

and lay the pipeline.

2.1.7 Nkugua Water Project

(1) Location and Service Area

This project is located within Nthimbiri sublocation of Ntima location about 8 km to the west of Meru town. The total supply area covers 3 villages and spans 5km². About 600 households reside within the service area.

(2) Organization and Management

The project was started in 1974 by residents of Nkugua village and currently has about 500 members.

The project has a well organized management structure consisting of 15 members with an executive committee of 7 members. The entire executive committee is composed of well educated members of the community and this has contributed greatly to the success of the project.

Elections are held once every three years and group meetings are held every month to deliberate on an ongoing augmentation programme.

There exists a clearly stated scope of roles and responsibility and rules and regulations to facilitate the smooth operation of the project.

(3) Intake and Distribution

1) Intake

The current intake is situated on the Kathita river and the method of abstraction is through a side intake. This has however aged over the years and a new intake set for construction 50 metres upstream. The yield will be very high and reliable, even though pollution cannot be ruled out at the source.

2) Reticulation System

The main trunk line is a 150mm diameter PVC pipe that runs for 2km to the storage tank which has a capacity of 20,000 gallons. This is a reinforced cement masonry structure with an iron sheet roof.

There are four (4) 50mm diameter distribution lines from the tank that have a combined running distance of 6 km. Water pressures are high and the flow must be regulated to avoid overflow at the tank.

The reticulation system has around 100 individual connections and plans are underway to construct a bigger storage tank and extend the pipeline to serve the other two villages.

(4) Finance and Demand

1) Development Finance

All the money invested in the project has been raised through members contribution and harambee. At inception the initial 25 members raised Kshs.3,700/= each (Kshs.92,500) and the rest of the money was raised through harambee. Members have been able to raise in excess of Kshs.200,000/= whereas harambees have realized over Kshs.400,000/=. The total investment cost is currently over Kshs.500,000. The group has a bank account with a healthy balance of about Kshs.96,000/-. No outside aid/assistance has been anticipated.

2) Water Consumption

Most of the water within the project area is utilized for small scale irrigation which takes about 70%. The rest is utilized in watering livestock and for domestic purposes. At present the water supply is adequate for the existing number of connections. Expansion of the system however requires the construction of an additional storage tank.

(5) Operation and maintenance

There are no technical personnel to maintain the system. The project does however have 4 line patrollers who also clean the intake at a daily rate of Kshs.50/=. Repairs are carried out under the supervision of the management committee.

Tariff Structure

The system is not metered and flat monthly rates are charged. The committee blames this on the great financial burden to complete the project. Plans are under way to introduce a monthly flat rate once all members start receiving

water.

(6) Key Problem Issues

The implementation, especially during the augmentation stage has been done in accordance with the technical design. The major problem lies in the need for extra storage and the construction of the new intake.

The lack of charging for water may also result to misuse by some members.

2.1.8 Magundu Water Project

(1) Location and Service Area

The project is located in Ntakira sublocation of Ntima location 2km on the north west of Meru town. The eastern fringes of the project serve areas adjacent to Majengo slum settlement.

The service area for the entire project is 10 km² and is occupied by about 500 households.

(2) Organization and Management

The project came into operational in 1974 utilizing a furrow for irrigation purposes. The current piped supply was initiated in 1976. The project has over 300 members and is managed by an elected committee of 9 members. Only half of the committee members are educated. Two women are in the committee.

Committee elections has been held since its establishment. Members normally hold an annual general meeting. This lack of meetings partly explains the deplored state of the project. There is a general lack of understanding about the roles and responsibilities of the committee members and none has been trained on the operation of water supply systems.

(3) Intake and Distribution

1) The Intake

The intake is located on the Kathita river 6 km away from Meru town. The old intake is a side intake, poorly constructed and utilizing filled gunny bags to

create a side water channel. The newly constructed intake at upstream is properly done but the main line has been damaged and left unattended. The yield is good and reliable but pollution from upstream agricultural activities cannot be ruled out.

2) Reticulation System

The main trunk line is a 150 mm diameter PVC pipe running for 1¹/₂ km from the intake to the storage tank.

The tank is made of concrete blocks and holds 20,000 gallons of water. It is well covered and elevated to provide a good head for gravity flow. Water flow in the main trunk line at half capacity and this results to less amount of water getting to the tank.

There are four main distribution lines from the tank. The longest line runs for 4 km through a 100 mm diameter PVC pipe, and the other lines are 75 mm diameter. Pipelines of 50 mm diameter PVC supplying the area around Magundu village. The project has a total of 300 individual connections but suffers from low pressures resulting in dry pipes in most areas.

The distribution lines also do have a higher capacity than the main trunk line feeding the tank.

(4) Finance and Demand

1) Development Finance

The project was started with initial contributions of Kshs.300 from 150 members. New members currently pay Kshs.2,500/= which includes a labour premium. The extension of the pipeline to provide an extra connection within the same homestead costs Kshs.600/=.

The project has managed to get assistance from the NCKK worth Kshs.175,000/= for improvement of the intake, construction of the water tank and for maintenance purposes. Additional material assistance has been obtained from 'Save the Children Fund – Canada.' To date, total project cost has bypassed Kshs.250,000/=.

2) Water Demand

Over 50% of the water available is utilized for small scale irrigation purposes whereas domestic uses account for about 30%. The project also supplies a cattle dip and the Kianjuri coffee factory. All these uses must however supplement their water supply due to the inadequacy of the system supply.

(5) Operation and maintenance

There is no clear maintenance programme for the scheme. Some members of the committee attend to the inspection of the intake. Patrolling of the pipeline for bursts and blockages is done by members interested in finding out why water is not flowing at their taps.

