (2) between 201 to 600 with 64.9 %, (3) between 602 to 1,000 with 23.9 % and (4) over 1,000 with 5.6 % in the whole Project area as shown in Table below with those of each District, average family size and number of households headed by male and female and its rates:

Table 3.4.8. Categories in Population Size in the Target Communities

(As of 1995)

Item	Total/average		District					
			Mpigi		Mubende		Kiboga	
	In figure	%	In figure	%	In figure	%	In figure	%
Total population	165,004	100.00	67,478	40.89	53,538	32.45	43,988	26.66
Family size	4.69	-	4.68	-	4.82	-	4.54	-
Number of communities categorized								
200 & under	18	6.25	4	4.12	4	4.12	10	10.64
201 - 600	187	64.93	59	60.82	61	62.89	67	71.28
601 - 1,000	67	23.26	26	26.80	28	28.87	13	13.83
Over 1,000	16	5.56	8	8.25	4	4.12	4	4.26
Total	288	100.00	94	100.00	97	100.00	94	100.00

Source : Result of Inventory Survey for Communities made by JICA, 1995.

As shown in the above Table, and the average family size is 4.69 persons consisting of 4.68 persons per household (HH) in Mpigi District, 4.82 in Mubende District and 4.54 in Kiboga District. These family sizes are rather small comparing with other similar countries in Africa. The total population is around 171,000 in the whole Project area as of 1995.

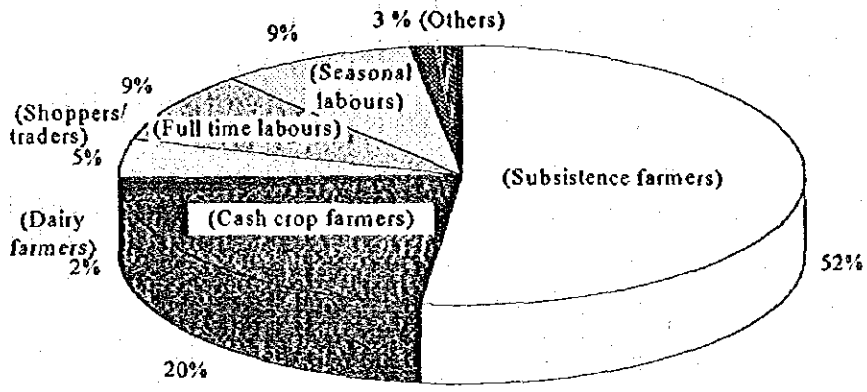
(2) Major Industry

Fig. 4.2.1 below shows a situation of occupation in the Project area based on the result of the said Inventory Survey as shown in APPENDIX D-11 in detail and in APPENDIX D-12 in summary. According to this figure, almost 74 % of people in the Project area are engaged in agriculture including subsistence farmers, cash crop farmers and dairy farmers.

According to the result shown in APPENDIX D-12, pastoralism related to the dairy farming is a high occupation rate in Mpigi comparing with the other 2 Districts as 2.1 % with 530 persons in number to the total occupation. Concerning this, Mubende has only 2

persons of pastoralists and Kiboga has only 30 persons of nomads with no any pastoralist. And only Mpigi has herdsmen related to pastoralism. Mpigi and Mubende have hunters of 50 persons and 30 persons respectively, this occupation relates to the dairy farming too.

Fig. 3.4.1 Occupation in the Project Area



Most animal husbandry is cattle in the Project area. In this viewpoint, a population of cattle in Kiboga is slightly higher as 38 % to the population of cattle than in Mpigi with 35 % and Mubende is the third with 28 % as mentioned in next clause on existing situation of communities.

In relating to construction industry, Mpigi and Kiboga have brick makers of 93 persons and 50 persons respectively but Mubende has none. On the other hand, Mpigi and Mubende have carpenters of 68 persons and 66 persons respectively, but Kiboga has none.

There are charcoal makers relating to the agricultural products and mechanics relating to manufacturing industry in Mpigi and Mubende, but Kiboga has no such occupation. Only Mpigi has bark cloth makers and bee keepers, and only Mubende has black smith and cobblers.

According to a UNDP report as the Report on the Census of Business Establishments in Uganda 1989, number of establishments in whole Mpigi was 130 firms with 12,000 persons

of employees but that in whole Mubende including whole Kiboga was only 70 firms with 2,000 persons of employees.

The above mentioned situation in the Project area resulted from the Inventory Survey seems to indicate almost the same pattern reported by UNDP.

(3) Population, Households and Family Size

As mentioned above, the total population in the Project area is 165,004 breaking down into Districts of Mpigi, Mubende and Kiboga as 67,478, 53,538 and 43,988 respectively as of 1995, and the total HH is 35,194.

The family size may therefore be calculated as 4.68 persons per HH, 4.82 and 4.54 in Mpigi, Mubende and Kiboga respectively. The average family size in the whole Project area is then resulted as 4.70 persons per HH.

(4) House Type

As shown in APPENDIX D-13, permanent houses in the whole Project area are 42.2 % to the total houses consisting of 74 % with tin roof and 26 % without tin roof to the total permanent houses. Remaining 57.8 % of houses are semi-permanent houses with mud and grass thatched houses. According to raw data of answer sheets of questionnaire for the Inventory Survey, most of these remaining houses are combined houses with mud and grass thatched.

Houses facilitated with latrine are 63 %, but those with modern sanplat or slab are only 9 % to the total houses with latrine. Remaining 91 % of houses have traditional ones with no modern sanplat or slab, but improved traditional ones. The other houses of 38 % have no latrine even if the traditional one.

Electrification rate of the communities in the whole Project area is only 14 %, and remaining 86 % have no electricity. Even the houses facilitated with electricity, the electricity is down 3 times a week in average, and the average down time is 4.6 hours per one time electricity down.

(5) Livestock

People living in the target communities have several kinds of livestocks as follows:

Table 3.4.9 Population of Livestocks in the Target Communities

(As of 1995)

Livestock	Population of Livestocks by District							
	Total		Mpigi		Mubende		Kiboga	
	(Heads)	(%)	(Heads)	(%)	(Heads)	(%)	(Heads)	(%)
Cattle	166,550	100.00	57,501	34.52	46,469	27.90	62,580	37.57
Sheep	6,854	100.00	2,900	42.31	2,150	31.37	1,804	26.32
Goats	30,548	100.00	9,464	30.98	5,421	17.75	15,663	51.27
Poultry	208,433	100.00	115,870	55.59	50,102	24.04	42,461	20.37
Others								
Pigs	10,157	100.00	530	5.22	5,820	57.30	3,807	37.48
Rabbits	210	100.00	0	0.00	200	95.24	10	4.76

Source : Result of Inventory Survey for Communities made by JICA, 1995.

Population of cattle in the Project area is almost the same level among 3 Districts, but slightly higher in Kiboga. This reflects a situation of animal husbandry in the Project area.

Poultry population in Mpigi is remarkable comparing with other 2 Districts. This poultry includes turkeys and/or ducks too, but most of the poultry is chicken according to original answer sheets of questionnaire for the Inventory Survey. The original answer sheets are summarized as shown in APPENDIX D-14.

(6) Occupation

As mentioned in previous sub-clause, most occupation in the Project area is subsistence farmers with share of 52 %, and the second one is cash crop farmers with share rate of 20 %. The third one is full time labours and seasonal labours with the same share rates of 9 %. Shopper/traders share a rate of 5 % as the fourth one and dairy farmers are the fifth one with share rate of 2 %.

There are other occupation groups in the Project area too such as hunters, brick makers, Pastoralist, local brewers, mechanics, bark cloth makers, bee keepers, herdsmen, carpenters, teachers, charcoal makers, medical doctors, tailors, butchers, civil servants, cobblers, security guards, black smiths, nomads, and hospital staff including nurses.

Among those occupations, there is not any carpenters in the Project area of Kiboga. Most pastoralists are in Mpigi as number of 530 persons, and those in Mubende are very few.

Kiboga has no pastoralists in the Project area according to the result of the Inventory Survey. Hospital staffs are only in Kiboga because it has modern Kiboga Hospital. Nomads are also in Kiboga only.

(7) Cultivated Land and Agricultural Products

An average accessible land in the Project area is 5.52 acre (around 2.2 ha) per household, but actual cultivated land is only 2.58 acre (around 1.0 ha) with cultivated rate of 47 % as shown in the Table (A) of APPENDIX D-15.

Agricultural products may be classified into 2 categories as (1) food crops and (2) cash crops.

Food crops include all agricultural crops for people's daily use, usually representative one is paddy. However, in the Project area, they do not produce paddy, but cassava, yams, sweet potatoes, Irish potatoes, maize, sorghum, beans, finger millets, soya beans, matoke bananas (plantains), sweet bananas, cabbages, onions, tomatoes, pineapples, ground nuts, fruits, and so on.

Following Table shows a situation of major food crops to produce, of self-use, and to sell their products to markets in the whole Project area based on a Table (B) of APPENDIX D-15.

Table 3.4.10 Situation of Major Food Crops to Produce, of Self-Use, and to Sell in the Project Area

(As of 1995, unit : %)

Item	Percentage (%) to total sampled communities by major food crops															
	Cas-sava	Yams	Sweet pota-toes	Irish pota-toes	Maize	Sorg-hum	Beans	Finger millet	Soya beans	Matoke bananas	Sweet bananas	Cab-bages	Onion	Toma-toes	Pine-apple	Ground nuts
To produce	83.26	50.88	95.09	61.75	95.44	64.56	96.49	42.46	40.70	92.98	79.65	48.77	46.67	70.18	38.60	89.12
Self-use	85.26	49.12	93.68	58.95	91.23	26.32	94.74	37.54	32.98	90.18	70.88	48.07	51.93	69.82	39.30	86.32
To sell	45.61	16.84	50.88	31.23	70.88	55.79	77.54	27.02	25.96	55.44	48.77	34.74	28.07	60.35	19.30	57.89

Source : Result of Inventory Survey for Communities made by JICA, 1995.

As indicated in the above Table, sweet potatoes, maize, beans and matoke bananas (plantains) are produced by most communities with around 95 % to the total communities as the first crop group. The second crop group includes cassava and ground nuts with around 86 % share rate of communities. Share rates of self-use of some crops are higher

than that to produce as shown in the Table like cassava and onions. People are buying these short crops from markets according to the raw data of the Inventory Survey.

Even food crops, people are selling their products to markets in the Project area. For example, almost 71 % of communities sell their produced maize, 60 % : tomatoes, 78 % : beans, 51 % : sweet potatoes, 55 % : matoke bananas (plantains), 58 % : ground nuts, and so on. Almost 65 % of people living in communities of the Project area produce their crops for double purposes as self-use and to sell. This is a way of getting their income in communities in the Project area.

Cash crops include cotton, coffee, tea, tobacco, and other crops which can be treated as trading crops for taking economic income of farmers. A representative cash crop in the Project area is coffee. They produce cotton and tea too, but very little. Tobacco is negligible small.

Following Table shows a summarized situation of cash crops together with a summary of food crops.

Table 3.4.11 Situation of Major Cash Crops in the Project Area

(As of 1995, unit of share rate : %)

Crops	Number of communities to produce crops	To use crops for themselves		To sell crops to markets	
		Number of communities	Share rate to communities	Number of communities	Share rate to communities
Food crops	3,235	3,027	93.57	2,093	64.70
Cash crops	274	148	54.01	277	101.09
Cotton	5	7	-	20	-
Coffee	256	113	-	240	-
Tea	13	28	-	17	-
Total/average	3,509	3,175	90.48	2,370	67.54

Source : Result of Inventory Survey for Communities made by JICA, 1995.

Total number of communities sampled is 285 communities in the Inventory Survey, and 256 communities produce coffee as shown in the above Table. It means that almost 90 % of communities are producing coffee in the Project area. Among these coffee production communities, 113 communities are self-users which are only 44 % to total coffee producers, but 240 communities are producing coffee for selling which are 94 % to total coffee

producers. So there seems to be a lot of coffee producers who are producing it for double purpose to use and sell.

Cotton and tea cultivation are not so much active in the Project area as indicated in the above Table, tobacco cultivation is negligible small as mentioned in the previous sub-clause.

3.4.4. Women's Role

(1) Participation in planning and decision making

The GOU encourages women to become involved in the planning and decision making at all levels, but generally women's involvement in village politics is limited. Only a quarter of the members in all LC1/Village Development Committees (VDCs) in the study area was women, and less than 15% of the chairpersons were females. But even the presence of women in village committees does not ensure their active participation. Cultural norms and traditional attitudes inhibit women from contesting for leadership or raising their voices in public assemblies. Often husbands actively prevent their wives from becoming political leaders and many women "retire" from a public carrier when they get married.

Women are the major users of water facilities. Domestic water-hygiene during water collection, storage and use is mainly determined by women. Men collect water for commercial business and during the dry season. Women and children collect water on foot. Men collect water on bicycles.

Women are under represented in most WES projects, not only during planning and decision making, but also during training. WES is traditionally a male dominated sector. Non-involvement of women at village level are, however, often attributed to the unbalanced distribution of work within the family, which leave women with little time for other activities. Consequently most village committees are male dominated and women lose access to decision making.

(2) Implementation

Most WES projects call for the active participation of the local community. During the implementation phase the community should participate in the site-selection, clearance of the site, collection of local materials and provision of food for the drillers. Here women are predominantly involved in their traditional roles; collection of local materials and

preparation of food. Whereas the site selection often take place without the active involvement of women.

In an attempt to address gender issues, most WES projects, demand that a certain quota of women be involved in WES activities, especially as active members in the WES Committees and as Caretakers. In the study area 37% of the WUC members were women. But the more powerful position as the chairperson of the committee is less commonly given to a woman. Only eight(8)% of the WUC committees had a female chairperson.

(3) Training

Women are commonly trained as Community Health Care Workers (CHW), as female CHWs easier can do home visits to all the "housewives", who manage the HH environment. Fifty % of the CHWs in the study area are women. The work as CHW bring social prestige and some times a few socio-economic benefits.

The active involvement and training of women in WES projects are often attached with a larger drop-out rate. Especially of young and unmarried women. Young and unmarried women, who often initially find it easier to break with traditions and hence, find the non-traditional duties more acceptable, often end up leaving the job upon marriage.

It is common to assume that women as the main water collectors feel more responsible for O&M of the water source. But the job as caretaker requires public authority and technical skills. Whereas women often cope well with the need for technical skills, public authority is traditionally men's duty and most female caretakers find it difficult to enforce the rules at the water source and collect the water fees. The present training of caretakers is not gender sensitive, as it fails to address this problem.

Many WES projects train local artisans to assist in construction and repair work of the installed facilities or production of san-plats or slabs. Women are rarely, if ever trained as water fundi, but more commonly involved in the production of san-plats and slabs. Water fundi are highly appreciated by the local community and well paid. The promotion of sanitation only survive on subsidies and provide no sustainable economic gain. Training of women as water fundi would improve their socio-economic status and empower women to influence community affairs. Training of women in sanitation production only provide a temporary socio-economic gain, as long as someone is willing to purchase the products at full cost for resale at subsidized prices. This artificial market is not sustainable.

(4) **Operation and Maintenance**

Community Based O&M aim to train two caretakers for each improved water source. The community chose the caretakers, but most WES projects demand that one "must" be a woman. Presently only about 20% of the caretakers in the study area are women.

Women often have multiple other tasks and find it hard to allocate the time for the job as caretaker. Whereas most male caretakers have few other duties and welcome the job as caretaker, which gives them a position of authority and respect.

Presently women are rarely involved in the technical aspects of WES and barely ever trained as HPM. If the HP breaks down, the daily task of water collection will remain with the women. Capacity to repair the HP would empower women to control their own lives, but instead women continue to do the commendable job of cleaning the pump site. Also most women make no money from their daily duty as caretakers, whereas most HPM can make a living from their training and job.

(5) **Conclusion**

The present pressure on gender issues in development has increased women's already heavy daily workload. Where as women's gain in social power has been comparably insignificant.

WES projects decrease the time women spend on water collection, but ask women to take active part in other activities. Women, however, mainly, get the unpaid and poorly recognized tasks. WES project should aim to enhance women's power in society, by enabling them to become self-reliant, public authorities. There is a need for gender sensitive training, addressing the specific problems women face as part of the society. The lack of gender awareness in the community needs to be addressed. Women should get equal access to learn skills, which enhance their financial power. Women should gain access to training as HPM and water fundi. There is no traditional roles which hinders women's involvement in technical aspects of WES. There is, however, a traditional role of women, which inhibits women's access to social influence and socio-economic power.

Attempts have been done to address the problem of non-involvement of women in the WES sector. The MGCD has developed gender specific guidelines for the WES-sector. But, this traditionally male dominated sector, is still gender biased and many grassroots communities are to a large extent gender segregative, as regards to WES issues as well as other

development issues. There is a need to address the grassroot problem of gender segregation in community based management and politics. Gender is a development issue concerning every-body in the community, men, women and children.

WES projects need to address the in-equity issues inherent in working with rural communities. WES projects, which aim to reduce women's work burden, should also aim to improve women's position and status in rural societies. WES projects should involve women on equal terms with men. Gender analysis should look at the roles, responsibilities and participation of both males and females, old and young, as opposed to women in development. After all it is difficult to talk about the involvement of women, if "people" in general are not involved in a programme through all stages.

All data on Community Based Management and Gender can be found in Table 3.4.12.