Tariff Structure

Water is supplied free of charge to members. This hinders raising funds for system expansion and maintenance costs.

(6) Key Problem Issues

Lack of a property representative and committed management team has been responsible for the many problems affecting the project.

Secondly, the reticulation system has been laid down in complete disregard of technical designs which makes water flow difficult.

Very few areas get water within the supply area. This has created some degree of apathy among the members. The flow of members contribution has thus been very slow.

2.1.9 Giatune Kithima Water Project

(1) Location and Service Area

The project is located in Mpuvi sublocation of Nthima location and serves residents of Matuntukene village. The area has a population of about 2000 persons but the project covers only 2.5 km².

(2) Organization and Management

The project was started in 1996 by residents of lower Matuntukene village as a community initiative and currently has 80 active and 40 inactive members.

Management of the project is in the hands of an elected committee of 9 members. All committee members with the exception of one have attained at least primary level education. There is one woman in the committee.

Elections have been planned to be held yearly and the group meets once every month. This is important in order to undertake their manual labour activities.

None of the members have been trained on water supply management but the group has benefited greatly from the past experience of the chairman and the treasurer.

(3) Intake and Distribution

1) Intake

The intake is located at the Kithima kia M'Mkindia spring that forms a stream to become a tributary of the Kathita river. The yield at the spring is high and adequate to supply the project. There are however many other projects utilizing the same intake which may create a problem of over exploitation in future. The upstream area is heavily farmed and this makes the intake area prone to pollution.

2) Reticulation System

The main trunk line is a 100 mm diameter PVC running a distance of 1.5 km to the main distribution chamber.

From the distribution chamber there are three (3) 50mm diameter distribution lines, and one (1) 25 mm diameter distribution line running for 0.5 km. Distribution to individual households is through a 12.5 mm diameter PVC pipe connected to a distribution chamber. Each chamber carries 6 - 8 lines. There are currently 8 chambers and 30 individual connections.

Pressures at the points of supply are high and the utilization of chambers makes the regulation and rationing of water supply easier.

(4) Finance and Demand

1) Development Finance

The initial investment costs for the project have been borne by the members and was at Kshs.410,000/=. Each of the 80 members contributed Kshs.7,000/=.

Additional funds are raised through members contributions that are deliberated and agreed upon from time to time.

2) Water Demand

The prime objective of the project has to provide enough water for domestic use, public institutions and for agriculture through small scale irrigation and watering livestock. Currently over 70% of the water is utilized for irrigation purposes whereas the rest is for domestic use. Plans are underway to supply water to 2 churches and 1 primary school.

For the 30 households already connected no water rationing is experienced.

(5) Daily Operation of the system

The project is a gravity flow system and in the absence of treatment there are very limited operation duties. The inspection of the pipeline and cleaning of the intake is done by the committee members with assistance from the group.

Technical aspects of the maintenance are handled by the treasurer from his work experience knowledge.

Tariff Structure

The project does not charge for water either through a metered system or a monthly flat rate. This project however plans to introduce a monthly flat rate as soon as all members are supplied with water.

(6) Key Problem Issues

The supply (service) area of the project overlaps with that of Matuutrikene water project, and cases of double membership have been reported. This results in duplication of the reticulation systems, which may result in reduced commitment to project duties by some members.

The lack of storage facilities is likely to result to low pressures once the number of connected households increase in the near future.

2.1.10 Ngithiria Water Project

(1) Location and Service Area

The project is located in Mpuri sublocation of Nthima location some 7km from Meru town. The project mainly serves residents of Kiemerero village. It is a small project and currently covers only 2km².

(2) Organization and Management

The project was started by members of the local community in 1980 to replace the furrow water supply that had been in existence since the 1960s. There are currently 70 members. The management of the project is under an elected committee of 9 members. All the committee members are educated at least to primary school level but there are no women in the committee.

Elections for the committee are held every year and the group meetings are held once every three months. None of the committee members has however been trained on management, operation and maintenance of water supply schemes.

(3) Intake and Distribution

1) The Intake

The intake is located on a tributary of the Kathita river 300m downstream the Gaiture Kithima Water Project intake. Due to the poor construction of the intake the yield is low from a highly potential source. The upstream and surrounding areas are heavily cultivated creating a high pollution potential.

2) Reticulation System

The main trunk line is a 100mm PVC pipe that runs for 400m and reduces to 75mm for a distance of 1km. Distribution is done from a 50mm pipe that crosses the entire supply line for a total length of 2km. Supply to individual households is facilitated through 12.5mm pipes.

The system has no storage tanks and has been implemented in complete disregard of any technical design. Pressures are thus low and dry pipes are

common especially when repairs become necessary.

(4) Operation and Maintenance

1) Development Finance

The initial investment cost for the project amounted to Kshs70,000. Each of the 70 members has to date contributed Kshs3200. New members are required to pay Kshs 6,000 which includes a labour premium for developments done to date.

The project has a bank account and has a present balance of Kshs. 3,000/=. This is not adequate provision to cater for maintenance. Requirement for repairs are deliberated upon and contribution allocations communicated to members.

2) Water Demand

Water demand within the project service areas falls within 3 categories - domestic, institutions and agriculture purposes. Current consumption are estimated at 30% for domestic, 10% institutions and 60% small scale irrigation and livestock use.

Present levels of supply are far less than demand due to low pressures in the reticulation system and incidence of dry tapes are common. 70No. households and 1No. schools have individual connections.

3) Daily Operation of the System

There being no technical man employed by the project, maintenance work is done by the group members themselves. The project is a gravity flow system and this cleaning of the intake and repair of burst pipes makes the bulk of the work.