Table 3.4.12. Community Based Management and Gender

	Mpigi		Mubende		Kiboga		Total	
No. of Villages	96	100.0%	96	100.0%	81	100.0%	273	100.0%
Total No. HHs	14,857	100.0%	10,983	100.0%	9,581	100.0%	35,421	100.0%
Female Headed HHs	3479	23.4%	1947	17.7%	2043	21.3%	7,469	21.1%
Total No. of VDCs	40	41.7%	30	31.3%	20	24.7%	90	33.0%
Mean No.of members in a VDC	8.6		8.4		8.3		8.4	[5; 10]
Mean No. of female members	2.1		2.4		1.7		2.1	[1; 3]
Total members of VDCs	336	100.0%	252	100%	165	100.0%	753	100.0%
Total Female members of VDCs	82	24.4%	73	29.0%	33	20.0%	188	25.0%
Total Female Chairpersons	3	7.5%	7	23.3%	3	25.0%	13	14.4%
Total Female Secretary	10	25.0%	14	46.7%	5	40.0%	29	32.2%
Total Female Treasury	23	57.5%	17	56.7%	8	85.0%	48	53.3%
Total No. of WUCs	42	0.4375	33	0.34375	25	0.30864	100	0.3663
Mean No.of members in a WUC	7.3	[2; 15]	6.5	[3; 12]	7	[2; 10]	7	[2; 15]
Mean No. of Female members	2.5	[0; 5]	2	[0; 4]	1.5	[0; 3]	2.5	[0; 5]
Total members of WUC	316	100.0%	209	100.0%	177	100.0%	700	100.0%
Female members of WUC	138	43.7%	73	34.9%	47	26.6%	258	36.9%
Total Female chairpersons	4	9.5%	3	9.1%	1	4.0%	8	8.0%
Total Female Secretary	11	26.2%	6	18.2%	2	8.0%	19	19.0%
Total Female Treasurer	23	54.8%	10	30.3%	7	28.0%	40	40.0%
Trained WUCs	9	21.4%	5	15.2%	5	20.0%	19	19.0%
WUCs w/ set rules	31	73.8%	27	81.8%	21	84.0%	79	79.0%
WUCs w/ written set rules	19	45.2%	12	36.4%	10	40.0%	41	41.0%
WUCs w/ Maintainance Funds	22	52.4%	10	30.3%	7	28.0%	39	39.0%
Total No. of Caretakers	212	100.0%	186	100.0%	108	100.0%	506	100.0%
Total No. of Female Caretakers	52	24.5%	34	18.3%	23	21.3%	109	21.5%

3.5. Existing Water Supply and Sanitation

3.5.1. Water Supply Facilities

The existing water supply facilities were categorised into the following kinds.

(a) Borehole with handpump (BH)
(b) Shallow well with handpump (WP)
(c) Shallow well without handpump (WL)
(d) Valley dam (DM)
(e) Protected spring (PS)
(f) Unprotected spring (US)
(g) Water hole (WH)
(h) Gravity fed system (GF)
(i) Rainwater harvest (RH)
(j) Others (Etc)

Each community was surveyed as to the availability, functionality and number of these facilities. The results are tabulated in Appendix C-1. The following Table 3.5.1 shows the summary in Nos. of water sources in use and not in use.

Table 3.5.1. Distribution of Various Water Sources in Each District

District	(1) No. of Water Sources in Use										
	BH	WP	WL	DM	PS	US	WH	GF	RH	Etc	TOTAL
Mpigi	12	7	40	18	12	68	38	0	22	5	222
Mubende	11	4	20	7	14	74	88	3	16	6	243
Kiboga	7	1	4	3	13	76	125	17	22	3	271
Total	30	12	64	28	39	218	251	20	60	14	736

District	(2) No. of Water Sources not in Use											GRAND
	BH	WP	WL	DM	PS	US	WH	GF	RH	Etc	TOTAL	TOTAL
Mpigi	8	6	9	9	8	5	14	5	2	1	67	289
Mubende	14	4	4	4	4	8	8	3	6	1	56	299
Kiboga	9	9	8	8	8	5	7	8	4	2	68	339
Total	31	19	21	21	20	18	29	16	12	4	191	927

The above table indicates that about 20 % or 191 facilities are out of service. Among the functioning water sources the yield was investigated and divided into three classes, i.e., low,

medium and high. The ranges of these classes are measured by the number of people dependent on the facilities. Facilities with low class yield have a capacity to supply water to up to 100 people, the medium class between 100 and 400 and the high class more than 400. The results are summarized in Table 3.5.2.

Table 3.5.2. Yield of Water Sources

DISTRICT	YIELD						TOTAL	
	LOW		MEDIUM		HIGH			
	No.	%	No.	%	No.	%	No.	%
MPIGI	90	40.5	66	29.7	66	29.7	222	100.0
MUBENDE	90	37.0	79	32.5	74	30.5	243	100.0
KIBOGA	95	35.1	88	32.5	88	32.5	271	100.0
TOTAL	275	37.4	233	31.7	228	31.0	736	100.0

Notes :Low yield covers up to 100 villagers.
Medium yield covers between 100 and 400 villagers.
High yield covers more than 400 villagers.

3.5.2. Existing Sanitation System

The existing sanitation system follows the National Sanitation Guidelines. All three districts have central and decentralised district casting yards.

Mpigi district receive support from AVSI and WES-UNICEF to their casting centres. Mpigi's casting centre has motivated and technical qualified personnel, who are ensured a continuos supply of quality materials. This ensures a stable production to meet the demand. Mpigi district has a well functioning district casting yard, with a high out-put of high quality san-plats and slabs. All san-plats and slabs from Mpigi casting yard have footsteps and come with a lid and the surface is nicely finished and smooth. Finally Mpigi has a distribution system, which make san-plats easily available at all Sub-County Headquarters (S/C-HQs).

Mubende and Kiboga districts are running their district casting centres without any external assistance, except from WES-UNICEF. Both districts has severe production problems, resulting in a very low out-put of a less good quality. They are unable to ensure a continuos supply of materials for production, especially quality is a major problem. All

san-plats and or slabs produced have neither foot-steps nor lids and their surface is rough and difficult to clean. Finally there is no distribution system to ensure availability at lower levels.

The sanitation coverage in the study area is as high as 87% having some kind of sanitation facilities. The sanitation coverage is highest in Mpigi (90%) and lowest in Kiboga (85%).

The majority (65%) uses a traditional pit latrine with log and mud floor and a rudimentary super structure. This provide some privacy and protect against rain, but is difficult to keep clean. Hence, it easily enhance the transmission of hookworms and breeding of insects.

About 10% of the HH has improved traditional latrines with a simple cement floor padded directly on the dirt ground. Less than six(6)% use pit latrines with san-plats, slabs or VIP latrines. Totally 16% has some kind of improved sanitation. This percentage is highest in Mpigi (24%) and lowest in Kiboga (8%).

Only 17% of the pit-latrines in the study area had a lid, this percentage is highest in Mpigi (20%) and lowest in Kiboga (14%).

Generally the sanitation coverage with improved sanitation was highest in Mpigi district, where access is also better.

District details on kind and availability of latrines can be seen in Table 3.5.3.

Table 3.5.3. Existing Sanitation Situation

		MPIGI		MUBENDE		KIBOGA		TOTAL	
Total No.of Household		100.0%	591	100.0%	627	100.0%	523	100.0%	1741
Sanitation Coverage	All types	90.2%	533	84.8%	532	84.7%	443	86.6%	1508
	Improved (excl.trad. w/mud)	24.0%	142	15.5%	97	7.8%	41	16.1%	280
	San-plat, slab and VIP	8.8%	52	5.6%	35	2.1%	11	5.6%	98
No pit-latrine		9.8%	58	15.2%	95	15.3%	80	13.4%	233
Traditional pit-latrine	with mud-floor	66.2%	391	69.4%	435	77.1%	403	70.6%	1229
	with cement floor	15.2%	90	9.9%	62	5.5%	29	10.4%	181
Pit-latrine	with sanplat	3.0%	18	1.8%	11	0.4%	2	1.8%	31
	with slab	3.7%	22	3.0%	19	1.0%	5	2.6%	46
Ventillated improved latrine		2.0%	12	0.8%	5	0.8%	4	1.2%	21
Respond rate of HH w/ pit		104.7%	558	109.2%	581	80.6%	357	99.2%	1496
Clean Pit-latrine		50.0%	279	39.9%	232	45.4%	162	45.0%	673
Respond rate of HH w/ pit		104.7%	558	110.0%	585	80.6%	357	99.5%	1500
Lid covered pit-hole		20.3%	113	16.1%	94	14.3%	51	17.2%	258
Respond rate of HH w/ pit		105.1%	560	110.2%	586	80.4%	356	99.6%	1502
Hand-washing facilities		22.1%	124	18.1%	106	15.4%	55	19.0%	285

3.5.3. User's Awareness

Table 3.5.4. shows a result of the village inventory survey on people's awareness of the relation between water, sanitation and health.

Table 3.5.4. Knowledge of Water, Sanitation and Health

	MPIGI		MUBENDE		KIBOGA		TOTAL	
Diseases Caused by Dirty Hands	100.0%	26	100.0%	28	100.0%	33	100.0%	87
Diarrhoea	84.6%	22	89.3%	25	93.9%	31	89.7%	78
Worms	42.3%	11	42.9%	12	57.6%	19	48.3%	42
Dysentery	26.9%	7	42.9%	12	27.3%	9	32.2%	28
Prevention of Diarrhoea	100.0%	26	100.0%	28	100.0%	33	100.0%	87
Boil drinking water	61.5%	16	64.3%	18	54.5%	18	59.8%	52
Wash hands before eating	42.3%	11	42.9%	12	48.5%	16	44.8%	39
Proper use of latrines	34.6%	9	32.1%	9	27.3%	9	31.0%	27
Prevention of Worms	100.0%	26	100.0%	28	100.0%	33	100.0%	87
Eat well-cooked food	50.0%	13	60.7%	17	42.4%	14	50.6%	44
Use latrines	30.8%	8	28.6%	8	36.4%	12	32.2%	28
Wear shoes	15.4%	4	35.7%	10	15.2%	5	21.8%	19
Knowledge of San-plats	100.0%	602	100.0%	641	100.0%	425	100.0%	1668
	72.3%	435	67.9%	435	64.2%	273	69.6%	1161
Information Source	100.0%	507	100.0%	482	100.0%	284	100.0%	1273
LC-Office	30.6%	155	23.4%	113	23.6%	67	26.3%	335
Radio	23.3%	118	23.9%	115	25.0%	71	23.9%	304
Health Care Worker	21.5%	109	20.1%	97	25.4%	72	21.8%	278
Chief	6.9%	35	7.9%	38	8.8%	25	7.7%	98
Poster	0.6%	3	0.4%	2	0.4%	1	0.5%	6
Other	17.2%	87	24.3%	117	16.9%	48	19.8%	252

(1) **The Awareness of the relation between water, sanitation and health.**

The majority (90%) of the sub-sample in the inventory survey knew that dirty hands can cause diarrhoea. However, only about 60% was aware, that diarrhoea can be prevented by boiling water before drinking it. Less than half (45%) was aware that washing hands before eating can prevent diarrhoea. Also the awareness of the link between diarrhoea and sanitation was low. Only about a third (31%) mentioned the importance of using a latrine for defecation to avoid the spread of diarrhoea.

Intestinal worms were perceived by a half of the population (51%) as best prevented by cooking food well. Only few (32%) were aware of the importance of using latrines to prevent the spread of worms. Even less (22%) was aware of the importance of wearing shoes or washing hands before eating.

Table 3.5.3. shows the sanitation coverage of sampled HHs in the study area.

The majority of the HHs in the study area had some kind of latrine facilities. Most likely to achieve privacy or be protected against rain, as the general awareness of the relation between water, sanitation and health were low. Consequently less than half (45%) of the latrines were clean and less than 20% had a lid or hand washing facilities.

About 70% of population have heard about san-plats or slabs, but less than five(5)% used one by themself. The main source of information was the LC-Office, the radio or the Health Care Worker. Less than one percent had seen a poster promoting san-plats.

In summary; the knowledge of the relation between water, sanitation and health is low in the study area. Consequently the awareness of the importance of clean water, good hygiene and sanitation, for health, is low. Whereas, most of the communities are aware of their need for water, few are concerned with the quality. And while most HH in the study area has a perceived need for privacy during defecation, less finds the hygienic condition of the latrine facilities important. The personal and environmental hygiene practices in the study area is in general poor, due to poor awareness of the importance for health.

The access to improved water source in high quantities will enhance the possibility of improved hygienic habits, but people need to be aware of the importance, to be motivated to enhance their behavior.

(2) O&M

User's knowledge of how to operate and maintain BHs is very limited. Despite that the users participate with local resources during construction BHs are still seen as advanced technology belonging to the GOU. Many communities do not know how to take care of their BH and are not aware that they can prolong the functional life time of a BH by taking better care of it. Repair is seen as the GOU's responsibility. Less than 10% of the communities with BHs have received any formal training in the recent GOU's concept of the CBMS. Whereas many extension workers have some knowledge of the CBMS, only few are aware, how to enable the district and the communities to implement CBMS.

(3) Gender

The WES sector has some knowledge of gender issues, but limited awareness of the importance of empowerment of women. Often WES projects insist on the involvement of women in positions, which just gives them an other task to perform. Nearly half the caretakers of water sources are women, whereas few are trained as HPM or water fundi. Presently women are getting over-burdened by development projects. The knowledge and awareness of gender issues are basically lacking at the community level. The present community efforts to change women's positions in the community is not based on knowledge and awareness, but mainly dictated. The situation is not much different for district extension staff.

3.5.4. Health and Hygiene

The Total Fertility Rate (TFR) in Uganda is 7.3 per fertile women and one of the highest in Africa. The Maternal Mortality Rate (MMR) is about 700 to 1,000 per 100,000 births[1] and, one of the highest in the World. The MOH estimates that one infant dies every fourth minute in Uganda. The Infant Mortality Rate (IMR) is 122 per 1000 live birth is one of the highest in Africa. Some of the main determinants of the IMR are maternal health, child birth, nutrition and malaria. Within the recent decade the IMR has further increased due to HIV/AIDS.

(1) The Infant Morality Rate in the Study Area

The average IMR for Mpigi, Mubende and Kiboga is respectively by 94, 119 and 138 per

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[1]: As two-thirds of all labours take place in the home the MMR, here quoted is likely to be an underestimate of the true value.

1,000 live birth. A large segment of the population in mainly Mpigi, but also Mubende, belong to the upper socio-economic segment of the Ugandan population. Further the access to health care is better in these districts. This decrease the overall IMR for these districts. The study areas within all three districts are, however, socio-economically equally poor and the IMR is estimated to be 140 per 1000 or more in the study area.

Table 3.5.5.A. Health Indicators

	Uganda			Mpigi			Mubende			Kiboga		
	Female	Male	Both	Female	Male	Both	Female	Male	Both	Female	Male	Both
IMR	111.8	131.4	121.7			94			119			138
CMR	193.7	215.6	203.4			154			198			231
Life.Exp at Birth	50.5	45.7	48.1	55.2	49.5	52.3	50.4	46.1	48.2	47.0	42.5	44.7

Source: The 1991 Population and Housing Census, MFEP, 1995

Table 3.5.5.B. Project Impact on Health

WATER - RELATED DISEASES		In-Patient	Out - Patients				Est. Prevalence in Study Area			Estimated Impact of Interventions			
		Mpigi	All Uganda	Mpigi	Mubende	Kiboga	HU/In-pt.	HU/Out-pt	Population	W / Only	W + S	W + HE	W+HE+S
Water-Borne	Diarrhoea w/ blood	0.10%	5.66%	2.96%	4.25%	4.81%	0.1%	5.0%	0.8%	17%	30%	33%	35%
	Diarrhoea non-bloody	0.00%	0.97%	No-record	1.10%	0.92%	0.1%	1.0%	10.0%	17%	30%	33%	35%
	Typhoid/Para-typhoid	0.50%	0.06%	No-record	No-record	No-record	0.5%	0.1%	0.1%	17%	30%	33%	35%
Water-washed	Trachoma	0.00%	0.01%	No-record	No-record	No-record	0.0%	0.1%	3.0%	15%	15%	50%	50%
	Eye-infections	0.00%	3.79%	1.91%	3.51%	3.86%	0.0%	4.0%	2.5%	10%	10%	30%	30%
	Skin infections	0.10%	4.01%	4.04%	0.04%	4.26%	0.1%	4.0%	7.5%	10%	10%	20%	20%
Water-based	Schistosomiasis	0.10%	0.00%	0.00%	0.00%	0.00%	0.1%	0.0%	0.1%	60%	65%	70%	77%
	Guinea Worm	0.00%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A
Water-related Vector-borne	Malaria	22.90%	28.11%	39.94%	25.43%	27.25%	23.0%	28.0%	20.0%	Increase	Increase	Decrease	Decrease
	Trypanosomiasis	0.00%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.03%	N/A	N/A	N/A	N/A
	Onchocerciasis	0.00%	0.08%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A
Faecal-related	Intestinal worms	No-record	9.61%	4.16%	No-record	9.16%	1.0%	9.6%	20.0%	5%	15%	25%	30%

Table 3.5.5.C Project Impact on Health and Medical Expenditures

WATER - RELATED DISEASES		ESTIMATED PRESENT SITUATION IN THE STUDY AREA							ESTIMATED IMPACT OF SELECTED INTERVENTIONS							
		Population Point-Prevalence	Study Population Cases			Medical Expenditure(USH)			Expected Yearly Decrease in Total no. of cases in the Study Population				Expected Yearly Decrease in Total Medical Expenditures (1000 USH)			
			Total in a Yr.	Health Care Use		Cost per Case		Total (1000)	W/Only	W+S	W+ HE	W+HE+S	W /Only	W + S	W + HE	W+HE+S
				P (HU)	Use HU	Self-care	use HU									
Water-Borne	Diarrhoea w/ blood	0.8%	1,328	0.65	863	1,000	5,000	4,782	17%	30%	33%	35%	813	1,435	1,578	1,674
	Diarrhoea non-bloody	10.0%	16,604	0.01	166	300	2,000	5,264	17%	30%	33%	35%	895	1,579	1,737	1,842
	Typhoid/Para-typhoid	0.1%	166	0.50	83	1,000	5,000	498	17%	30%	33%	35%	85	149	164	174
Water-washed	Trachoma	3.0%	4,981	0.05	249	1,000	5,000	5,978	15%	15%	50%	50%	897	897	2,989	2,989
	Eye-infections	2.5%	4,151	0.10	415	1,000	3,000	4,981	10%	10%	30%	30%	498	498	1,494	1,494
	Skin infections	7.5%	12,453	0.06	747	1,000	3,000	13,948	10%	10%	20%	20%	1,395	1,395	2,790	2,790
Water-based	Schistosomiasis	0.1%	166	0.05	8	500	5,000	120	60%	65%	70%	77%	72	78	84	93
	Guinea Worm	0.0%	0													
Water-related Vector-borne	Malaria	20.0%	33,209	0.15	4,981	1,000	4,000	48,153	< 0%	< 0 %	10%	10%	0 or less	0 or less	4,815	4,815
	Trypanosomiasis	0.03%	50	0.50	25	1,000	4,000	125	0%	0%	0%	0%	0	0	0	0
	Onchocerciasis	0.0%	0													
Faecal-related	Intestinal worms	20.0%	33,209	0.05	1,660	1,000	4,000	38,190	5%	15%	25%	30%	1,910	5,729	9,548	11,457
Total			106,318		9,199			122,038					6,564	11,759	25,199	27,328

* Population in the project Area 166,044 (1995)

P (HU) = The probability that a patient with the disease seek Health Care at a HU

W = Improved Water Supply

S = Improved Sanitation

HE = Health Education

(2) **The Child Mortality Rate in the Study Area**

The average Child Mortality Rate (CMR) for Mpigi, Mubende and Kiboga is respectivly 154, 198 and 231 per 1,000 live birth. As for the IMR the estimated average CMR is lower in Mpigi and Mubende due to representation of better of socio-economic segment of the population and better access to health care. The household environments in the study area is, however generally very poor, as is access to health care. The probability that a new born baby reach an age of five years is therefore estimated to be 75%, equal to a CMR 250 per 1000 live births in the study area.