4) Tariff Structure

The project has not installed any meters neither does it charge a flat rate for water use.

(5) Key Problem issues

The implementation of the project especially the laying down of the pipework in

disregard to technical designs has resulted in low pressures within the system. The rectification of this problem requires replacement of the pipes which is a very expensive exercise. This problem is compounded by the lack of storage facilities.

The management of the group seems to lack devotion and has grossly failed in fund raising. Since inception about 15 years ago the group has raised no more than Ksh 150,000/= which has been a big impediment to project enlargement.

2.1.11 Mulathankari Women Water Project

(1) Location and Service Area

The project is located within Mulathankari and Thimagiri sublocations and serves areas on the right hand side of the Meru - Giaki road. The total service area is 8km².

(2) Organization and Management

The project was started in 1965 as a county council naval water supply scheme. In 1991 the project was handed over to the women group by the county council. By the time of taking over the project life span had elapsed and a complete rehabilitation was required.

The women's group has 80 members and is managed by an elected committee of 9 members. The level of literacy is medium as only two committee members are illiterate.

Group elections are held once every 5 years and the group meets once every two months. None of the members has however been trained on management and operation of water supply schemes.

(3) Intake and Distribution

1) The Intake

The project has its intake at the Kithima Kia M^uMugania Spring which is located 1km from Mulathankari Secondary School. The spring is one of the tributaries of the Kathita river. The yield of the spring is high and can adequately supply the service area.

The spring is well protected but sewage overflows from Meru town are likely to pollute the upstream area.

2) Reticulation System

The main trunk line is a 100mm PVC pipe for 200m to the 1st tank. This reduces to 75mm between the two tanks for a distance of 360m. There are 4 main distribution lines of 50mm, two from each tank with a running distance of 1km.

There are two storage tanks each with a capacity of 20,000 gallons. The main trunk line is however of a small diameter and cannot supply adequate water to the tanks. This results from the implementation of the project in disregard to technical designs from the Ministry of Water.

(4) Operation and Maintenance

1) Development Finance

Money for the project was raised from members' contributions who contributed Ksh. 2,000/= each. In 1993, the group obtained donor assistance from 'Country Women of the World-London' equivalent to Ksh200,000. The group has so far been able to utilise Ksh276,000 for the rehabilitation of the project.

The group keeps a bank account and currently has a balance of Ksh6,000/=.

2) Water Demand

The current water demand situation outstrips supply. Three major uses have been identified to include domestic uses 20%, agricultural purposes 70% and institutions about 10%

There exists 80 individual connections and the scheme supplies 1 school, 2 churches, a village polytechnic and social welfare centre.

3) Operation

The project has no water technician and thus simple maintenance works are done by the women themselves or contracted to local technicians. These are however minimal since the project utilizes a gravity flow system. Inspection of the pipeline is also done occasionally by contracting.

(5) Key Problem Issues

The major problem experienced is mainly from interference by men on the management especially after the donor assistance. This created some differences among the women themselves. The implementation of the project ignoring technical design provisions has resulted in low pressures.

2.1.12 Thuura Giaki Water Project

(1) Location and Service Area

The project is located within Nyaki and Giaki locations and serves parts of Thuura sublocation in Nyaki and Giaki Location. The total service area covers 20km² with a population of about 6,000 people.

(2) Organization and Management

The project was started by the local community in 1980 with a total membership of 756 members, only about 300 members are now active. The project is managed by an elected committee of 15 members. Only 4 women sit in the committee. Half of the committee is composed of illiterate members. The group last held elections in 1987 and the last group meeting was held in 1994. The group has thus been experiencing leadership problems that have culminated in the existence of a splinter group known as Karukuma Wats Association to take care of the interests of Thuura Sublocation members.

No member of the committee is trained on water supply management, operation and maintenance.

(3) Intake and Distribution

1) The Intake

The intake is a weir constructed across the Kathita river. The yield at the intake is high but the problem has resulted in the installation of illegal intake pipes by the Karukuma water association and other individuals creating conflicts in maintenance and co-ordination.

The agricultural activities upstream and broken sewers from the Meru town have resulted in contamination.

2) Reticulation System

The main tank line is a 200mm GI pipe running 6 Km in lengths and an equal size PVC pipe running 200m. This gradually reduces to 50mm PVC pipe within 2km and runs for 10km to Giaki. The implementation of the pipework has thus ignored technical designs.

Only 58 individual connections have been installed to date. This is one storage tank with a holding capacity of 30,000 gallons which has never been utilized.

(4) Operation and Maintenance

1) Development Finance

Money from the project has been raised through members contribution and initial investment amounted to Kshs300,000. Members contribution have not been coming due to existing problems that have caused divisions.

The group has a bank account but only Kshs.6000/= is available in the account.

2) Water Demand

The little water that trickles in is all used for domestic purposes only. The broader objective of providing water to institutions and for farming has not been realised to date 15 years after inception.

3) Operation

The project is actually neglected and no maintenance is done currently. To ensure water flow to the connected 58 households individuals gang up together to facilitate repairs.

4) Tariff Structure

No payment is done for any water utilized. The system is unmetered and no flat rate charges are in place.

(5) Key Problem Issues

The major problem afflicting the project is the leadership wrangles that have caused divisions between the people of Thuura and Giaki. Not much progress is expected of this project before this is resolved.

The laid down pipes cannot be expected to supply adequate water to the service area. Poor implementation had led to the need for pipe replacement.

2.1.13 Nkurene Water Project

(1) Location and service area

The project is located within Nkurene village Mpuri sublocation of Ntima location a distance of about 6km from Meru town. It is a small scheme as the same village is also served by Vijana and Manduru water projects.