The CMR is determined by factors influencing death before five years of age. The major determinants of the CMR is the IMR and the household environment of early childhood. Poor hygiene and crowded living conditions, decrease the access to food and the immune defense and increase the exposure to infections, this enhance the risk of severe infection and premature death of children below five years of age.

(3) **WES related Diseases in the Study Area**

WES related disaeses can be classified according to their route of transmisson, a classification system usefull for planning, monitoring and evaluation of intervention strategies is shown in Table 3.5.6. below:

Table 3.5.6. Classification of the Major WES Related Diseases

Water-borne diseases transmitted by water. Water is a passive transporter for the infective agent, e.g., diarrhoea, dysentery, typhoid, giardiasis, cholera.

Water-washed diseases due to lack of water or insufficient use of water for personal or domestic hygiene, e.g., trachoma, some skin infections.

Water-related vector-borne diseases transmitted by insects breeding or biting in relation to water, e.g., malaria, trypanosomiasis and onchocerciasis.

Water-based diseases caused by infecting agents spread by contact with or ingestion of water. An essential part of the life cycle of the infecting agent takes place in an aquatic animal, e.g., schistosomiasis and Guinea worm.

Faecal-disposal-related diseases transmitted due to faecal contamination of soil. Human infection is either through direct penetration of the intact human skin (e.g., hookworms) or through ingestion, either with an intermediate host (e.g., tapeworm) or without (e.g., roundworm).

The control of water-borne diseases requires a safe water source of a high quality and with enough water for the practice of general water hygiene, to ensure that the water stays safe. The provision of a water source with an improved quality of water will prevent the transmission of water borne diseases provided that the water source remain safe and that the individual practices appropriate water hygiene, so that the water does not get contaminated, when collected or stored in the home. Most importantly people should be motivated through hygiene education to use more water for general hygiene.

The control of water-washed diseases depends on easy access to large quantities of water and the motivation to use more water for personal hygiene, whereas the quality of the water used is less important. Most importantly, people should be motivated through hygiene education to use more water for personal hygiene.

The control of vector-related water-borne diseases depends on improved environmental hygiene and decreased exposure to the vector. Pools of water around the water source should be avoided, to prevent the breeding of Anopheles mosquitoes the main vector of malaria.

The control of water-based diseases depends on elimination of contact with the infected water source. Many villages in the study area presently use traditional water sources (water holes or un-protected springs) They often prefer the taste of these water sources and will continue to use them also after the installation of a BH. Especially if the distance to these traditional sources are shorter, than the distance to the new BH. Here hygiene education is important to improve the populations awareness of the diseases related to these water sources.

The general access to and the quality of water in the study area is very poor, especially during the dry season. The present water situation leads to poor general hygiene, the fact, which combined with poor environmental sanitation, contribute to increased child morbidity and mortality from WES related diseases such as malaria, diarrhoea, dysentery, intestinal worms, skin diseases, eye-infections and trachoma. The major reasons for morbidity and mortality are, therefore, preventable through improved water, sanitation and environmental hygiene combined with improved housing and an adequate balanced diet.

According to the Health Unit (HU) statistics from the study area, malaria, dysentery and Acute Respiratory Infections (ARI) are the leading causes of mortality, and along with intestinal worms, skin and eye infections among the ten main causes of morbidity in the study area.

HU statistics, however, only represent the morbidity and mortality of the few children, who are seen at the HUs in the study area. HU statistics severely under-represent the population prevalence of infections, which cause limited acute, severe illness (e.g., intestinal worms, skin and eye infections) . Also infections, which culturally is considered to be less in need of medical care (e.g. diarrhoea[2]) will be under-represented. Morbidity from these diseases

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[2] Diarrhoea is so common, especially in children under two years of age, that local cultural beliefs often does not considered it to be a disease and attribulate death to other symptoms.

decrease the quality of life and contribute to short or long term disability. Here especially infection with intestinal worms is one of the biggest health problems in the study area.

Malaria, which is endemic in the study area, is the overall leading cause of morbidity and mortality in children under five years of age.

Diarrhoea is the second most common cause of morbidity and mortality in children under five years of age[3]. Here the self-reinforcing diarrhea-malnutrition cycle, with diarrhea leading to malnutrition, and malnutrition predisposing to diarrhea, is a well established concept.

Nutritional disorders are common in the study area. About half of all children under five show signs of stunting, related to chronic malnutrition. Finally the combined effect of malaria and malnutrition increase the prevalence of anemia a major cause of morbidity and mortality in children under five.

The incidence of ARI is the second most common reason for visit to the HU and the third most common reason for morbidity and mortality in children under five in the study area. Other prevalent airborne infections are measles and tuberculosis (TB). Here poverty with malnutrition, crowding, poor housing and poor ventilation are major determinants. But further the prevalence of TB has increased due to HIV/AIDS.

Bilharzia is endemic in areas where people use streams as alternative water sources. Further trypanosomiasis is likely to exist in endemic areas, despite the present lack of diagnosis of human cases. Guinea worm which is prominent in the Northern part of Uganda, is not anticipated to be a problem in the study area.

(4) The Projects Impact on Health

The actual impact of an improved water supply, sanitation and hygiene education on WES related diseases is difficult to measure, due to the multifactorial etiology of disease, which make it difficult to say what proportion is caused by poor hygiene or water.

Improved water facilities give more time for child care and agricultural production and

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[3] The National Programme for Control of Diarrhoeal Diseases (CDD) estimate the incidence of diarrhoea in children under five years of age to be 5,200 per 1,000 per year, comparable to 5.2 episodes per child per year.

have a positive impact on the health status (decrease the prevalence of malnutrition and diarrhoea and improve child health).

A international review of studies evaluating the impact of improved water and sanitation found the estimated median reduction in diarrhea morbidity, Ascaris, hookworm and schistosomiasis to be 26, 29, 4 and 77% respectively. Same review found the median reduction in diarrhea diseases to be only 15 and 20% for improved water quality and quantity[4], but 33 and 36% for hygiene education and sanitation. Improved access to water was estimated to decrease the prevalence of intestinal worms by five (5)%; improved water combined with sanitation by 15%; improved water with Health education (promoting hand washing after defecation and before eating) by 25%. The combined intervention of water, sanitation and health education was estimated to decrease the prevalence by 30%.

Based on the health facility statistics from the project area and some assumptions on the use of health care services, the prevalence of important WES related diseases in the study area was estimated as shown in Table 3.5.4.B. The estimated impact of interventions were based on the above review of more than 144 studies on the impact of water, sanitation and hygiene education on WES related diseases.

The projects impact on health and medical expenditures were assessed based on the estimated prevalence of disease and the impact of different interventions on the specific disease. The average cost of cure per case of selected WES related diseases were estimated for use of health facilities, use of tradditional medicine or self cure. The utilization of health care services influence the cost of cure the probability that a patient with diseases would seek health care was estimated for each disease category.

The total medical expenditure on WES related diseases for the entire study area was estimated as: The point prevalence P(HU) cost per case at HU plus the point prevalence 1-P(HU) cost per case with self care.

The estimated impact of the selected interventions were estimated using the percentages in Table 3.5.4.B. The expected annual decrease in total medical expenditure were estimated for each selected intervention by multiplying the total medical expenditure for each disease

[4] The difference between water quality and quantity reflect the fact that water quantity determine water quality. The availability of large quantities of water make more water available for general hygiene, e.g., cleaning of buckets.

with the percentage estimated impact of intervention.

The impact of the project on health and medical expenditures are shown in Table 3.5.4.C. The columns showing the expected annual decrease in total medical expenditures, were estimated the overall saving for the entire study area in 1995. It is clearly seen from this table that the impact of health education on health and medical expenditures are larger than any other intervention alone. The impact of water only will have limited impact on health in comparison with water combined with health education.

3.5.5. The Needs of Water Supply and Sanitation Systems

In general, the availability of water is essential for water hygiene and consequently an easy accessible water source facilitates the practice. But to ensure that water hygiene is practiced daily the water source must be reliable through out the year. Reliable in quantity and quality. Problems of poor water quality or low quantity discourage improved hygienic behaviors. e.g., in areas with corrosion problems community members often prefer to use the traditional water sources, as the brownish-yellow colour and the taste of the improved water source are less attractive.

The reliability of a water source depends on its daily operation and maintenance. An improved water source can be contaminated if poorly maintained. The motivation of the community to maintain and protect their water source is, therefore, of critical importance to ensure a sustainable reduction in not only water borne diseases, but also to prevent an increase in the incidence of water-related vector-borne diseases, due to breeding of mosquitoes in stagnant water around the water source.

As all water-borne and faecal-disposal-related diseases, as well as some water-based diseases, depend on infecting agents from human excreta, the provision and hygienic use of adequate sanitation are crucial for their control.

Finally proper refuse disposal is important for the control of some faecal-oral and vector-related water-borne diseases, as it prevents the breeding of insects.

Hygiene education is crucial to increase the community's knowledge and awareness of the link between water, sanitation, hygiene and health. Hygiene education enables a behavioral change to ensure a lasting health and economic benefit from the improved water and

sanitation facilities .(Mothers who can explain the link between faeces and diarrhoea have children, who are less likely to have diarrhoea than mothers, who do not understand this connection). Hygiene education is of major importance to motivate the population for appropriate utilization, to ensures a maximum health impact, reduces recurrent cost of maintenance and improves the sustainability of the improved water facilities.

Poverty, poor hygiene, lack of knowledge and education are, however, often strongly associated. Lack of knowledge of how to stay healthy is a basic problem, but the lack of resources remain crucial.

3.5.6. User's Participation in O&M

(1) Human resources

In all three districts, the district WES staff consist of a DHI, a DCDO and a BMS. Kiboga and Mubende has a DWO. The BMS of Mpigi is presently acting as DWO. Other district staff important for WES activities at distict level is the DHT and local representatives for the Minister of Education. As earlier mentioned all three districts are WES-UNICEF project areas. Within the framework of this project, AVSI supports the district WES staff in Mpigi with two advisors and a social mobiliser.

The main problem for community capacity building in the study area is lack of resources, financial as well as human. There is a general shortage of extension workers, especially CDAs and HEs, in the study area. This limits the support and follow-up necessary for community development.

(2) Community Based Organisation

In general the project area is poorly organised. The VDC are only found in areas with the Community Based Health Care (CBHC) and the CHW. Presently the main organisation for community development is the Local Council structure, which is politically based. LC reach from national to grass root level; at district level called (LC5), County (LC 4), Sub-County (LC 3), Parish (LC 2) and community level (LC 1). The LCs are responsible for planning and management of development within their areas through their development sub-committees. Under the decentralization policy 70% of tax funds retained at the LC3 are remitted back to LC2 and LC1 level. This has strengthened LC 2 and LC1.

The district based WES staff use the LC system extensively for all their activities, but especially for mobilisation. The LC system fast and efficiently reach community level to inform them of plans of water improvement in their area. The LC system also efficiently raise a demand of water from the communities to the district WES staff. Naturally areas in which the LC system is stronger and the LC receive more local support often "mobilise their water demands" faster. The LC system is efficient for water activities. Water is a popular commodity. Environmental hygiene and sanitation, is less popular. Here the GOU employed staff is more efficient. Similar O&M of improved water sources are also a less popular topics, better meditated through GOU staff.

(3) O&M

Most of the communities in the study area are willing to contribute labour, locally available materials and food to support the implementation of an improved water source. The problem, however, remain "to ensure local willingness and ability to maintain the water source after construction". To facilitate the management of WES activities, S/C WES committees has been established throughout the three districts. Further about a third of the villages have a Village Water Committee (VWC)[5] based at LC1 to oversee all water sources in the community. The VWCs are not the users of all the water sources they oversee, hence they have limited interest in their O&M. The construction of BHs are presently fully subsidised and done by an external agent. The construction of most other water facilities is only partially subsidised[6] and done by the users under guidance from local qualified personnel. Most communities fail to comprehend, why they should be responsible for the O&M of a BH installed by the GOU. They lack the feeling of ownership and do not understand the importance of preventive O&M. BHs are advanced technology. Especially in areas with natural water sources in abundance, water from BH is considered to taste less good. BHs are mainly appreciated in areas where water is scare.

The present focus in the project area is on mobilisation. Presently most communities are involved in the implementation of water sources, but few commit themselves to O&M. Most water sources in the project area are poorly maintained and have no WUC committees or caretakers. Funds for O&M are sometimes collected when a BH completely cease to function, but mainly the community awaits for the central district staff to repair

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(5 The VWC is an administrative unit at LC1, in contrast the WUC is an administrative unit at water source level.

(6 The main subsidies in the water sector are equipment (e.g. HP) tools, construction materials and monetary "incentives".

their BH. A large amount of BH has been rehabilitated through out the project area, but many are still found to be in a very sorry state. Further the use of local, but poorly trained or supervised masons has resulted in unacceptable aprons and drains or springs, which dried up during protection.

(4) **Human Resource Development**

WES-UNICEF has developed extensive training guidelines and manuals for use at district level. The training packet recommended by UNICEF consist of several modules among others: (a) Orientation, (b) Training of Trainers (Training of Trainers (TOT)-Extension workers), (c) Management Training, (d) Extension Staff Training (spring and BH), (e) HPM training, (f) Community Mason Training, (g) Care taker Training (springs and BH), (h) Community leader training and (i) CBMS training. Most district staff in the three districts has been trained to facilitate the implementation of these training modules. But the implementation is inhibited by the severe lack of WES extension staff and no overall plan for how to manage training at district level. Finally funds are limited compared to the proposed training.

A WUC consists of the actual users of the specific water source, this enhnaces their interest in O&M.

(5) **Handpump Mechanics**

The maintenance of water sources equipped with HPs are done by a local HPM. HPMs are mainly men with former technical experience (e.g. bicycle repair). They are selected by the S/C WES and trained locally by GOU staff. The have to pass their exams in English. After being certified they get a bicycle and tools. All three districts has trained HPMs, with the aim to have one in each S/C. Many of these HPM go idle today, as there is too few BHs in most S/Cs. It has been estimated that it takes a minimum of 40 to 45 BHs to keep a HPM busy full time. This is assuming that the HPM also will be engaged in preventive maintenance. Presently most HPM are only called when the BH is beyond repair.

(6) **Existing Situation in O&M of Water Sources**

Only 100 of the communities in the study area had a VWC. Only 25% of these had received any training. The main trainer was GOU, NGOs or donors. Most of the VWC, took care of several water sources of different types, everything from BH with HP to water holes. Nearly 80% (79/100) of the VWC had set rules for use of the water source, but only about half of the committees could present a written set of rules. About 40% had a

maintenance fund for their water source. The majority collected funds at the time of break-down.

Out of 30 HPs inspected, 13 were observed to be out of order. The main reasons for lack of repair of the mechanical faults were: lack of a HPM in the area (4/13), the HPM not being able to repair the source (3/13), the users not being able to pay (3/14) or lack of spares (2/13). The main structural needs for repair was needs for repair of cracks in the cement of the pedestal, apron, spillway or platform..

The majority of all improved water sources inspected were in need of better daily management. The surroundings of most water sources were generally in poor condition and only found to be clean in less than 10%. The grass was not cut on nearly 80% of the water sources and less than 10% was fenced.

3.6. Pilot Study

3.6.1. Introduction

A pilot study was carried out as a link of the study to assess the impact of training on the communities willingness and ability to improve the environmental health in their community and to take responsibility for the O&M of their new BH.

The following five communities were selected for the pilot study:

	Community	Sub-county	District
(1)	Seeta	Nungabo	Mpigi
(2)	Magere	- do. -	- do. -
(3)	Namyeso	Butayuuja	Mubende
(4)	Ssinde	Lwamata	Kiboga
(5)	Kawawa	- do. -	- do. -

Two pilot communities, Namyeso and Ssinde, and three other priority communities were splitted. One each borehole facility was installed in five communities. The training intervention were covered only for two pilot communities.

After initial information meetings with all districts, S/Cs, Parishes and Communities, the activities for the two pilot communities took place as follows:

(a) Baseline survey,
(b) Training of trainers from S/C and parish level
(c) BH sited, drilled and pump-tested
(d) Training of the community and selection of WUC with Caretakers.
Training of WUC, Caretakers and HPM
(e) BH fully installed
(f) Follow-up training in O&M of the WUC with caretakers, the HPM and some selected key persons from the earlier trained S/C and Parish
(g) Monitoring and evaluation

3.6.2. Training Intervention

The training of the pilot villages was done by two facilitators, specialized in Promotion of the Role of Women in Water Supply and Sanitation (PROWWESS)[7] environmental health and O&M. The training materials used were internationally developed, but adapted culturally for local use. Key-persons at S/C and parish level were trained as trainers during a two day course. After the BH had been successfully pump tested, the community, the WUC and the Caretakers were trained for two days. Finally a one day training in O&M of HPs were held for WUC and Caretakers after the HP had been installed on the BH. District extension workers were invited to participate in all training.

The general training covered environmental health, community participation and O&M. The participants developed a detailed plans for improvement of the environmental health in their community. This included the improved O&M of the improved water sources. The communities were taught how to select the WUC and encouraged to re-select the WUC yearly. The WUCs were further trained on management of improved water sources, e.g. collection and management of funds and preventive O&M. After HP installation they were given practical training together with the local HPM.

(7 PROWWES stands for Promotion of the Role of Women in Water and Sanitation Services. Here it is used to refer to a Community Participatory teaching methodology with focus on women.

3.6.3. Monitoring and Evaluation

A baseline survey was done in all five villages before the intervention. The base line survey assessed the environmental health and the O&M of all water sources in the five communities. Twenty randomly selected HHs were included from each community. Data on socio-economy, environmental health and child health were collected from all 100 HHs.

Further a survey was done after intervention. The repeated survey measured the effect of the training on O&M at community level.

3.6.4. Findings

The present findings clearly show that the training had an overwhelming effect on the communities' willingness and capacity to participate in the O&M of their BH and to improve their personal and environmental hygiene.