The total service area of the scheme is about 2km².

(2) Organization and Management

The project was started by the local community in 1972 and currently has 40 members. The management of the scheme is under an elected committee of 7 members. Only one woman sits on the committee. Half of the committee members are educated.

Elections of the committee are held once every two years and group meetings are held once every month. None of the committee members have been trained on management, operation and maintenance of water supply schemes. There is a clear lack of understanding of the roles and responsibilities of the committee as well as Ministry of Water regulations pertaining to water abstraction.

(3) Intake and Distribution

1) The Intake

The intake is located on the Muirane stream $\frac{1}{2}$ km from Mpuri primary school and 300m downstream the Vijana water project intake. The yield at the intake is very low resulting from the poor construction of the intake chamber.

The site is on a farm with cultivation taking place all round the chamber and upstream. This creates a very high potential for source pollution.

2) Reticulation system

The main trunk line is a 50mm PVC running from the intake for a distance of 900m. Distribution to individual connections is through a 12.5mm PVC pipe.

There are no water tanks for storage and consumers are supplied direct from the intake.

Water pressures in the system are less and inadequate water is supplied. This emanates from the fact that the pipework was laid down in complete disregard of the technical design from the MLRRWD.

(4) Operation and Maintenance

1) Development Finance

All funds utilized in the project have been raised by members of project. Initial investment cost amounted to Ksh.50,000/= and a total of Ksh.150,000/= has been spent on the project to date.

Low incomes among the residents have resulted in very limited contributions. Through the project used to keep a bank account, this has been left dormant for the last 7 years.

2) Water Demand

The demand for water from the project outstrips supply. Initially 8 families came together but currently membership has grown to 40 households. Most of the water (about 70%) is utilized for agriculture (mainly small scale irrigation) and the rest 30% is utilized for domestic purposes. The augmentation of the system and construction of a storage tank is long overdue.

3) Operation

Operation and maintenance works that mainly comprise of the inspection of the pipeline for the bursts and cleaning of the intake is undertaken by the members in turns under the supervision of the committee members.

No trained technician is employed to take care of the system.

4) Tariff Structure

Members with individual connections do not pay for water. The system is unmetered and no flat rate is in operation.

(5) Key problem issues

The inadequacy of the intake and poorly laid down reticulation system is a major drawback to the supply of adequate water. This has resulted into excessive rationing.

Leadership is also a major problem. The inability of the committee to adequately plan for the expansion has resulted into the existence of other splinter schemes leading to misunderstanding. Double membership to schemes is thus common and this may create problems of cohesion and commitment.

2.1.14 Vijana Water Project

(1) Location and service area

The project is located within Nkurene village of Mpuri sublocation around the same area with Nkurene Water Project. The project was initiated with the idea of supplying water to 11 households but currently serves only 8 within an area of less than $\frac{1}{2}\text{km}^2$.

(2) Organization and Management

The idea to set up the project was borne by members of Nkurene water project in 1992 with the aim of obtaining a new intake to serve households situated on higher ground.

The group is too small to have a separate committee but sits to elect a chairman, secretary and treasurer every year. Meetings are held only 3 times per year. None of the members is trained on management, operation and maintenance of water supply schemes and the lack of understanding of their roles and responsibilities is very evident.

(3) Distribution Network

The intake is located on the Nkurene stream near Mpuri Primary School 300m upstream the Nkurene water project intake. The yield is low due to poor construction and both the surrounding area and upstream are heavily farmed.

The main trunk line is 25mm PVC pipe running for 1km from the intake. Individual connections are done using 12.5mm pipes. There exists no storage

tanks and the system suffers from low pressures that leads to retraining. The laying of the pipework was done with no technical design from the ministry.

(4) Operation and Maintenance

1) Development Finance

Initial investment cost for the project amounted to Ksh30,000 and was raised from individual members' contribution of Ksh 2000 and assistance from members of Nkurene Water Project.

No other funds have been forthcoming and consequently the system has not been expanded. The project keeps no bank account and money required to handle maintenance and repairs is collected on an ad hoc basis.

2) Water Demand

Demand for water greatly outstrips supply. Most of the water is utilized for agriculture (90%) and the rest for domestic purposes (10%). Rationing is however necessary and only two members are allowed to use their sprinklers per day. Domestic uses are not restricted.

3) Operation

Inspection of the pipeline and cleaning of the intake is done by members on an ad hoc basis.

4) Tariff Structure

The system is unmetred and members do not pay for water. There exists no monthly levies for the group members.

(5) Key Problems Issues

The implementation of the project without any technical designs from the ministry has led to low pressures and inadequate supply. Improvement of the water supply will require a complete replacement of the entire pipeline system and construction of a storage tank. The group is too small and its ability to raise sufficient funds for the construction of an adequate intake, tank and pipework is highly doubtful.

2.1.15 Matigari Water Project

(1) Location and service area

The project is located within Kiathumbi sublocation of Katheri location and Mpuri sublocation of Ntima location. It is a small project and covers an area of about 2 square kilometres.

(2) Organization and Management

The project was initiated by members of the local community in 1987 and currently has 27 members. It is managed by an elected committee of 7 members who include 2 women. Most of the committee members have only primary school education and none has been trained on management, operation and maintenance of water supply schemes.

Elections for the committee are held every year. Members meetings are infrequent and one held only when problems arise. The committee roles and responsibilities include maintenance of the system and intake, water retraining and fund raising.

(3) Intake and Distribution

The intake is located on the Kathita Munyi stream a tributary of the Kathita river. The stream has a moderate yield but its location can not serve all places within the proposed area. Areas upstream the intake are heavily cultivated and this creates a high pollution potential at the source.