The baseline study found the priority communities are significantly better socio-economic situation than the pilot communities. Nevertheless, after the training, the latters achieved what they were trained, with their limited resources, much more than the non-trained communities which are better access to resources and higher education level.

Presently, the pilot communities are clearly well organized and actively involved in their plans to improve the environmental health in their communities and to ensure that the installed BH will remain functional for a long time.

CHAPTER FOUR: PROJECT PLAN

4.1. Basic Strategy for Project Planning

4.1.1. Introduction

The project aims to improve the WES sector of the Study Area through the following three components:

(a) the extension of the proper hygienic knowledge and practices among the users:
(b) the spread of facilities for safe water supply and better environmental sanitation: and
(c) the empowerment of users in the operation and maintenance of above facilities.

The project is, therefore, divided into the software and hardware categories. The items (a) and (c) above consist in the software category and the item (b) belongs to the hardware category.

In the software category, the system has been already set forth by the GOU through a lot of experiences and knowhows accumulated by the previous WES projects assisted by UNICEF, DANIDA and other donors. The project plans in the software category are, in principle, to respect and follow the existing system in the GOU. Some proposals to supplement and augment the existing system may be placed where necessary.

In the hardware category, the basic strategy is placed at any facility to be allocated to the target communities under the Study is to be sustainable in term of CBMS. The facility is to be, due course, examined and rationally designed to meet with the existing specific conditions of individual community in consideration with the affordability in O&M cost. The strategy in planning of water supply and sanitation sectors is to be as below:

4.1.2. Water Supply Sector

(1) Population Coverage

The water supply is to cover, as far as possible, all population in any target community. Plural number of facilities or systems are, therefore, to be allocated to cover all inhabitants in the target community.

(2) Facilities to be Applied

The types of water supply facilities and the conditions of their application in the Study are as follows:

(a) Borehole (BH)

A deep (depth of 30 m or more) borehole equipped with handpump is deemed to be the most appropriate water supply facility to rural community in terms of availability of safe water, initial cost and community-based O&M. The facility is to be applied only to those communities where deep groundwater is available.

(b) Level-II System (LTS)

A Level-II (stand-pipe) system with deep BH equipped with a power pump could be applied only to those communities which are densely populated, and where deep groundwater is available, the initial cost is in a reasonable extent and O&M cost is affordable to the users.

(c) Protected Spring (PS)

A natural spring protected from contamination of wastes is only applied to those communities where any natural spring is available.

(d) Shallow Well (SW)

Shallow hand-dug well (depth less than 30 m) equipped with HP could be applied to those communities where shallow groundwater is available.

(e) Valley Dam (VD)

A water storage reservoir made up of an earthen dam at a valley bottom is to be applied to those communities where the population size reached to a certain extent and neither deep groundwater nor spring water is available.

(f) Gravity-fed System (GF)

A gravity-fed system could be applied to those communities where a natural spring at a high elevation is available. Unfortunately, any potential community of the system does not exist in the project area.

(g) Rainwater Harvesting System (RH)

Rainwater harvesting system is also applicable for those communities where is small size and groundwater is hardly available. As stated previously this system might be applied for supplemental measure. The system is to be excluded from the project plan.

The raw water available for the above facilities shall be, in principle, safe with respect to the drinking water standard.

From this issue, the facilities in the item (a), handpump equipped BH, is desirable to be placed at the first priority to any community where deep groundwater is available since the initial and O&M costs of BH facility are within a reasonable extent and the deep groundwater seems to be free from the biological hazard. However, in order to economize the project cost and to meet "some for all" principle, the improvement of other facilities, which are as such shallow wells without handpump and/or cover slab and unprotected springs, and now in use, are to be taken into the project. The LTS is to be adopted only in case that the initial cost is in a reasonable extent and O&M cost is affordable to the users.

4.1.3. Sanitation Sector

Any rural water supply scheme could not be independent from the sanitation sector. The GOU has set forth National Sanitation guideline in 1992. As the recent GOU's strategy, the extension of sanitation facilities is to be left to the WES programme or the private sector. In this study, therefore, an additional guideline related to the extension of facility and hygiene education is to be proposed.

4.2. Water Resources Development

The yield of respective hydrogeological unit was assessed as shown in Table 4.2.1. The table shows that the high potential area is located in the north-west of Kiboga where Gneiss Complex and Buganda-Toro System are distributed, and estimated average yield is 2.1 to 2.5 m^3/hr. Total borehole depth in the area is 70 m on average.

The second high potential area is distributed in Mubende underlain by Mityana Series. Two test boreholes drilled in the Series were dry, but it is believed that high yield will be obtained when siting and drilling method are built firmly. Average total borehole depth is

80 m.

The low potential area is located in the west and center of Mubende where Buganda-Toro System is distributed. The System in the area is mostly composed of fine grained rocks and weathered deeply. The yield is low even though aquifers are in sandstone and quartzite. Total borehole depth will be required 100 m on average.

The total depth of borehole varies with hydrogeological unit and location, but 80 m is needed on average in the area.

The successful rate of borehole is estimated as shown in Table 4.2.1. It varies with hydrogeology and location, but it is affected by the siting method, drilling technique and experience on borehole conditions of the area. The rate in each district is estimated as follows:

Mpigi	80%
Mubende	60%
Kiboga	70%.

Table 4.2.1. Groundwater Potential in the Area

Hydrogeology	Location	B/H Depth (m)	Yield(m^3/hr)	T(m^2/day)	S.C.(l/s/m)
Mityana Series	Mubende	80	2.0	-	-
Buganda-Toro	Mpigi	110	1.3	-	-
	Central	100	0.9	-	-
	North-East	70	2.1	0.8 - 30.7	0.01 -0.32
	Mubende	100	0.8	-	-
	Central	100	1.5	0.5	0.01
	East	95	1.0	-	-
	Kiboga	65	0.9	0.5 - 68.9	0.01 - 0.36
Gneiss Complex	Mpigi	70	2.5	-	-
	Mubende	95	0.8	-	-
	Kiboga	70	1.0	-	-
Granite	Mubende	70	0.6	-	-

Notes : T = Transmissibility
S.C. = Specific Capacity

4.3. Facilities and Equipment

4.3.1. Planning Criteria

The Scope of Work and the related Minutes of Meeting agreed by and between the Preparatory Study Team, JICA and the Ministry of Natural Resources, GOU specified that:

(1) **Target Year of Plan : 2005**
The designed population sizes of target communities are to be projected for the year 2005 based on those estimated in 1995. The annual population growth rates adopted for the projection in the three project districts are 2.65%, 3.11% and 2.89% for Mpigi, Mubende and Kiboga Districts, respectively

(2) **Basic Water Supply Rate : 20 lcd**
The basic water supply rate per capita per day is to be 20 litres for each of the service population in the target communities.

(3) **Maximum Distance of Facility Coverage : 1.5 km**
The maximum distance of coverage by any water supply facility is to be 1.5 km.

Besides the above, other criteria are necessary to formulate the project plan as below:

(4) **Basic Capacity of Handpump : 900 l/hr**
An average pump capacity taking an average water-head (30m) and lesser capability of some operators (women or children) into account, the basic handpump (U3 pump) capacity is to be 900 l/hr.

(5) **Operating Efficiency of Handpump : 0.8**
The operating efficiency of handpump is to be 80% of basic capacity taking the idle time during changing of pump operator into account.

(6) **Designed Capacity of Handpump : 720 l/hr**
Based on (4) and (5) above, the designed capacity of handpump becomes :
720 l/hr (900 l/hr x 0.8).

(7) **Pump Operating Hour per Day : (a standard case) 10 hr/day**
: (an extreme case) 12 hr/day

In an ideal case, the pump operating hour per day is 8 hr (4 hr in the morning and another 4 hr in the evening). In view of the "some for all, and not more for some" principle, 10 hr/day in a standard case and 12 hr/day in an extreme case are to be taken in the Study.

(8) **Water Supply Capacity per Handpump : (a standard case) 7,200 l/day**
: (an extreme case) 8,640 l/day

From (6) and (7) above, the water supply capacity per handpump per day becomes 7,200 l/day (720 l/hr x 10 hr/day) in a standard case and 8,640 l/day (720 l/hr x 12 hr/day) in an extreme case.

(9) **Service Population per Handpump : (a standard case) 360 to**
: (an extreme case) 432

Based on (2) and (8) above, the service population per handpump (borehole since a handpump is to be equipped with a borehole) becomes :

360 (7,200 l/day/20 lcd) in a standard case and
432 (8,640 l/day/20 lcd) in an extreme case.

(10) **Selection of Casing and Handpump Material**

The results of water laboratory test sampled from boreholes reveal that more than 80 % of boreholes are over the DWD's permissible limit in the value of colour and total iron. The reason of high value is derived from the concentrations of pH, total alkalinity, calcium, sulphate, chlorride and bicarbonate which are the parameters relevant for corrosion on galvanized iron. The limit of values of the parameters are not decided, however, the results of the laboratory test indicate that materials of handpump and casing are corroded in more than 80 % of the boreholes. PVC for casing, stainless steel and brass materials for handpumps are to be used.

(11) **Successful Yield of Borehole : (a standard case) 720 l/hr**
: (an extreme case) 360 l/hr

From the item (6) above, any borehole which yields 720 l/hr of safe water is deemed to be successful in a standard case. It is not reasonable in a financial view to give up any drilled borehole which yields less than 720 l/hr. Therefore any borehole which yields 360 l/hr or more is deemed to be a half (0.5) borehole to cover a service population up to 216.

(12) **Successful Rate of Borehole**

A successful rate (or a dry hole rate) of borehole is necessary to estimate the project cost. The rate is evaluated to be 80 % in Mpigi, 70 % in Kiboga and 60 % in Mubende through the review of past drilling records and the test borehole construction (refer paragraph 3.3.2. Potential of Aquifer).

(13) **Minimum Community Size for Borehole Facility : 150**

In view from the cost per performance and O&M cost of a borehole facility, the minimum community (population) size shall be 150 in the target year of 2005. Those community which is less than this size shall be allocated another type of water supply facility.

(14) ***Allocation of Number of Borehole by Community Size:***

The number of borehole to be allocated by community size is as per Table below:

Table 4.3.1. Allocation of Number of Borehole by Community Size

No. of Borehole	Community (Population) Size
1	150 to 430
2	431 to 860
3	861 to 1,290
4	1,291 to 1,720
5	1,721 to 2,150
6	2,151 to 2,580
7	2,581 to 3,010
8	3,011 to 3,440

The actual numbers of BH facility are to be finally decided taking the service population by the existing safe water source(s), if any, into account.

(15) **Application of Level-II System**

A Level-II (stand-pipe) system is to be examined in those communities which are densely populated and available groundwater sources are scattered. The system is to be adopted only in case that the initial cost is in a reasonable extent and O&M cost is affordable to the users.

The power sources for the system, such as commercial power, diesel generation, solar power, wind power, and so forth will be carefully examined in order to mininise the O&M cost.

(16) User's Participation in the Facility Construction

The GOU's guideline indicates that the users are to participate themselves into the construction of water facility providing their own labour force, materials locally available and others.

While, the present project will be completed within a very limited construction period due to the funding and other reasons.

In consideration of above issues, the user's participation in the construction of facility proper is hardly involved, but the related works such as the improvement access condition for the transportation of equipment and materials, provision of soak pit and wooden fence around facility and so forth.

4.3.2. Facilities

(1) Facilities Allocation

The following procedure was adopted for planning and allocation of new water facilities in the Study area. Firstly, the water sources under use at present were taken into consideration. Water sources of boreholes, shallow hand-dug wells with pumps, protected springs and gravity fed schemes are considered to be acceptable water. The beneficiary population of these acceptable and existing facilities is subtracted from the projected population of the target year 2005. Secondly, improvement of the existing unprotected spring (spring protection) is proposed. The protection shall involve full rehabilitation and upgrading of the springs for supply of clean and safe water. The beneficiary population of the protected springs is again subtracted from the remaining target population. Thirdly, if there still exists population without safe water supply, the existing shallow wells without any cover slabs and/or handpump proposed to be improved. The improvement shall include redigging, bailing or total renewal and installation of cover slab and/or handpump. The cost required for improvement is to be estimated at that of total renewal since the grade of improvement are different and unknown by each well.

Finally, if water is still insufficient for the community, new boreholes are proposed to supply water to the remaining service population. If boreholes are not feasible due to lack of groundwater or for other reasons, other alternatives are proposed such as valley dams,

and level II (stand pipe) system depending on the hydrogeological and demographic conditions. The above process is tabulated in Appendix C-2 and the summary is as follows;

Table 4.3.2. No. of Proposed Water Supply Facilities and No. of Communities

( ): No. of communities

Facilities \ District	Mpigi	Mubende	Kiboga	Total
No. of Boreholes	162(70)	164(77)	120(65)	446(212)
Spring Protection	57(31)	65(33)	65(31)	187(95)
Improvement of Shallow Well	37(19)	20(11)	4 (1)	61(31)
Valley Dam	5 (5)	8 (8)	0 (0)	13(13)
Level II (Stand Pipe) System	0 (0)	0 (0)	1 (1)	1 (1)
Total No. of Facilities	261(93)	257(95)	190(88)	708(276)

(2) Facilities Design

(a) Introduction

The water supply facilities necessary for the Project are;

- Borehole equipped with handpump,
- Shallow hand-dug well equipped with handpump,
- Protected spring,
- Valley dam; and
- Level-II (Stand-pipe) system.

There is no suitable water source for the gravity-fed system in the Study Area. In view of the population size of the target communities, the valley tank and rainwater harvesting system are considered to be not suited to the Project.

(b) Borehole

As previously stated, the drilling of borehole in Uganda is limited with air-hammer method only. In many cases, borehole sites in the Study Area are composed, more or less, of soft formation overlying the bed-rock formation. Besides the air-hammer drill, the mud-circulating method is quite necessary in order to effectively drill boreholes and increase the successful rate. The bed-rock portion of most existing boreholes in Uganda is open and uncased. In order to prolong the life period of the borehole as well as the

handpump, the whole portion of the borehole is to be properly cased and packed by gravels.

Thus the proposed design of borehole is to be as shown in Figure 4.3.1.

As a result of reviewing existing boreholes, the average depth of the project boreholes is planned at 80 m, with 25 m of soft formation and 55 m of bed-rock formation. The diameter of permanent casing is to be 125 mm (5 inches) which is the DWD's standard.

The standard design of headworks of boreholes is also to follow that of the DWD as shown in Figure 4.3.2.

(c) Protected Spring

The typical design of protected spring is to follow the standard set forth by the DWD/RUWASA project, as shown in Figure 4.3.3.

(d) Shallow Well

The typical design of shallow well is also to follow the standard set forth by the DWD/RUWASA project, as shown in Figure 4.3.4.

(e) Valley Dam

A valley dam is to be adopted for those villages which are highly populated and neither groundwater nor spring is available. In view of the rather hilly topography, valley tanks may not be suitable in the Study Area but valley dams will be. In the Study, therefore, typical valley dam is examined as below.

Figure 4.3.5 shows the typical design of valley dam and its appurtenant structures. The designs of the dam body and the spillway follow the typical designs of DWD.

The storage capacity of the designed reservoir is about 3,500 m^3. This capacity would supply water for 1,200 population if 150 non-rain days continue. The dam height is to be determined in accordance with the required storage capacity which may be derived from the service population and the runoff capacity of the catchment basin.

The regulation capacity of spillway is designed at 5.0 m^3/sec (an emergency capacity is about 15.0 m^3/sec). It is to be also re-examined in accordance with the actual basin area of catchment of the dam. The water-intake facility is designed as a horizontal filtre layer and a vertical well which are installed in a trench excavated and back-filled in one of the banks of the reservoir. The water may be tapped by handpump(s) or a bucket from the well. A soakaway is to be installed to drain the waste water to the lower side of dam.

To prevent the entering of people, particularly children, into the reservoir area, fence

(wooden post and barbed wire) is to be placed all around the area.