The main trunk line from the intake is a 75mm PVC that runs for 200m before reducing to 50mm for 300m, 37.5mm for 300m and finally to 25mm for 300m. The entire distribution line stretches 1km. Distribution to individual households is through a 12.5mm PVC pipe, and there are no storage facilities.

The laying down of the reticulation system has been done in complete disregard of technical designs from the MLRRWD. This has resulted in inadequate water supply and low pressures within the pipeline.

(4) Operation and Maintenance

1) Development Finance

Initial investment capital amounted to Ksh.30,000/= and was raised through individual contributions of Ksh1300 per member. New members pay Ksh.4000/= which includes a labour prevention premium for works already done. Other moves to expand the system come from members contributions that are collected when needed. The group has a bank account and currently has Ksh 5,000/=.

2) Water Demand

Most of the water is utilized for small irrigation to farm french beans and food crops and to water livestock. This accounts for 80% of the total consumption. The remaining 20% is used for domestic purposes. Water supplied is however inadequate and the need to expand the system is long overdue.

3) Daily Operation of the system

The project utilizes a gravity flow system which reduces maintenance and operation costs. Inspection of the system and cleaning of the intake is coordinated by the management committee.

4) Tariff Structure

The system is not metered and no monthly flat rate is charged for the use of water. This creates problems in raising funds for repairs and maintenance of the system.

(5) Key Problem Issues

The capacity of the intake to supply enough water for all intended uses is limited. This is basically due to it's siting and the general topography in the area.

The management of the scheme has problems. Committee members lack a clear understanding of the Ministry of Water regulation regarding the abstraction of water. This has led to the formation of a parallel water project known as Mishiiri in order to obtain an extra intake splitting the project into smaller groups reduces their ability to raise enough funds to expand the system.

2.1.16 Karimainga Water Project

(1) Location and Service Area

The project is located within Mulathankari sublocation of Nyaki location and serves Karimainga and Rumithu villages. The total service area is about 6km² and is inhabited by approximately 500 households.

(2) Organization and management

The project was initiated by the local community in 1992 and has a current membership of 240. It is managed by an elected committee of 13 members. Half of the committee members are educated at least to primary school level whereas the rest are not. No woman sits on the committee.

The committee meets once per month while the group only holds an Annual General Meeting. Elections to the committee should be held after every 5 years. From discussions with the committee it is evident that there is lack of understanding on their roles and responsibilities. None of the committee members has received any training on management operation and maintenance of water supply schemes.

(3) Intake and Distribution

1) The Intake

The intake is located at the Koiga Springs about 4km from Meru town. The spring yield is high and has great potential to produce/supply more water. There is also limited cultivation upstream and proper protection can minimise pollution and contamination of the source.

2) Reticulation System

The main trunk line is a 75mm PVC running from the intake for 300m. This reduces gradually to 67.5mm for 150m, 50mm for 150m and eventually to 25mm for a distance of 2km.

There are storage tanks and distribution to individual connections is done through 12.5mm pipes. Currently a total of 100 connections are in place.

The system however suffers from low pressures due to poor implementation.

The network has been laid down in complete disregard to MLRRWD technical designs.

(4) Operation and Maintenance

1) Development Finance

All funds utilized for the development of the project have been raised through members contributions. Registration for membership is Ksh1600. Due to poor record keeping the committee could not tell the initial investment cost for the project. All other monies required are raised on demand and there exists no monthly members subscriptions.

2) Water Demand

Water demand greatly outstrips supply. Most of the water available is utilized for small scale irrigation agriculture (70%) whereas the rest is used for domestic purposes (30%). Plans to supply water to a nearby primary school have been shelved due to inadequacy.

3) Operation

The project committee is charged with the responsibility of inspecting the pipeline and cleaning the intake. This is however carried on ad hoc basis when lack of water flow is noticed in the supply lines.

4) Tariff Structure

The system is not metered and the project does not charge any monthly flat rates to water users. This may promote wastage and makes it difficult to keep adequate reserves for maintenance and repairs.

(5) Key Problem issues

The implementation of the system without following technical designs from the ministry is responsible for the inadequacy of water in the system.

The ability of the existing management committee to plan for expansion and maintenance of the project also doubtful.

2.1.17 Mukera Water Project

(1) Location and Service Area

Mukera water project is located within Chungu sublocation and serves the residents of Kathinga and Kiandiu villages. The total service area for the project is about 3km².

(2) Organization and Management

The project was started by the local community in 1987 and has a current membership of 80 members. Its management is under an elected committee of 9 members. The chairman, treasurer and secretary are educated and serving teachers whereas the rest are semiliterate. No woman sits on the committee and non of the committee members have been trained in management, operation and maintenance of water supply schemes.

Elections for the committee are held once every three years and the group meets once every 3 months.

(3) Intake and Distribution

1) Intake

The intake is located at Mukera Springs next to Kaaga Girls High School 200 metres of the Meru-Maua road. The yield at the spring is low and the intake chamber is poorly constructed. This is clearly cultivated agricultural area and prone to pollution and contamination.

2) Reticulation system

The main trunk line is a 150mm PVC pipe that reduces to 100mm and runs for 500 metres. It reduces further to 75mm and runs for 5km to reach the service area. The distribution lines within the service area are of 50mm dia with the total of length 3km, whereas individual households are supplied via 12.5mm pipes. Water pressure in the system is very low due to use of smaller pipes. There are 35 connections.

(4) Operation and Maintenance

1) Development Finance

The total investment capital for the project has been raised from members contributions of Ksh2000 each. Initial investment cost was valued at Kshs140,000. No external source of funding has been forthcoming.