(f) Level-II (Stand-pipe) System

Level II (Stand-pipe) system is proposed for the population of 3,642 in Kiboga Town. The parameters for design are as follows;

i) *The total water quantity per day:*
$3,642 \times 20\lambda \div 80\% = 91,050\lambda$
80%: after consideration of 20% service loss.

ii) Public water points:
10 posts with double faucets are planned at about 500 m intervals.

iii) Hours of supply per day: 8 hours (5 in the morning, 3 in the afternoon)

iv) Discharge rate at each water point:
$91,050\lambda/8$ hr/10 points = $1,138\lambda$/hr/point
say $1,200\lambda$/hr/point = 20λ/min/point

v) Maximum discharge rate at each water point:
When both faucets are in use, the discharge at each water point would be double the quantity derived at item 4).
$20 \times 2 = 40\lambda$/min/point = 0.67λ/sec/point
This value is used for the pipeline network calculation.

vi) Distribution and pumping balance of water:
Distribution per day:
1.2 m^3/hr/point × 10 points × 8 hr = 96 m^3/day
Pumping per day:
10 m^3/hr × 9.6 hr = 96 m^3/day

vii) No. of boreholes:
The discharge capacity of a deep borehole can be expected to be about 2.5 m^3/hr. Ten (10) hours of pumping operation would be suitable considering the service hours of 8 hours. The number of boreholes is calculated as follows;
96 m^3/day ÷ 2.5 m^3/hr/BH ÷ 9.6 hr = 4 BH

viii) Capacity of Reservoirs

a) Capacity of Distribution Reservoir:

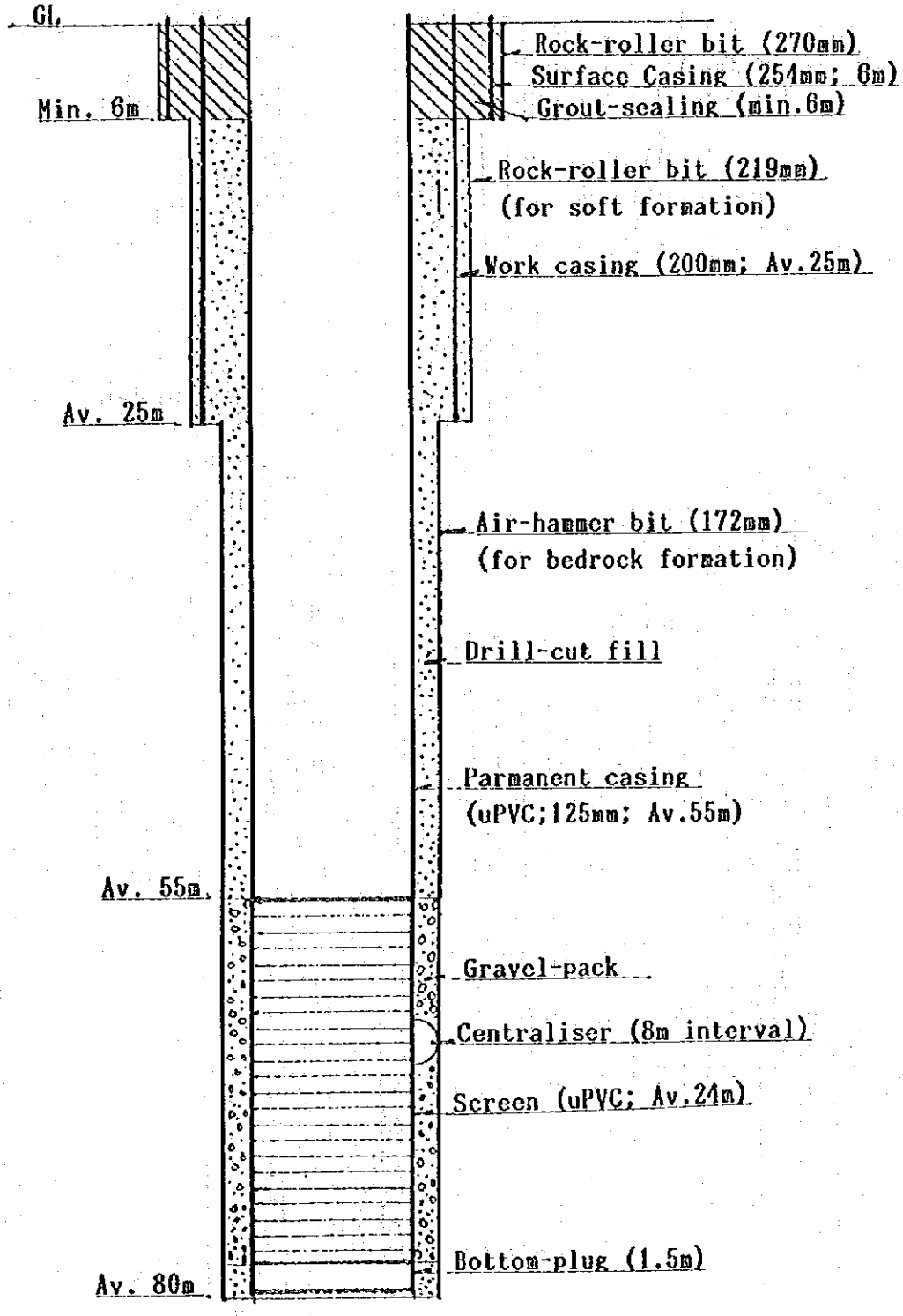
From the quantity balance pattern of pumping and distribution water of Figure 4.3.6, the maximum volume would be 40 m^3. With 5 m^3 tolerance 45 m^3 capacity is adopted.

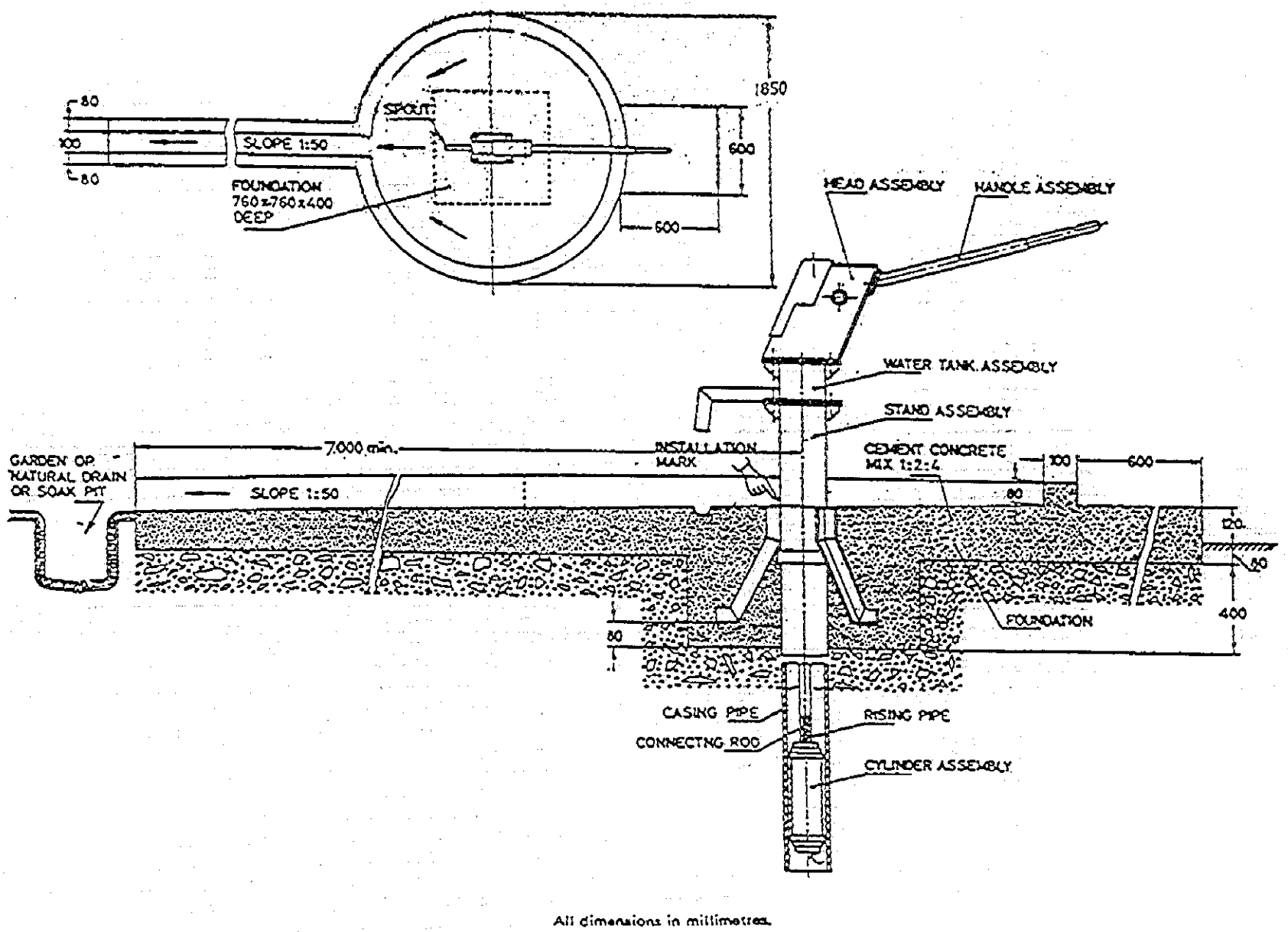
b) Capacity of Collecting Reservoir:

The collecting reservoir is used to temporarily store water pumped from the boreholes. As the hourly pumping capacity is 10 m^3/hr, 4 hour storage capacity or 40 m^3 is taken as 30% (3 hrs) of total pumping hours (9.6 hrs) and 10% (1 hr) tolerance.

The overall layout and plan of the level-II (stand-pipe) system of Kiboga Town is illustrated in Figure 4.3.7.

Figure 4.3.1. Typical Design of Borehole



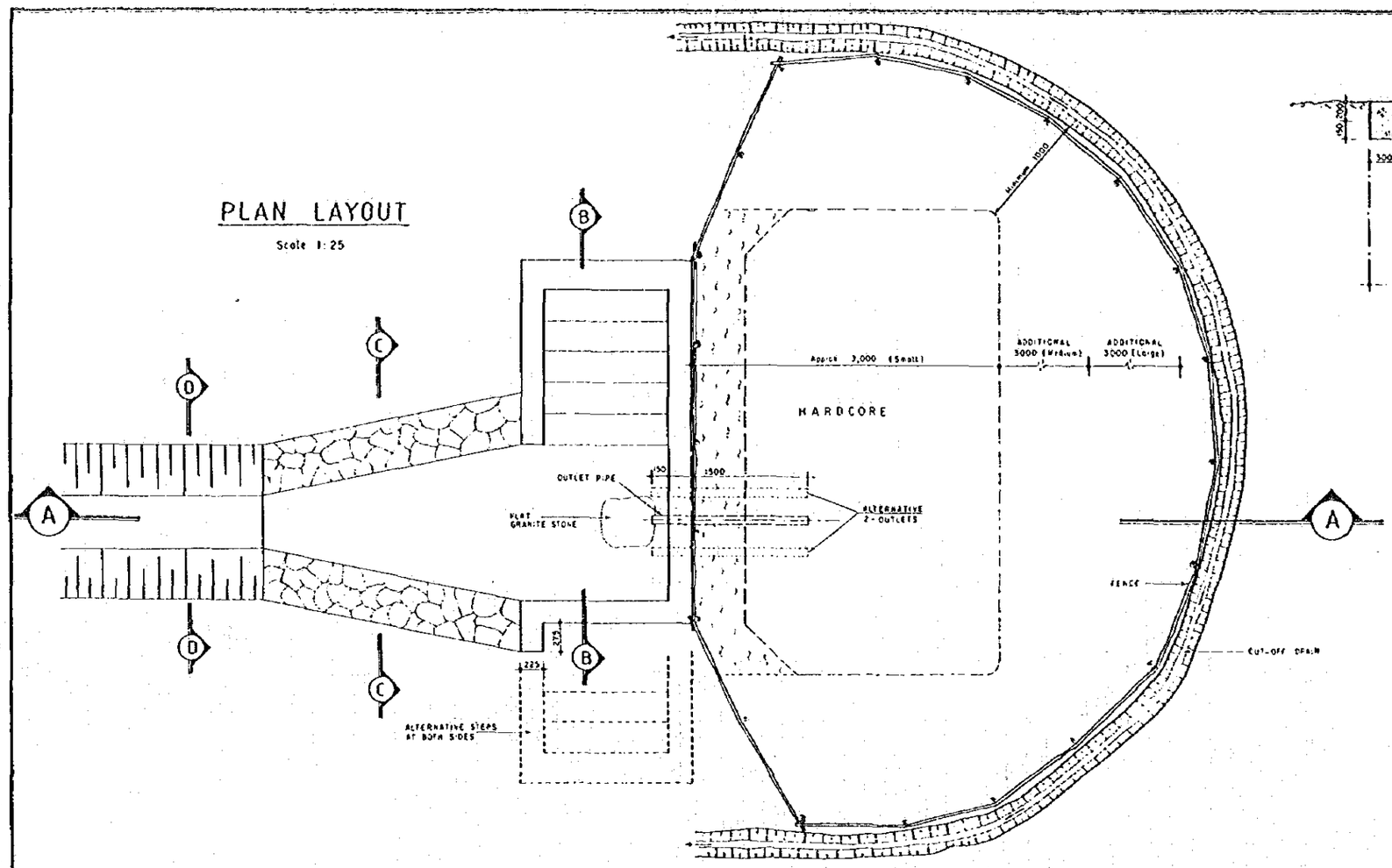


All dimensions in millimetres.

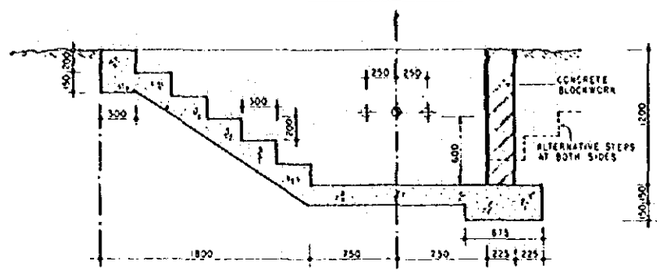
Figure 4.3.2. Typical Design of Borehole Headworks

PLAN LAYOUT

Scale 1:25

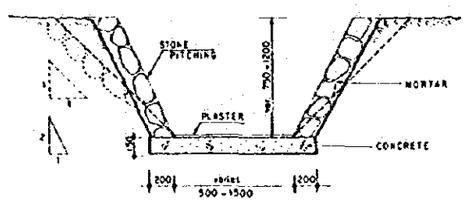


SECTION B-B



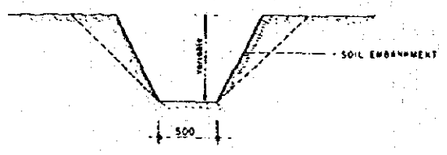
SECTION C-C

SLOPE VARYING FROM 1:1 TO 1:2 ACCORDING TO SOIL CONDITION

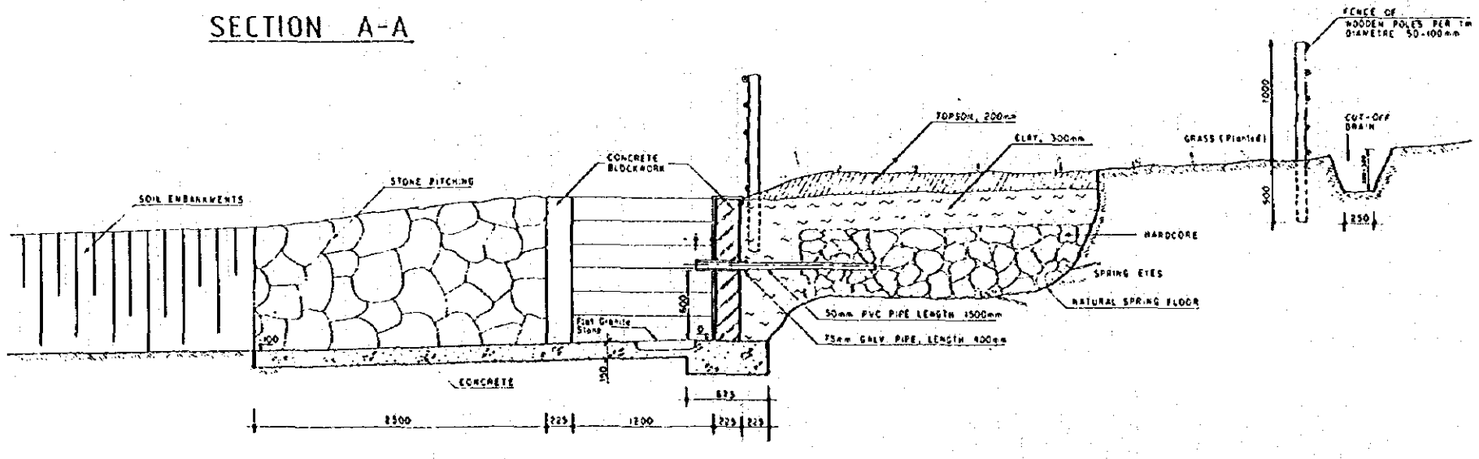


SECTION D-D

SLOPE VARYING FROM 1:1 TO 1:2 ACCORDING TO SOIL CONDITIONS



SECTION A-A



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETRES (mm)
2. NATURAL SPRING FLOOR MUST BE CLEANED BEFORE HARDCORE AND CLAY ARE FILLED IN.
3. HARDCORE MUST BE CAREFULLY PLACED TO ALLOW WATER FLOW AND TO AVOID CRUMBLING.
4. CLAY MUST BE HOMEGENOUS BEFORE PLACING (Not Stick in Palm When Rolled).
5. CONCRETE TO BE 1:2:4 Mix. Aggregate 12mm, max 18mm SAND MUST BE FREE OF CLAY AND SOIL.
6. MORTAR TO BE 1:3 Mix.
7. ALL VISIBLE SURFACE OF BLOCKWORK TO BE PLASTERED

JAPAN INTERNATIONAL COOPERATION AGENCY	
DIRECTORATE OF WATER DEVELOPMENT, THE GOVERNMENT OF THE REPUBLIC OF UGANDA	
STUDY ON RURAL WATER SUPPLY IN MPIGI, MUBENDE AND KIBOGA DISTRICTS	
PROTECTED SPRING AFTER DWD/RUWASA DESIGN	
DATE	Mar. 1996
FIGURE NO.	4.3.3
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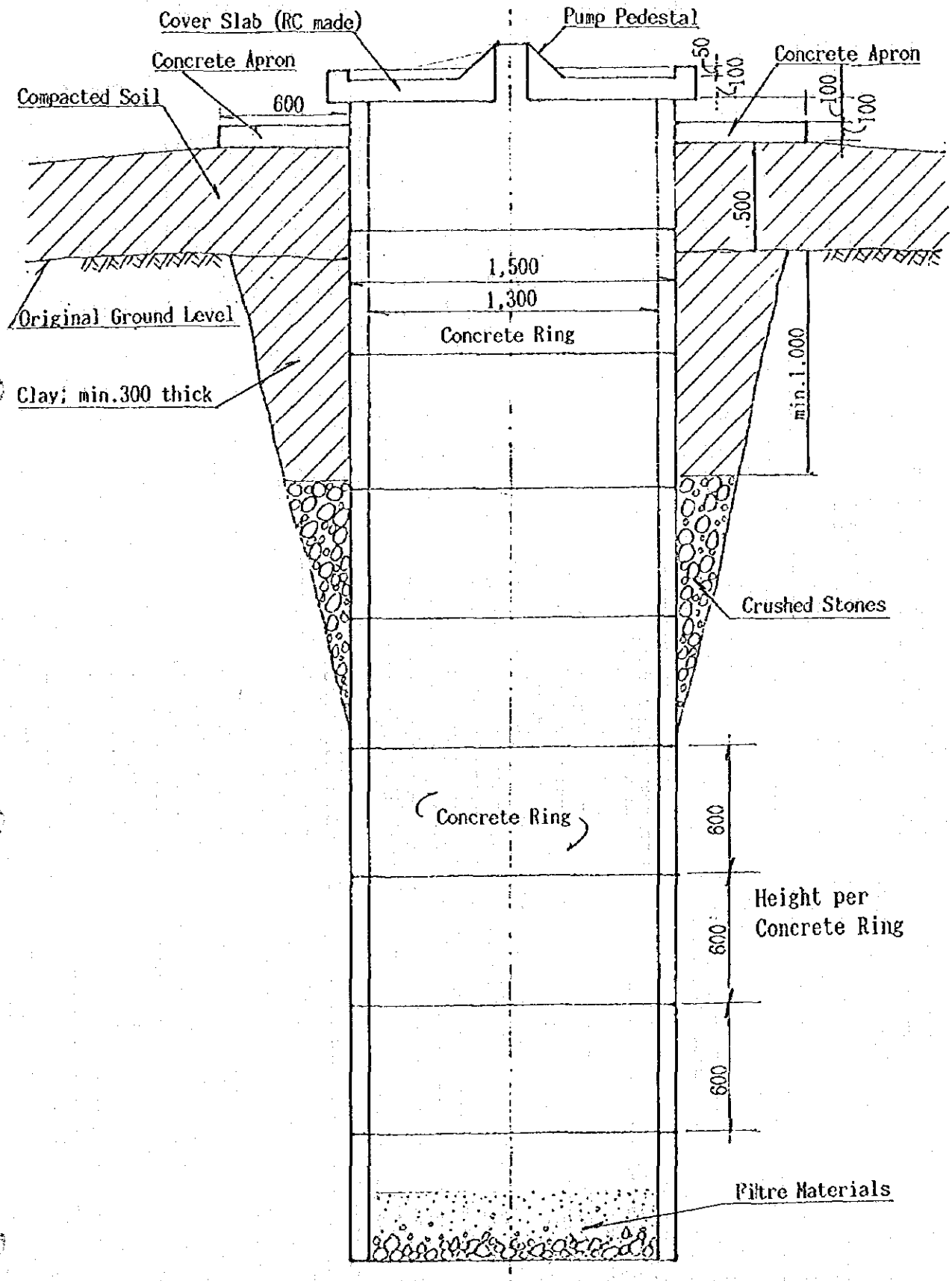
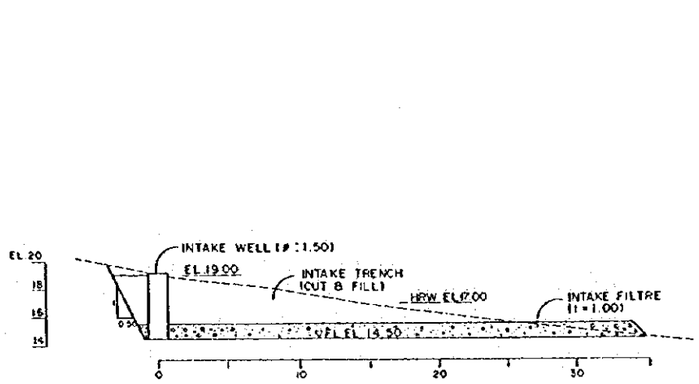
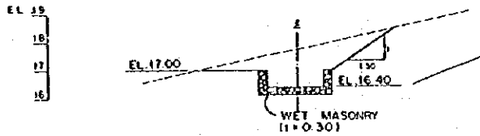
Figure 4.3.4. TYPICAL DESIGN FOR SHALLOW DUG WELL (After RUWASA)



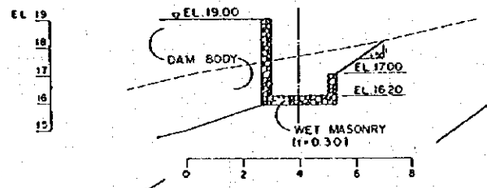
Note: All dimensions in millimeter.



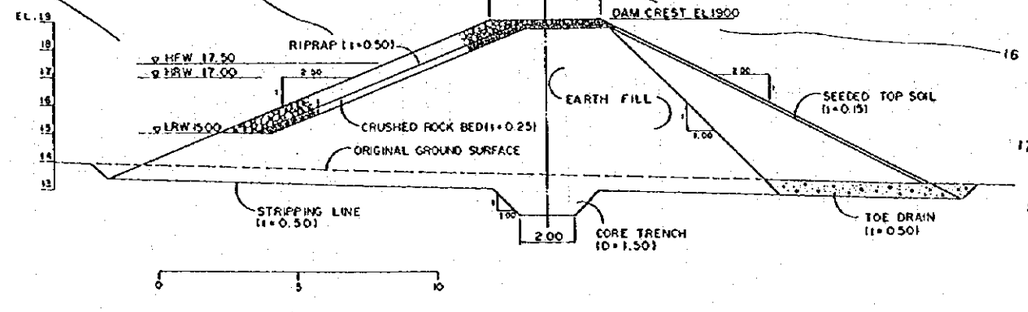
SECTION C-C'



SECTION A-A'



SECTION B-B'



TYPICAL SECTION OF DAM

NOTES :

(1) ALL DIMENSIONS ARE IN METRES.

(2) ALL ELEVATIONS ARE TENTATINE AND IN METRES

(3) ABBREVIATIONS ;

℄ : CENTRE LINE

ϕ : DIAMETER

t : THICKNESS

LRW : LOWEST REGULATED WATER LEVEL

HRW : HIGHEST REGULATED WATER LEVEL

HFW : HIGHEST FLOOD WATER LEVEL

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DIRECTORATE OF WATER DEVELOPMENT, THE GOVERNMENT OF THE REPUBLIC OF UGANDA

STUDY ON RURAL WATER SUPPLY IN MPIGI, MUBENDE AND KIBOGA DISTRICTS

TYPICAL DESIGN OF VALLEY DAM

DATE	Mar. 1996	FIGURE NO.	4.3.5

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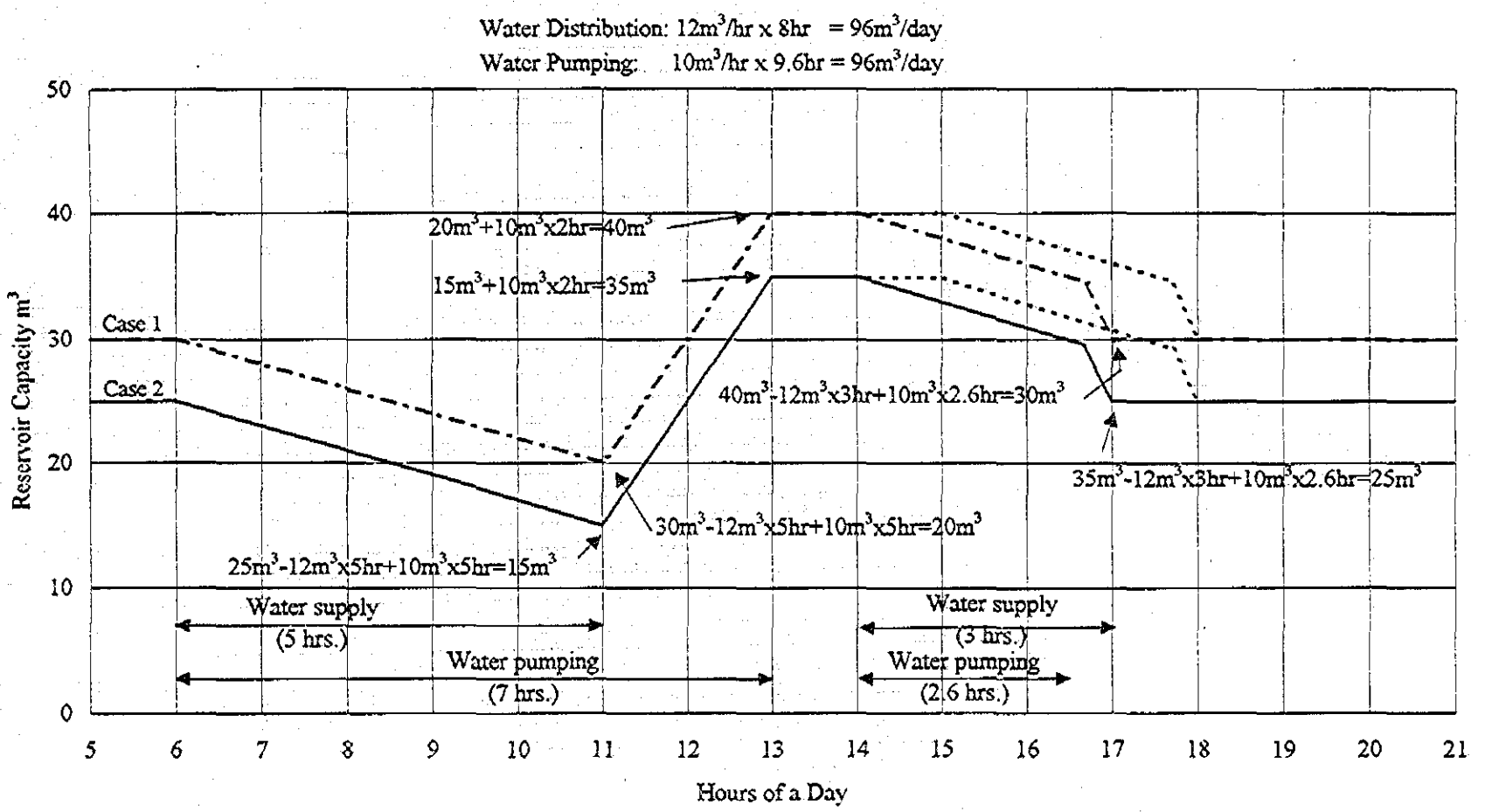
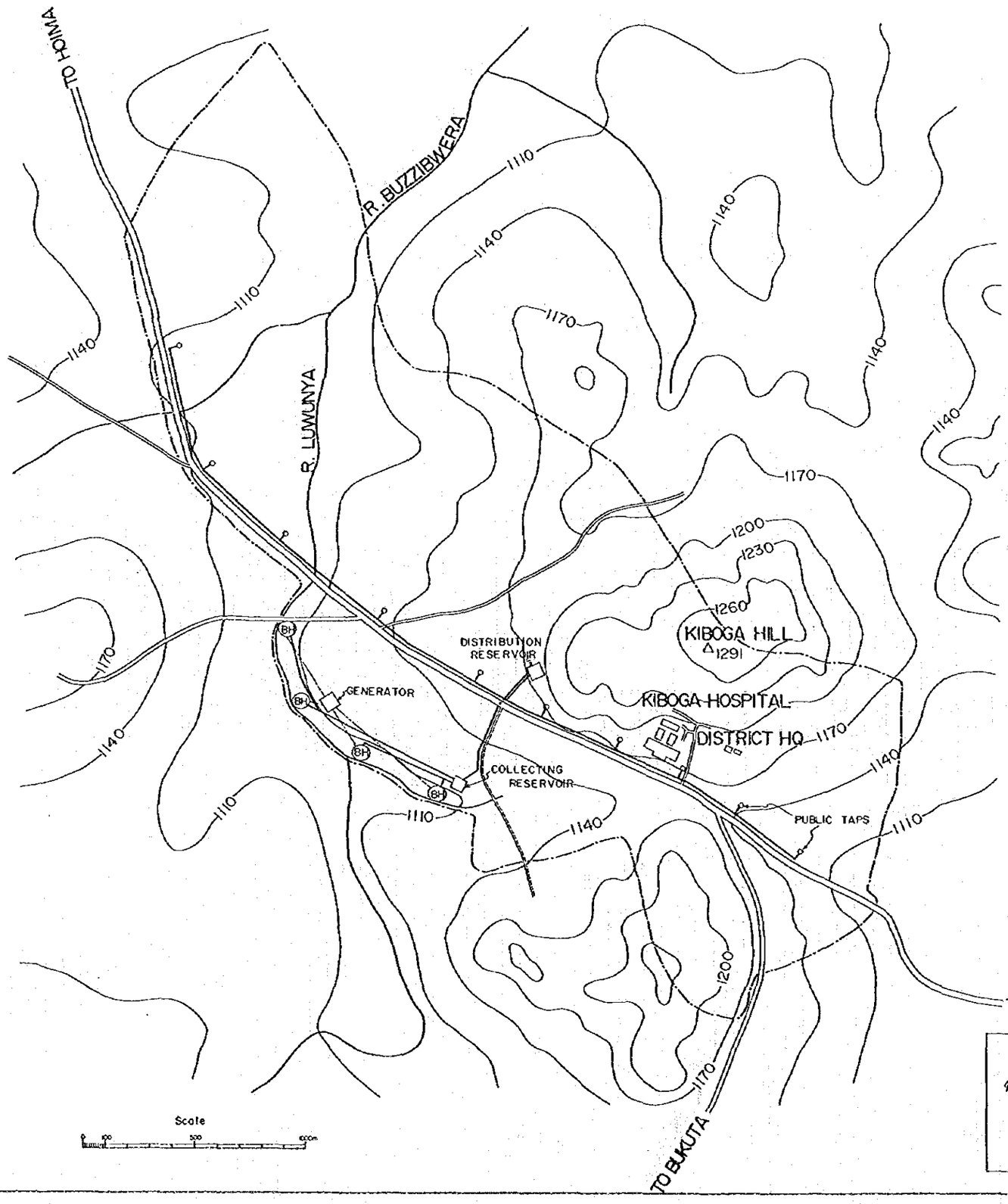
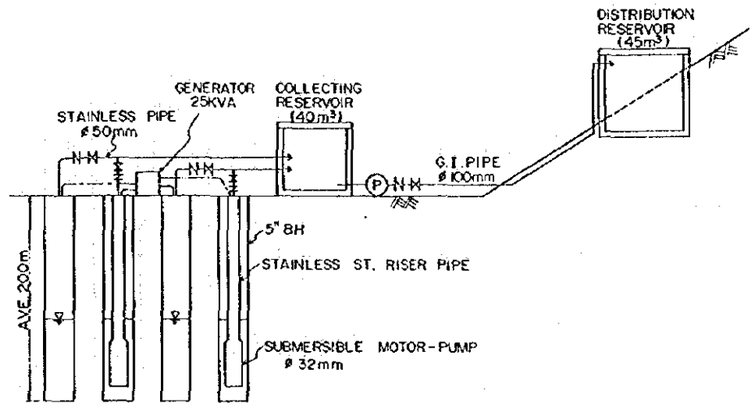
Figure 4.3.6 Change in Water Quantity in Reservoir by Hour of Day

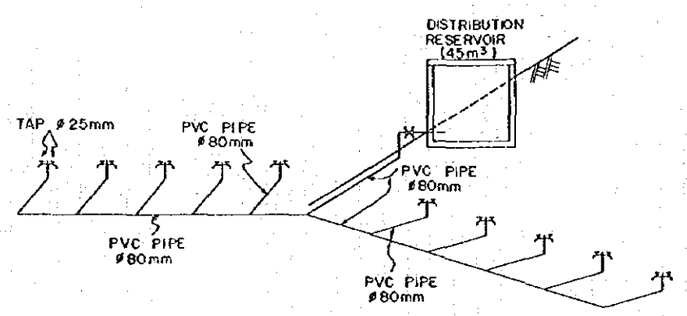


Note:
Case 1 (– – –) and Case 2 (——) are shown to accommodate possible fluctuations in water use pattern.





PUMPING SYSTEM



DISTRIBUTION SYSTEM

LEGEND

- 1200 CONTOUR
- TOWN BOUNDARY
- BH BOREHOLE

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STUDY ON RURAL WATER SUPPLY IN MPIGI, MUBENDE AND KIBOGA DISTRICTS

KIBOGA TOWN STAND PIPE SCHEME

DATE	Mar. 1996	FIGURE NO.	4.3.7

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4.3.3. Equipment

For smooth operation and maintenance of the project facilities the following equipment are recommended and are to be procured in the project.

(1) Station Wagon

A station wagon (4WD) is to be procured for the transportation of project management staff of the DWD headquarters.

(2) Pick-up Truck

One each pick-up truck (4WD, double-cabin type) is to be provided for the transportation of District WES staff and equipment. Another pick-up truck is for Kiboga Town Council for the transportation of O&M staff and fuel of diesel generator for Level II system.

(3) Workshop Equipment

The workshop equipment is intended to be used for major repairs of the handpumps and the servicing rig. One set of equipment is to be procured for the workshop.

(4) Servicing Rig for BMU

A servicing rig is to be used as a mobile servicing equipment by the Borehole Maintenance Unit (BMU) which caters to the needs and difficulties encountered by the handpump mechanics at the borehole locations. One set of the servicing rig including a winch, an air-compressor, tools, etc. is recommended for the project.

(5) Water Analysis Kit for Districts

For the control of water quality, periodical check of the water is required. To facilitate water analysis tests, a water analysis kit is to be equipped at each district.

The summary of the required equipments is shown in Table 4.3.3.

Table 4.3.3. List of Equipments

Equipment	at DWD HQ	BMU	at District	Kiboga Town	Total
Station wagon	1	-	-	-	1
Pick-up truck	-	-	3	1	4
Workshop equipment	-	1	-	-	1
Servicing rig	-	1	-	-	1
Water analysis kit	-	-	3	-	3

4.4. Education and Training

4.4.1. Community Management Training

All training activities will focus on the empowerment of the individuals users, especially women, in the overall community. The aim is to enhance self-reliance. The communities will be enabled to plan for improved environmental health and better O&M of their water sources. They will be encouraged to be self-reliant and, hence, focus on optimal utilisation of locally available resources.

The main training methodology will be PROWWESS, a gender sensitive community participatory approach. All training will be done in consecutive small segments. The Training of District Facilitators will be done at an early stage. Whereas the Training of the Trainers at Community level first will take place after ensured successful drilling in the community. This approach has been selected, to enhance the cost-effectiveness, as dry drillings are known to be a common problem in the study area, and the resources for training are limited.

The community based trainers will be trained to use the PROWWESS approach for training of the commmunity.

The communities understanding for the importance of improved water hygiene and sanitation for better health will be considered crucial for sustainable O&M of the newly installed BH. The communities will be encouraged to take an active role in the development of better environmental health and the improved water source in their community.

The communities willingness and ability to maintain the improved water source will be measured. But as all target communities has been pre-selected already, a demand driven approach will not be used. The basic indicators will be; (a) the community commit themselves to form a WUC and select caretakers, (b) the selected WUC obtain the requirements for one year's O&M and make agreement with a HPM on preventive O&M (c) the Community protect their improved water facilities (e.g. fencing and improved drainage) (d) the Community make plans to improve the environmental health in their community (e.g., increase the coverage of hygienic latrines).

4.4.2. Hygiene Education

The project is to use a gender sensitive community participatory approach to train available human resources at the community level. The focus of the training is to enable the communities to plan, develop and manage their own WES resources. Special attention and additional training is given in the area of O&M of BH with HPs, to motivate the community for preventive O&M. Hygiene Education is considered crucial. Hygiene Education will enhance the community's understanding for the link between water, sanitation and health. This will motivate the community to take better care of their BH and improve their environment, through use of locally available resources. The combined effect will generate better environmental health.

Specific attention should be paid for the users of spring, dug well and valley dam which are mostly contaminated by coliform and other bacteria. "Water Boiling" campaign becomes very important as the preventive measure for water-borne diseases.