Money to pay for repairs and expansion of the system is raised by the members after deliberating to fix the individual contributions.

2) Water Demand

The demand for water outstrips the supply and water utilization ratios between existing uses do not conform to budgeted allocations. Currently 80% of the water is utilized for domestic purposes and 20% on watering livestock. No irrigation farming is allowed because the existing pressure cannot turn the sprinklers.

3) Operation

The project utilizes a gravity flow system with very limited operation and maintenance costs. Inspection of the pipeline and clearing of the intake is undertaken by the committee members since there is no employed technician.

4) Tariff Structure

There are no charges for water. Members with individual connections use water freely and this may promote wastage in times of abundance.

(5) Key Problem Issues

The intake as it exists has a very low yield and very limited scope of expansion to supply enough water for invented purposes. The reticulation system has also been laid down in complete disregard of the technical designs from the Ministry of Water.

Lastly the committees ability to organise and plan for the expansion and daily operation of the project is doubtful.

2.1.18 Memeo Water Project

(1) Location and Service Area

The project is located within Munithu sublocation and serves Kabit and Kanthene villages. The design population for the project is 8000 persons within a service area of 12km².

(2) Organization and management

The project was started by members of the local community in 1964 and currently has a total membership of 360 members. The project is run by an elected committee of 17 members. Most of the committee members are educated only to primary school level but none has received any training on management, operation and maintenance of water supply projects. No woman sits on the committee.

Elections for the committee are held once every three years and meetings are held 3 times a year.

(3) Intake and Distribution

The intake for the project is located at the Ngachiuna river 6km from Meru town along the Meru-Maua road. It is a poorly constructed side intake resulting into a low yield. The potential to produce is however high. The surrounding area and the upstream are a source of pollution due to the intensive cultivation taking place.

The main trunk line from the intake to the tank is a 100m PVC pipe running for a distance of 1km. The initial 120m are made of 100m GI pipes. The storage tank is small and holds only 6000 gallons of water. There are 5 distribution lines from the tank, all of which are 50mm PVCs. Individual household connections are facilitated through 125mm PVC pipes. In all there are 200 connections.

(4) Operation and Maintenance

1) Development Finance

Funds to run the project are mainly raised from individual members contributions. The initial investment cost for the project was approximately Ksh.100,000/=.

No external funding has been forthcoming to the project.

Money to expand and maintain the system is budgeted, deliberated and each member is required to pay a stipulated contribution. The project has a bank account with a balance of Ksh.3000/.

2) Water Demand

The project was intended to provide water for domestic, agricultural and institutional uses/purposes. The amount available has however not been adequate and consequently it is utilized only for a domestic purposes (90%). A small fraction is utilized in institutions (10%). This scenario has been created by the low pressures in the pipeline resulting from the small pipes.

3) Daily Operation of the System

The system is a gravity flow system. Inspection of the pipeline and cleaning of the intake is done by the committee members. There is no employed technician and consequently more difficult jobs are done by hired local technicians.

4) Tariff Structure

The system is not metered and no flat monthly rate is charged on users. This makes the maintenance of the system difficult due to lack of funds.

(5) Key Problem Issues

There exists a very weak management structure within the project. This explains why the project has been unable to expand for the last thirty years it has been in existence.

The implementation of the project was done disregarding technical designs from the Ministry of Water.

2.1.19 Ngachiuma Kathima Water Project

(1) Location and Service Area

The project is located in Kithoka sublocation with it's proposed service area covering Themba village on area of 3km².

(2) Organization and Management

The project was initiated by the local community in 1975 and it's currently in it's implementation stage. It's management is in the hands of an elected committee of 19 members with an executive team of 7 members two of whom are women. Total membership to date stands at 120.

The group meets twice monthly and elections are held every 2 years. No member of the committee has obtained any training on management and operation of water supply schemes.

(3) Development Finance

Funds to finance the project are being raised through members registration and monthly contributions. The group has also been able to hold a harambee and currently have Ksh1.004 million in their bank account. The budgeted cost for full implementation is Ksh5.3million.

(4) Present Implementation Status

The intake works at the Ngathiuma river are ready as well as one storage tank.

2.1.20 Mwanika Kanja Water Project

(1) Location and Service Area

This project is located in Kathoka sublocation and is intended to serve Mwanika Village. The proposed supply area is about 4km².

(2) Organization and Management

The project was initiated in 1996 by the local community and currently has a membership in excess of 200. The management of the group is by an elected committee of 7 members. The committee members have at least secondary level education but none has been trained in water supply management.

Elections for the committee are held every year and meetings are held once every month. Discussions held with the committee do reveal a clear misunderstanding of their roles and responsibilities.

(3) Development Finance

Funds for the project have been realised from individual members contributions. Registration fee is Kshs 2,000 per member. About Kshs 100,000 has already been spent on the construction of the intake. The group has a bank account with Kshs157,000.

(4) Present Implementation Status

The construction of the intake at a tributary of the Nyachiuma is already complete and the laying of the main trunk line has started.

2.2 Other Towns**2.2.1 Nkubu**

The township of Nkubu is served with MLRRWD Nkubu water supply scheme. The supply is however inadequate and this has resulted in the development of other schemes to serve mainly the peri-urban and rural areas.

The survey of community based water supply schemes identified 5 main supply schemes in Nkubu.

2.2.2 Isiolo and Chuka

There is no community based water supply schemes in the areas. But in Isiolo, there are several individual instituion boreholes.