In the central and southern areas, this campaign already succeeded to extend a habit in the rural households to boil drinking water always (UNICEF, 1995). The additional requirement for fire-woods for the boiling water may be saved if the households use an improved cooking stove in a twin-range type, one for cooking food and another for the boiling water.

As per the users of valley dam, another attention shall be given to "limit access to stored water" to prevent the parasitic diseases.

4.4.3. Training Programme

The sequential order for the activities to take place, are outlined below:

1) Training District Facilitators; by the Training Facilitators in coordination with the District.

2) Information and mobilisation of District, S/C, Parish and Communities; by the Consultant and the LC5 to LC1.

3) Formation of the WUC; by the Community Trainers.

4) Selection of Hand-Pump Mechanics in S/Cs; by S/C.

5) Community dialogue for selection of water point sites; by LC3, LC2, the Community, the Consultant and the drilling contractor.

6) Training of HPMs; by the Training Facilitators and a Private Training Institution.

7) Construction of Water Facilities; by the DWD, the Consultant and the Drilling Contractor.

8) Training of Trainers at Community level; by the Training Facilitators.

9a) Training of the Community;

9b) Baseline monitoring at Community level;

10) Continuous training of HPMs; by the Drilling Contractor.

11) Training of the WUC; by the Community Based Trainers.

12) Training of the Caretakers; by the Training Facilitators.

13) Commissioning of water supply facility; by the Community.

14) Continuous planning, monitoring and evaluation; by the Community.

15) Selection of Spare Part Dealers; by SC.

16) Training of the Sparepart Dealers; by the Training Facilitators.

4.5. Guidelines for Sanitary Facility

4.5.1. Introduction

The provision and use of adequate sanitation facilities is important to decrease faecal contamination of the environment. Further sanitation facilities provide privacy and protect against the rain. Increased use of improved sanitation would decrease the prevalence of worms, especially if combined with hand washing after defecation. Increased use of hygienic sanitation facilities would decrease the prevalence of hookworm, especially if combined with increased use of foot wear. But mainly, sanitation is an essential component in most water projects, as it decrease the faecal contamination of the environment. This is, especially important for protected springs and shallow wells, but also for deep water sources, such as BHs.

4.5.2. National Sanitation Guidelines

The promotion of rural sanitation facilities is mainly the responsibility of MOH. The Public Health rules of 1968, state that "...it is the duty of every household to provide and maintain a proper sanitary pit-latrine"... It goes on to stay that ..."any person who contravenes or fails to comply with any provision of these rules commits an offense and shall be liable." The Public Health rules of 1968 have earlier been strongly enforced by the Health Inspectorate staff from MOH. This effectively ensures a high sanitation coverage, but not necessarily a high utilisation, in rural areas in Uganda.

The law is still in force, but the MOH now recommend that sanitation should be implemented through community participation as a part of over all development. The communities should be educated to achieve an awareness of the importance of sanitation for health. Once willing to improve their sanitary situation based on improved awareness, they should be enabled to plan and implement improved sanitation. To assist the implementation of this approach, the MOH's Health Directorate has developed "The National Sanitation Guideline" in 1992.

The Guidelines are specially developed for rural and peri-urban areas and provide guidance on operational issues during management of sanitation activities aimed to improve the health of people in Uganda. The main strategy is to ensure community participation and involvement. The guidelines recognise that all communities have a

capacity to solve their problems and must be given an opportunity to assess and analyse their problems and take action.

The National Guidelines provide detailed technical designs for san-plats, slabs and VIP with considerations for difficult terrain, e.g. rocky, sandy or water logged areas. HH level and Institutions. Further it includes technical designs and recommendations for the construction of other basic sanitation facilities, such as refuse and waste water disposals.

Presently most projects aim to promote improved sanitation in the community through health education, to enhance the awarenees of the importance for health and increased utilisation. The suggested technology should be at a cost the community can afford, therefore, it has become increasingly common to broaden the concept of hygienic latrines at HH level, to include the improvement and hygienic use of traditional latrines, in addition to the improvement of excreta disposal facilities by installation of a san-plat. The use of hygienic traditional latrines are by most projects seen as an improvement when compared to the existing situation. It is therefore expected to have a positive impact on the health of the population. The National Guidelines recommend the san-plat for use at HH level if affordable, else improved traditional latrines.

4.5.3. Guidelines for Project

The project will follow the National Sanitation Guidelines. The main focus will be to improve the present sanitation situation through use of locally available resources. The Community based health education, which will be done by the Community Based Trainers, will aim to increase the community's awareness of the link between water, sanitation and health . This will enhance the need for access to improved traditional latrines, which are easier to keep clean. Once the need for improved latrines is created, there might be a market for privatisation of sanplats or slabs. The initial target will be to increase the utilisation and access to improved traditional latrines.

4.6. Operation and Maintenance (O&M)

4.6.1. Water User Committee (WUC)

The O&M of the improved water source will be the responsibility of the users. The focus will be on preventive O&M.

The Community Based Trainers will facilitate the selection of a Water User Committee (WUC), after a positive pump-test of the new water facility. The WUC will have a minimum of six members, including the caretakers. The Community will be encouraged to ensure that minimum 50% of the WUC members are women. The WUC will be encouraged to elect a female chairperson.
The Community Based Trainers will train the WUC after the HP, has been installed. The training focus on enabling the WUC to perform its duties. The WUC will after training be motivated and able to manage the O&M of the water source. This will enhance the sustainability of the newly installed water source.

Caretakers will receive same basic training as the WUC. Further they will be given some follow-up training in practical O&M. This training will include caretakers from several communities. It will be an opportunity to exchange experiences.

The trained Caretaker will ensure daily O&M of the water source. The WUC will arrange for preventive O&M visits from a certified local HPM. This HPM will give on the job-training to the Caretakers during these visits.

The project area is wide spread. Hence, all S/Cs (LC3s) will be encouraged to select at least one person for training as HPM[1]. The selection of women will be encouraged. All HPMs will be sent for one weeks training at a private training institution. This training will be followed by one months practical work with the crew installing the HPs in the respective S/C of the future HPM. The training needs of pre-existing HPMs will be assessed. The trained HPM will have the tools and bicycle free of charge.

The marketing of spareparts will be open and non-subsidized. The sparepart distribution will take place through local hardware dealers. Interested dealers with the financial capacity to become sparepart dealers will be trained after pre-election by the S/C.

Larger dealers could become district wholesale dealers and sell spareparts to smaller S/C based dealers or directly to the HPM or the WUC.

[1] It is estimated that one HPM can provide regular O&M services to about 40 HPs.

4.6.2. Gender

The community will be encouraged to share the daily work burden more evenly. Men will be encouraged to take a more active role in daily household tasks. Women will be encouraged to take a more active role in the management of community activities, e.g. WES activities. The community will be encouraged to promote women as influential leaders in management of WES and other activities in their community. The promotion of female chairpersons will be encouraged at all levels. Women will be encouraged to seek training and enter the private sector as HPMs. The S/C will be encouraged to select female HPMs.

4.6.3. Monitoring and Evaluation

The monitoring and evaluation system will be community based. The communities will be encouraged to collect data, easy to obtain, and useful for their own management of WES resources (e.g. total number of HH with none, traditional or improved latrine, total number of clean HH, the O&M of the improved water source).

4.7. Institutional Strengthening

4.7.1. Governmental Levels

(1) National Level

The project will follow the national guidelines for the WES sector provided by the DWD. At national level the project will coordinate with the GOU and liaise with UNICEF and other relevant NGOs or donors working in the sector.

(2) District Level

The District Administration will be responsible for implementation of the national policies and guidelines set forward by the DWD. At district level the project will coordinate with the WES staff (DHI, DCDO, DWO and BMS). The project will liaise with the CAO, the District Administrator (DA), the DMO and Donors or NGOs active in WES and CBHC activities within the project area.

(3) S/C, Parish and Community Level

S/C, parish and communities are to be well informed and committed to the project. The

S/C are to be responsible for selection of HPM and smaller sparepart dealers based on project guidelines. The S/C and Parishes are to assist the communities.

Community leaders are to assist, train and coordinate the communities planning, development and monitoring of water schemes and improved environmental hygiene.

4.7.2. Private Sector

Contractors will be responsible for the construction of water schemes.

A consultant is to be responsible for the design, siting and construction supervision of the water supply facilities. The Consultant is also to be responsible for training of community level trainers, monitoring and evaluation.

4.7.3. Human Resource Development and Institutional Strengthening

Presently the project focus on the human resource development at community level. Community leaders will be trained as trainers of the community and the WUC. Local people will be trained as HPMs to do preventive O&M. Local hardware dealers will be trained as the sparepart dealers.

Like in most other WES projects, the essential coordination between the drilling-works and the training of the communities is problematic. Community training is slow, whereas the implementation of BHs is comparably faster. The training facilitators will, therefore, be required to invest full time on training activities to keep up with the drilling works. This excludes the use of the district based extension staff, as day to day facilitators. Especially due to their present limited numbers and their already heavy workload.

The project will therefore use the external project facilitators. These project facilitators will work in close cooperation with the District Extension Staff. The support of district staff to the target communities is, however, considered essential for success. The district extension staff such as CDAs and Health Assistant (HAs) in the project area is now far short to the prescribed number. It is strongly recommanded to allocate a reasonable number of staff untill the commencement of the project. District extension staff will be trained as facilitators through the project and encouraged to use any opportunity to follow-up and provide advice to the local communities. If possible the BMS and the

DWO should get actively involved in the training for O&M. This will enhance a sustainable support to the project communities at the end of the project.

4.8. Groundwater Monitoring

Increasing population and poor water supply conditions in the study area will require a number of boreholes in the future. As mentioned in the Chapter 1.3., some town's groundwater table is affected by overpumping of boreholes. Groundwater conservation management is necessary to allow groundwater development within a permissible limit and to avoid such as mentioned above. Groundwater potential in the area is low, therefore, monitoring of water level, rainfall, river runoff and groundwater quality are required for sustainable groundwater development.

Sustainable groundwater resource development should be implemented within the range of long-term groundwater recharge by recognizing groundwater is an element of the hydrogeological cycle.

A monitoring system recommended is as follows:

- rainfall: new station in driest region; Maddu Sub-County in Mpigi
- river runoff: representative rivers in the study area; 5 catchment areas
  (Mayanja, Nabakazi, Mpongo, Katonga, Wamala)
- groundwater level ; representative water basin 10 stations
  (Kiboga, Ntwetwe, Butemba, Kasambya, Mityana, Kikandwa, Bukuya, Maddu, Mpigi, Nangabo)
- water quality; representative basin 10 stations
  (Kiboga, Ntwetwe, Butemba, Kasambya, Mityana, Kikandwa, Bukuya, Maddu, Mpigi, Nangabo)

The installation of monitoring system is to be included in the project. The cost of installation is to be covered by the contingency of the project cost since it is a small amount.

4.9. Project Cost Estimate

The Project Cost consists of the following;

(1) **Facilities Construction Cost**

The unit construction costs and the numbers of the water supply facilities are as follows (Unit Cost and amount are as of 1995):

Facility	Unit Cost	No.	Amount (US$)
i) Borehole with handpump (successful)	$14,500	446	$6,467,000
ii) Borehole (dry)	$9,240	134	$1,238,160
iii) Shallow well with handpump:	$3,770	61	$229,970
iv) Protected spring:	$2,300	187	$430,100
v) Valley dam:	$75,860	13	$986,180
vi) Level II system:	$298,760	1	$298,760
Sub-Total			$9,650,170

(2) **Procurement of Equipment**

The number and costs for the equipment necessary for maintenance of the facilities

i) Station wagon :	$20,000	1	$20,000
ii) Pick-up truck	$20,000	4	$80,000
iii) Workshop equipment :	$20,000	1	$20,000
iv) Servicing rig for BMU incl. winch, compressor, tools :	$30,000	1	$30,000
v) Water analysis kit for District water labs :	$7,000	3	$21,000
Sub-Total			$171,000

(3) **Assistance for Training Intervention**

(a) TOT (Training of Trainers) and Training of WUC (Water User Committee) incl. remuneration, allowances and transport of facilitator as well as training materials L.S. $420,000

(b) Training of Handpump Mechanics incl. one week class room, 4 weeks on-the-job training, plus supply of tools and bicycles. L.S. $26,000

Sub-Total $446,000

(4) **Total of (1), (2) and (3)** = $10,267,170

(5) **Engineering Fee**
(10% of Total (4)) = $1,026,717

(6) **Administration Fee**
(5% of Total (4)) = $513,359

(7) **Total (4+5+6)** = $11,807,246

(8) **Contingency**
(10% of Total (7)) = $1,180,725

(9) **Grand Total**
(Total ((7) + (8)) Grand Total = $12,987,971
say $13,000,000

4.10. Financial Management Plan

4.10.1. Required O&M Cost

O&M cost consists of two major items i.e., the running cost and the maintenance cost. Among the proposed water supply facilities the following facilities require positive attention involving maintenance of mechanical parts. The running cost concerns only the generator used for level-2 installation. The running cost per year for the generator (25 kW) is estimated as follows:

Table 4.10.1. Running Cost of Generator per Year

(Unit:US$)

	Personnel cost	Material cost	Machinery cost	Total
Local currency	5,000	180	0	5,180
Foreign currency	0	1,620	0	1,620
Total	5,000	1,800	0	6,800

The maintenance costs are incurred by handpumps installed to boreholes and shallow dug wells, pumps, both submersible and booster and a generator for the level 2 (stand pipe) system.

Table 4.10.2. Maintenance Cost for Water Facilities

1) Maintenance Cost for Handpump per Year

(Unit:US$)

	Personnel cost	Material cost	Machinery cost	Total
Local currency	50	9.5	0	59.5
Foreign currency	0	85.5	2.5	88.0
Total	50	95.0	2.5	147.5

2) Maintenance Cost for Submersible and Booster Pumps per Year

(Unit:US$)

	Personnel cost	Material cost	Machinery cost	Total
Local currency	250	46.3	0	296.3
Foreign currency	0	416.2	25	441.2
Total	250	462.5	25	737.5

3) Maintenance cost for Generator per Year

(Unit:US$)

	Personnel cost	Material cost	Machinery cost	Total
Local currency	600	245	0	845
Foreign currency	0	2,205	20	2,225
Total	600	2,450	20	3,070

4.10.2. Financial Background

According to the Inventory Survey, among the 458 samples, 384 samples (about 84 %) have never paid for water. In spite of this situation, a weighted average amount of payment for water from the existing water source is estimated at UShs. 10 per 20 litre jerrycan in Kiboga District. In Mpigi District, out of 569 samples, 379 samples (about 72 %) have never paid for water, but the weighted average amount of payment for water from the existing water source comes to UShs. 31 per 20 litre jerrycan. Also in Mubende District, out of 645 samples, 564 samples (about 87 %) have never paid for water, but the weighted average amount of payment for water is UShs. 11 per 20 litre jerrycan. A weighted average water charge in three Districts, becomes to UShs. 19 per 20 litre-jerrycan.

And, the other weighted average amounts of payment for water by paid samples only were estimated at UShs. 62, UShs. 111, UShs. 86 in Districts of Kiboga, Mpigi and Mubende respectively. It means that, when the existing unpaid samples become necessary to pay for water, they would pay these amounts for water.

And, when it will become necessary to pay to take water, the result of the Inventory Survey says that people will pay sums of UShs. 35 in Kiboga District, UShs. 50 in Mpigi District and UShs. 45 in Mubende District. A weighted average of the amount of willingness to pay comes to UShs. 45 per 20 litre-jerrycan. These amounts of willingness to pay are rather low comparing with actual weighted average amounts by the existing paid samples, but it means that those amounts are affordable for them.

Furthermore, the actual paid amounts for water vendor per 20 litre jerrycan were estimated at UShs. 180 in Kiboga District, UShs. 150 in Mpigi District and UShs. 140 in Mubende District in a weighted average. These amounts are actually what they paid for water vendor for supplementing shortage of water.

An average used volume of water per day was estimated at about 80 litres (4 jerrycans) per household which means 18 litres per person. If they will pay a sum of UShs. 19 per jerrycan or a sum of UShs. 45 per jerrycan, total amount of water charge would come to around UShs. 2,550 per household per month, or UShs. 7,650 per household per annum in the existing-paid-amount basis and UShs. 5,770 per household per month or UShs. 69,240 per household per annum in willingness-to-pay basis, respectively.

4.10.3. Income Distribution

(1) Income Distribution in Overview

The following table shows income level of people living in the study area based on income distribution resulted from the Inventory Survey.

Table 4.10.3. Income Level of Average HH by Community Size

(As of 1995, unit : UShs)

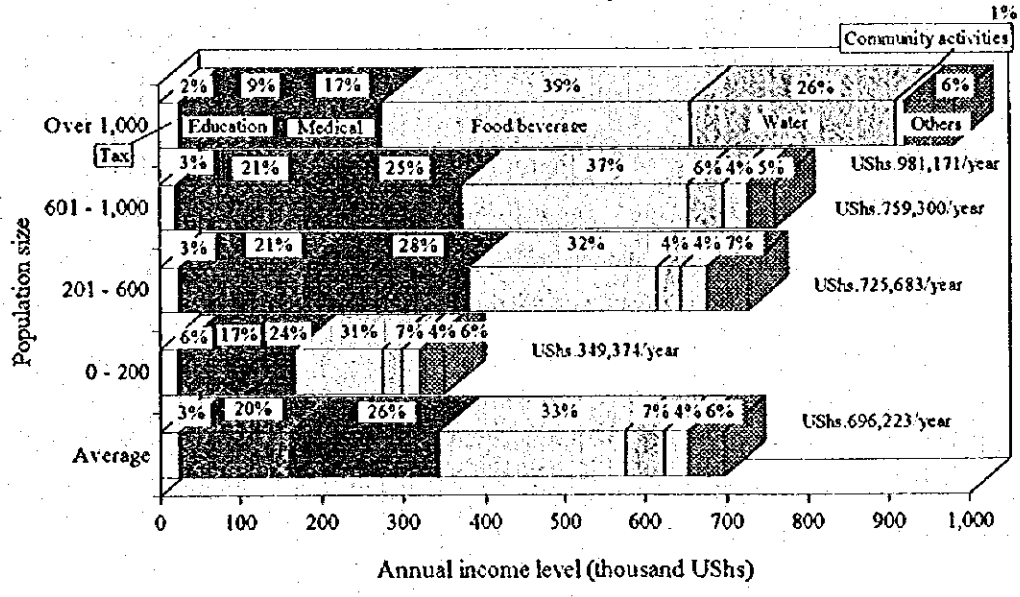
Community size	District							
	Average		Mpigi		Mubende		Kiboga	
	Annual	Monthly	Annual	Monthly	Annual	Monthly	Annual	Monthly
Average	696,223	58,019	874,957	72,913	627,913	52,326	585,798	48,816
200 & under	349,374	29,114	373,513	31,126	342,400	28,533	332,208	27,684
Between 201 - 600	725,683	60,474	968,655	80,721	621,442	51,787	586,953	48,913
Between 601 - 1,000	759,300	63,275	771,567	64,297	560,571	46,714	945,763	78,814
Over 1,000	981,171	81764	976,350	81,363	1,500,563	125,047	466,600	38,883

Source : Inventory Survey, JICA, 1995.