Table D2-2 Institutional Boreholes within Isiolo

Owner	Depth (m)	WRL (m)		Yield (m ³ /hr)
		Static	Dynamic	
Isiolo Barracks	54.9	37.5	28.5	4.7
Veterinary Dept.	97.4	50	34.4	10.9
Isiolo Airstrip	184	46.6	18	30
Ngare Mala	48	58	10.9	-
Isiolo District	-	-	-	-
Hospital	-	-	-	-

Source: DWO

2.2.3 Chogoria

The survey of community based water supply systems in Chogoria identified 4 number of schemes.

2.2.4 Maua

The water schemes covered in Maua are generally located in the North and South of Maua town. Some schemes have had a slow implementation tempo due to funding limitation. The oldest schemes are Maua Methodist Hospital and Mboone Water Schemes which were commissioned in 1940s and 1977 respectively. Only a few of the projects were solely financed by the local community. The majority have had assistance from the local Non-Government Organization – ‘Plan International.’ Maua Methodist Hospital water supply was funded by the church. The majority of the schemes have the sources in streams within Nyambene forest.

2.2.5 Tigania

There are more than 13 community water projects in Tigania, the source of which is either a stream or spring with the catchment in Nyambene forest. There are a few special cases where the community is allowed to tap their water supply from a MLRRWD pipeline. However, in such cases the individual connection households pay a flat monthly levy to the MLRRWD.

Several projects in the area have wholly been constructed by the Catholic Diocese of Meru. The schemes mainly supply water through designated communal standpipes. The community forms committee for every communal water point through which the Catholic Diocese receives the monies collected. The community committee takes responsibility of its watering point.

3. WATER QUALITY ANALYSIS

3.1 Selected Community Water Supply Schemes

In order to assess the quality of water abstracted and supplied by the representative community water supply schemes, water sampling and testing were carried out during dry

season (February 1996). The selected community water supplies are 18 in Meru, two in Tigania and one in Maua. The schemes in Tigania and Maua are operated by NGOs, while all schemes in Meru are by communities and/or institution (factories).

The sampling points were at the intake site and at a house connection tap of the community water supply scheme.

3.2 Sampling Methodology

One litre plastic sample bottles were rinsed with the river water at the sampling site and filled with water sample, then closed tight to exclude spill.

The bacteriological water sample was collected in a 250ml sterilized bottle which was closed tight. Both 1 litre and 250ml bottles were stored and transported in low-heat exchange cool boxes.

3.3 Quality Test Analysis

Laboratory analysis of all samples collected was carried out at Nairobi. Water quality standards in Kenya are based on WHO Guidelines for Drinking Water. Therefore the comments on the analytical results refers to the WHO guidelines, which are summarised in *Tables D3-1* (Meru) and *D3-2* (Maua and Tigania). Analytical results are given in Attachment - 1.

Table D3-1 Comments on Water Quality Analytical Results in Meru

Community Water Supply Scheme	Sample source	Comments on Water Quality Result
1. Thura Giaki River	1. Intake on Kathita	Clear fresh neutral soft water with minimal organic pollution requiring treatment to meet WHO guidelines for drinking water. The intake and the tap water are grossly contaminated with both faecal and non-faecal coliform bacteria.
	2. Mr. Paulo Mbooki Home Stand pipe	
2. Muguna Egoki Nkabune	1. Intake on Kathita River	The intake and tap water have very similar characteristics. The water is clear, fresh neutral and soft with minimal organic pollution. The water is contaminated with both faecal and non-faecal coliforms.
	2. Mr Mworja's Plot pipe in Katimbini area	
3. Ruwogone	1. Intake on Ngaciuma River	Ngaciuma river water is clear, neutral and soft - with minimal organic pollution. The tap water has similar characteristics both. Both sources are grossly contaminated with faecal coliform and require treatment before consumption. Chlorination is recommended
	2. Mrs. Florence makena Home Stead pipe	
4. Nkugua	1. Intake on Kathuita river	Kathita river water at the water supply source was clear, fresh neutral with minimal organic pollution. Tap water had similar characteristics. Both sources were grossly contaminated with faecal and non-faecal coliform. The water requires chlorination
	2. Mr Francis Ngera homestead pipe	
5. ASK Water Supply	1. Source at Upper Gatabora Springs	Gatabora spring water is clear, neutral and soft. Tap water at Mr. Njagi's home has similar characteristics. both the spring water and tap water are contaminated with faecal and non-faecal coliform bacteria. Chlorination is essential before drinking.
	2. Mr. Nagi's Home stand pipe	
6. Magundu	1. Intake on Kathita River	The river water is clear, neutral and soft with slight organic pollution. The tap water has almost similar physico-chemical characteristics. River water is contaminated with both faecal and non-faecal coliform and requires treatment. Chlorination is recommended as essential treatment process.
	2. Mr. Andrea Ngate Home yard standing pipe	