The figures indicating in the above Table show typical patterns of relationships between community size and income level.

When the income level is different, the expenditure scale will also be differed. However, the proportion of each expenditure item is usually not so much different. An average expenditure pattern of HH in the study area is shown below.

Table 4.10.1. Annual Income Distribution per HH by Community Size



In Uganda, males and females who are 18 years old and over should pay a kind of basic property tax (the Graduated Tax) usually at least an annual amount of UShs.10,000 even if they do not have any properties. Housewives do not necessary to pay any tax. So the amounts of tax paid by an average household are almost the same. Therefore, the proportion of tax payment amount to the total expenditures becomes higher in a household of low income level than in that of high income level.

An average amount of tax paid is UShs.23,000 per year according to the result of the Inventory Survey. It means that there are around 2.3 persons of tax payer per household in the study area on an average.

The most typical school systems in Uganda are seven (7) years for primary school, six years for secondary school and university. The secondary schools are divided into two (2) systems, such as six-year system and four-year system. When someone graduated from the four-year secondary school want to enter into an university, they should pass through two years advanced school (or high school). University has usually three-year system.

Usually around UShs.30,000 per term are necessary to pay in cheaper case of a primary school, so it becomes UShs.120,000 per year. On the other hand, public primary school fees are around UShs.50,000 per year.
Considering their income level, these school fees pressured people's livelihood. In the study area, about UShs 140,000 per year are used for school fees on an average as of 1995.

The medical examination and treatment fees are very high in Uganda. Furthermore, the disease infection rate is also very high in the country. Therefore, a medical fee also pressed upon people's livelihood. They spend about UShs.180,000 per year for the medical fees in the study area on an average, and this amount is almost 26 % to the total expenditures.

The prices of foodstuff, if the people want to buy them from shops or markets, are expensive even though in the rural area considering their income level. Some samples are shown in Table below:

Table 4.10.4. Prices of Daily Foodstuff in the Project Area

(As of 1995, unit : UShs/kg)

Food-stuff	Cas-sava	Yams	Irish pota-toes	Maize	Beans	Soya beans	Mato-ke ba-nanas	Swee bana-nas	Cab-bages	Onion	Toma-toes	Pine-apple	Ground nuts	Cattle meat	Pork	Chicken
Price	200 - 1,000	250 - 500	250 - 350	100 - 150	200 - 400	300 - 600	2,000 - 3,500	150 - 250	200 - 400	250 - 350	300 - 500	400 - 700	800 - 1,000	2,000 -3,000	1,000 -1,500	2,000 - 3,000

Source : Resulted from field survey by JICA Expert, January 1996.

(Note 1) Price for matoke bananas (plantains) is not for 1 kg, but for 1 bunch (about 15 kg).

(Note 2) Price for pineapple is not for 1 kg, but for 1 piece (about 2 kg).

The average amount of expenditure for foodstuff is UShs.230,000 per year in the study area with 33 % of total expenditure.

(2) **Expenditures for Water**

As a result of the Inventory Survey, the expenditure for water in the area is as shown in the table below:

Table 4.10.5. Annual Average HH Expenditures for Water in the Project Area

(As of 1995, unit : UShs)

Category	Categories in population size				
	Average	200 & under	201 - 600	601 - 1,000	Over 1,000
Amount paid	49,755	24,025	29,369	44,017	254,828

Source : Inventory Survey, JICA, 1995.

Even in the communities in population size of 200 and under, an average HH actually pays a sum of UShs.2,000 per month. And this amount is equivalent to 7 % of the total expenditures.

By the same manner, UShs.2,450 per month, UShs.3,670 per month and UShs.21,240 per month may be calculated for communities in population size of 201 - 600, 601 - 1,000 and over 1,000 respectively.

On the other hand, the Inventory Survey shows the following figures :

Table 4.10.6. Average HH Expenditures for Water Based on Actual Use

(As of 1995)

Item	Unit	District			
		Average	Mpigi	Mubende	Kiboga
Paid amount/20 ltrs jerry can	UShs.	-	31	11	10
No. of 20 ltrs jerrycan used/day	cans/d	-	4.5	4.3	3.6
Daily expenditure for water	UShs/d	-	140	47	36
Monthly expenditure for water	UShs/m	2,547	4,185	1,419	1,080

Source : Inventory Survey, JICA, 1995.

As the same way, people's willingness to pay for water and actual paid amount for water vendor are also resulted from the Inventory Survey as shown in the following Tables:

Table 4.10.7. People's Willingness to Pay for Water

(As of 1995)

Item	Unit	District			
		Average	Mpigi	Mubende	Kiboga
Amount of willingness to pay	UShs/can	-	50	45	35
No. of 20 ltrs jerrycan used/day	cans/d	-	4.5	4.3	3.6
Daily willingness to pay	UShs/d	-	225	194	126
Monthly willingness to pay	UShs/m	5,770	6,750	5,805	3,780

Source : Inventory Survey, JICA, 1995.

Table 4.10.8. Actual Paid Amount for Water Vendor

(As of 1995)

Item	Unit	District			
		Average	Mpigi	Mubende	Kiboga
Actual amount paid to vendor	UShs/can	-	149	144	180
No. of 20 ltrs jerrycan used/day	cans/d	-	4.5	4.3	3.6
Daily expenditure for water	UShs/d	-	671	619	648
Monthly expenditure for water	UShs/m	19,377	20,115	18,576	19,440

Source : Inventory Survey, JICA, 1995.

Apparently there seems to be some relationships between both expenditures of households categorized in population size for the actual water use, their willingness to pay, and their actually paid amount for water vendor as shown in the following Table:

Table 4.10.9. Comparison of Amounts To Pay or To Be Paid for Water

(As of 1995, unit : UShs/month)

Amounts to pay for water resulted from the Inventory Survey for communities in population size		Amounts to pay or to be paid for water resulted from the Inventory Survey for Households	
Communities categorized by population size	Actual paid amount for water in average of 3 Districts	Kind of amounts to pay or to be paid	Amount to pay or to be paid for water in average of 3 Districts
200 and under	2,002	Actual paid amount for water from existing water source	2,547
201 - 600	2,450	Amount of willingness to pay for water	5,770
601 - 1,000	3,670		
Over 1,000	21,240	Actual paid amount for water vendor	19,377

The relationships between expenditures spent by average households categorized by community size and the amount to pay or of willingness to pay may be considered as follows:

Relationship between Average HH Expenditure for Water in Community Size under 200 and Amount to Pay of Average HH Resulted from Actual Water Use

The amount of UShs.2,002 is resulted from the Inventory Survey for Communities, and UShs.2,547 is from that for Households. There is no such significant difference between both amounts. It means that the households in every community want to collect cheaper water and usually they do so as a whole. This is to say that a payment level of around UShs.2,000 per month is an actual level as a result of the Inventory Survey.

On the other hand, the number of communities under 200 in population size shared only 9 % to the total communities in the study area, but they are not in such economic active environment. Therefore, it seems that the said figures of UShs.2,002 were reflected the most typical human behavior. In some of these small communities, they usually pay for water as fees for operation and maintenance of their water facilities by fixed rate.

Relationship between Average HH Expenditure for Water in Community Size between 201 and 1,000 and Amount of Willingness to Pay

In the community size of 201 to 1,000 population, the actually paid amount for water ranges UShs. 2,450 to 3,670 per month per HH. The amount of willing to pay for water in those communities reaches to UShs. 5,770 per month per HH.

It seems that the said amount of willingness to pay, UShs.5,770, is the fact. However, most of them establish their own WUCs, and has respective payment regulations in communities in a large size. Usually they settled a water fee for O&M of their water facilities, and the WUCs collect water charges per jerry can by fixed rate. Therefore, the paid amount for water becomes automatically higher than that in the monthly fixed rate system in communities in small size. This fixed rate per jerrycan is almost the same amount of willingness to pay ar UShs.50 per jerry can in Mpigi, UShs.45 in Mubende and UShs.35 in Kiboga.

The number of communities with population size of 201 to 600 is almost 63 % to the total communities sampled, and that with population size between 601 to 1,000 is 21 % according the said result. So 84 % of communities belong to this group.

Relationship between Average HH Expenditure for Water in Communities Size More Than 1,000 and Actual Paid Amount to Water Vendor

About 7 % of communities in the study area are the population size more than 1,000, and 23 % of households seem to belong to such communities. Most of these communities are trading centres or towns which are economically active.

The HHs in the communities in a large size are busy for their business and gain a high income. They have to buy water and have a capacity to pay UShs. 20,000 pre month per HH for water.

4.10.4. Affordability to Pay

(1) Operation and Maintenance Cost to be Paid

In the case of Level II system, the O&M cost includes the costs for operation and maintenance for pumps (US$737.5/annum per unit, 5 units in total, so US$3,687.5/annum in total amount) and diesel generator (US$3,070/annum, one unit), and annual running cost for the system (US$6,800/annum). The Level II system serves water for 3,604 persons in population which means 794 households.

In the case of borehole facilities, the O&M cost includes the cost for operation and maintenance for pums only (US$147.5/annum.unit). One unit of pump will serve water for 430 persons based on the design criteria which means 91 households in average.

(2) Replacement Cost to be Reserved

In the case of Level II system, the replacement cost includes the costs for replacemnt of pumps (US$10,000/unit, 5 units in total, so US$50,000 in total) and diesel generator (US$50,000/unit, one unit only). Pumps will be replaced in every 7 years, and diesel generator will be replaced in every 15 years. The service population and households are as mentioned in previous sub clause.

In the case of borehole facilities, the replacement cost includes the cost for replacement of pums only (US$2,000/unit) which will also be repced in every 7 years. The service population and households are as mentioned in previous sub clause too.

(3) Affordability to Pay

As mentioned in previous clause, actual paid amount and willingness to pay for water are summarized in Table below:

Table 4.10.10. Actual Paid Amounts and Willingness to Pay for Water

(As of 1995, unit : UShs/month)

Results from the Inventory Survey for Communities by size		Results from the Inventory Survey for Households	
200 and under	2,002	Actual paid amount for water from existing water source	2,547
201 - 600	2,450	Amount of willingness to pay for water	5,770
601 - 1,000	3,670		
Over 1,000	21,240	Actual paid amount for water vendor	19,377

And amount to be paid or reserved estimated are summarized below under the condition mentioned above:

Table 4.10.11. Amount to be Paid/Reserved for O&M and Replacement Cost

(UShs/month.HH)

Cost item	Level II	Borehole	
		Case A*	Case B**
O&M cost	1,451	136	362
Replacement cost	2,202	445	1,275
Total	3,653	581	1,637

(Note)

* : The case based on the design criteria.

** : The case of probable minimum community size.

Comparing the above 2 Tables, the total amount to be paid/reserved for Level II system, UShs.3,653, is within the amount of willingness to pay and almost the same amount of actual paid amount of communities which have population between 601 and 1,000. As mentioned above, Level II system is planned to be constructed in one location in Kiboga District consisting 5 communities, and these communities have population of 720 in average in the year of 2005. It means that they have enough affordability to pay for O&M and replacement costs without any burden.

The total amount to be paid/reserved for O&M and replacement costs for borehole systems in the case of probable minimum community size of 150 in population, UShs.1,637, is less than the actual paid amount, UShs.2,002, of communities with population of 200 and below. And in 2005, minimum community size will be 168 persons in population according to extrapolated population projection by based on the past population growth ratio

mentioned in previous clause. It means that the actual amount to be paid/reserved for O&M and replacement costs should be lower than the said estimated amount. Therefore, they have enough affordability to pay for O&M and replacement costs without any burden in borehole systems too.

CHAPTER FIVE : PROJECT EVALUATION

5.1. Introduction

The project is to be synthetically evaluated from the views of finance, socioeconomy, technology, and environment.

The financial evaluation is made by means of a Financial Internal Rate of Return (FIRR), by providing that the O&M fee for water facilities is to be collected from water users as financial revenue based on the technical criteria mentioned previously.

On the other hand, the economic evaluation is also carried out by means of an Economic Internal Rate of Return (EIRR), by using the estimated economic cost and benefit of the project.

In accordance with the design criteria, the target year of services population is set at 2005. So the full benefits will be appeared at 2005. The benefits accrued from the period after completion of the works to 2004, and those for the period from 2005 to the end of project life will be different from each other.

The project life is taken as 30 years after completion of the construction works. The project benefits (both the financial and economic benefits), together with O&M costs, are assumed to occur every year during the period of the project life. But the replacement cost is set at seven years each for pumps after completion of the construction works, and at 15 years each for diesel generator for Level II system after completion of the works.

5.2. *Project Benefits*

5.2.1. Time Spent for Water Collection

People lived in the study area mainly used unprotected springs and water holes in both wet season and dry season according to the result of Inventory Survey. The water holes were used more than the unprotected springs in wet season, but this tendency reverses in dry season. The water holes are rather shallow than the other ones, so those are easy to dry up in dry season. Therefore, they would like to go to springs, but protected springs are quite little, so they go to the unprotected springs more for taking water.

Usually they spend a time to go to water source about 50 minutes in one way in wet season, and 100 minutes in dry season including the water taking time from the source. Water taking time is about 10 minutes. So, the actual times spent to go to and to come back from the water source are 80 minutes in wet season and 190 minutes in dry season.

Table 5.2.1. Average Time to Get Water

(Minutes)

Districts	Wet season	Dry season
Kiboga	44	99
Mpigi	56	96
Mubende	43	94
Average	48	96

Source: Inventory Survey, JICA, 1995.

When the water source like borehole is located at 1.5 km in maximum from house in these villages, it will take about 30 minutes under the condition of 4 km/hour by foot in one way for taking water including water drawing time whether it is in wet season or not. Therefore, if the water service is constructed with the condition mentioned above, they can save the time spent to take water about 30 minutes in wet season and 140 minutes in dry season.

The average child share rate may be estimated at 25 % which means that about a quarter of total water collector is child. When they could save the time spent mentioned above, almost all these children could have a time for receiving education.

And about 60 to 70 % of total water collectors were female according to the said Table. When they could save the time spent for water collection, they could attend more to social activities or their daily works in their houses or out-door works like agriculture.

Furthermore, the result of the Inventory Survey says that times per day to collect water were 2.5 times to 2.8 times in average in the study area. It means that the said time spent would become 75 minutes to 85 minutes in wet season, and 350 minutes to 390 minutes in dry season.

5.2.2. Medical Expenditures

As mentioned previously, the HH in the study area spend the medical expenditures at rounded amount of UShs.180,000 per year on an average which is equivalent to 26 % to the total expenditures as summarized in the following Table.

Table 5.2.2. Annual Average HH Medical Expenditures

(As of 1995, unit : USh)

District	Categories in population size				
	Average	200 & under	201 - 600	601 - 1,000	Over 1,000
Average	181,286	85,556	200,741	192,501	162,311
Mpigi	196,735	75,500	229,530	179,667	162,583
Mubende	147,526	87,000	156,617	140,019	163,750
Kiboga	199,596	94,167	216,075	257,818	160,600

Source : Inventory Survey, JICA, 1995.

On the other hand, major diseases may be classified as follows:

Table 5.2.3. Classification of Diseases by Causes

Water borne	Water washed	Water based	Water related vector borne	Faecal disposal related	Housing and crowding related
(1)	(2)	(3)	(4)	(5)	(6)
Gastroenteritis, diarrhoea (non bloody), diarrhoea with blood, cholera, typhoid	Trachoma, other eye infections, skin infections	Schistosomiasis, guinea worm	Malaria, onchocerciasis, trypanosomia-sis	Hepatitis, hook-worms, worms, hookworm anemia	Tuberculosis, meningitis, measles, malnutrition

Source : Ministry of Health, Uganda.

Among the above mentioned diseases, those on the item (1) to (4) may be said as water related diseases. As per the evaluation of share rate of infections of water related diseases to the total cases, a data on cases of diagnosis reported by the MOH can be applied. The data has been clarified by kind of diseases per month as of 1995. Following Table shows a summary of this data by water related diseases (case 1) and by non-water-related ones (case 2).

Table 5.2.4. Number of Cases of Diagnosis in Uganda

(As of 1995, unit : 1,000 cases)

Cases	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1	302	233	189	224	227	227	200	188	67	37	29	89	2,012
2	346	278	300	308	318	317	273	236	187	50	39	37	2,689
Total	648	511	489	532	545	544	473	424	254	87	68	126	4,701

Source : OPD Report 1995 prepared by the Ministry of Health, Uganda, 1995.
(Note 1)Figures in row of Case 1 is the cases of diagnosis for water related diseases.
(Note 2)Figures in row of Case 2 is the cases of diagnosis for non-water related diseases.

On the view from the cases of diagnosis, the share rate of water related diseases to the total cases can be estimated at 43 %. Using this rate, the medical expenditures for water related diseases may be estimated at around UShs.77,600 per year on an average as shown in the Table below.

Table 5.2.5. Annual Average HH Medical Expenditures for Water Related Diseases

(As of 1995, unit : UShs)

District	Categories in population size				
	Average	200 & under	201 - 600	601 - 1,000	Over 1,000
Average	77,589	36,617	85,916	82,389	69,468
Mpigi	84,201	31,314	98,237	76,896	69,585
Mubende	63,140	37,235	67,031	59,927	70,084
Kiboga	85,426	40,303	92,479	110,345	68,736

5.3. Financial Evaluation

5.3.1. Methodology

(1) Project Cost

The construction cost consists of local and foreign currency portions, and is estimated on preliminary design. The annual price escalation assumed to be a rate of 10 % for the O&M cost for the period of the project life.

(2) Project Revenue

The O&M fees for water facilities are given as the project revenue as mentioned above. In this case, a fixed annual equal fee is applied for service HHs based on the monthly equal payment basis considering the family size of each District. Average family size is 4.69 persons per HH resulted from 4.68 persons in Mpigi, 4.82 in Mubende and 4.54 in Kiboga.