7. Mwiteria Kithiu	1. Kathita river source near DEB Primary School	The Kathita river water is neutral, soft and fresh with slightly organic contamination. The tap water has similar characteristics.
	2. Mr. Samson Kirimania plot pipe in kioroni area	Sources are contaminated with faecal and non-faecal coliforms. The water requires to be chlorinated for disinfection.
8. Kongoacheke	1. Kitoro Stream	The spring water is neutral, soft, fresh and clear with no indication of organic pollution.
	2. Charity Marcte homeyard stand pipe	The tap water has similar characteristics and are contaminated with coliform bacteria. The source requires disinfection with chlorine.
9. Meru Teacher College Threesteers Hotel	1. Spring in Kinora area near	The spring water is neutral, soft and clear with minimal organic pollution. The tap water has similar characteristics with both
	2. Meru Teachers College stand pipe near workshop	samples contaminated with coliform bacteria. The water should be chlorinated.
10. Muguna Kithiu	1. Makutano Springs	The spring and tap water is neutral, soft and clear with only minimal organic pollution.
	2. Mrs paskwalina Kivuki Homestead pipe	The samples had coliform contamination but no indication of faecal coliform. Chlorination is however recommended.
11. Mutathankari (Women Group)	1. M'Mungania Springs	The spring water is slightly acidic, soft and clear with very slight organic pollution. the
	2. Mutathamkari Secondary School yard stand pipe	tap water has almost similar characteristics. Both sample are contaminated with coliform bacteria. The water should be chlorinated.
12. Consolata Sisters Primary School	1. Swamp Springs	The spring water is neutral, soft and clear with very slight organic pollution. The
	2. Consolata Sisters stand pipe	samples were contaminated with non-faecal coliform bacteria. Chlorination is recommended.
13. Kaaga Rural Training Centre (Kenya Methodist University Campus)	1. Kagwa Nkunguru Stream	The stream and tap water was neutral, soft and clear with only slight organic pollution.
	2. Pipe outside the Campus Kitchen	The water was contaminated with non-faecal coliform. Chlorination is recommended.
14. Meru Technical Training Institute Springs	1. Sump drain at Gitoro	The spring was in neutral, soft and clear with only slight organic pollution. The tap water
	2. Meru Technical Training Institute pipe	had similar characteristics. Both samples indicated gross faecal and non-faecal coliform contamination. Treatment with chlorination is recommended.
15 Kambakia	1. Upper Gatobara Springs	The spring water is neutral, clear soft with only slight organic pollution. The tap water
	2. Tenerikyo Children Clinic tap	had very similar characteristics. The samples had non-faecal coliform contamination Chlorination is recommended.

16. Gaitune Rutuntune	1. Channel in Swamp near St John Catholic Church	Neutral, clear water with slight organic pollution and coliform contamination. The tap water has similar characteristics. The source should be chlorinated.
	2. Mr. John Mugambi homestead in Gaitune area	
17. Nkirote (Gieto Wome Group) catholic Church	1. Springs near St. Johns	The spring water is neutral, clear and soft with only very slight organic pollution and non-faecal coliform contamination. The tap water has similar characteristics. Chlorination is recommended.
	2. Mrs Eidah Mbiro Nyaga's homestead tap	
18 Mwimenyi catholic Church	1. Springs near St. Johns	The spring water is neutral, clear and soft with only very slight organic pollution and both faecal and non-faecal coliform contamination. The tap water has similar characteristics. The source should be chlorinated.
	2. Mr. Erastus Mbabu Mugambis home yard stand pipe	

The water at the intakes of the community water supply systems that were sampled has satisfactorily physico-chemical quality with reference to WHO Guidelines for sources for drinking water.

However, the water is grossily contaminated with both non-faecal and faecal coliform bacteria which are also present at the consumer taps.

It is recommended that chlorination units be installed at the intake and/or service reservoirs to ensure disinfection of water before supply. A residue chlorine of at least 0.1ppm should be maintained at the supply tap.

Table D3-2 **Comments on Water Quality Analytical Results (Maua & Tigania)**

Community Water Supply Scheme	Sample source	Comments on Water Quality Result
1. Maua Methodist Hospital	Mboone River	Neutral and soft water with minimal organic pollution. The water is grossly contaminated with both faecal and nonfaecal coliforms. Fluoride content is low. Treatment including chlorination is recommended.
2. Kamberia Catholic Project	Katheru Springs	Neutral and moderately hard water with slight organic pollution and coliform contamination. Fluoride content is low. Treatment including chlorination is recommended.
3. Tigania Catholic Hospital	Community Standpipe	Neutral and moderately hard water with minimum organic pollution and coliform contamination. Fluoride content is low. Treatment including chlorination is recommended.

In the cases for Tigania Catholic Hospital and Kamberia Catholic Community water Schemes, the springs concrete protection and infiltration galleries are totally enclosed and are without outlet drain pipes. The only outlet from the springs are the supply delivery pipes. In these two water supplies schemes, no faecal coliform contamination was observed.

4 SOCIAL CONDITIONS

4.1 Background

The study area is endowed with many rivers, streams and springs, therefore access to safe water was not a problem 30 years ago (situation analysis 1992). But as a consequence of rapid population growth and poor environmental conservation practices, many of the hill tops and riverbeds have been cleared, which has resulted in the increase of soil erosion. This leads to drying of many rivers and remaining rivers become highly contaminated.

4.2 Community Participation

Community participation is well known in Meru, a spirit of self help already existed in the community and people have always worked in groups. Among the Meru, the clan elders play a key role in decision making. As elders, they are responsible for initiating community based projects.

In the case of community water supplies, the schemes were started in Meru immediately after independence. Most of the schemes were started to provide water for irrigation, most of the schemes are organized on clan basis while a few schemes were started as a result of difficulties caused by the topography of the area. On the other hand, Community water schemes in Tigania and Maua were initiated to ease problems associated with water for domestic use.

While the community water supplies in Meru were initiated by the local communities, most of the schemes in Tigania and Maua were initiated by the donors but with major funding from Non Governmental organizations such as Catholic diocese of Meru, Plan International, NCCCK, etc.

In order to support community effort, the government has provided social development assistants (CDAS) who work closely with the community and its leadership. CDAS do advise the communities on what activities to undertake. They also facilitate in the registration of community projects. In order to support community efforts existing social structure at the community does contribute materials and labour.

5 MAIN FINDINGS

The study found out that community water supplies play an important role in supplementing government efforts in provision of water. The coverage for community schemes is higher than government schemes, and in most cases there is an overlap of projects especially in Meru. Some of the projects are not registered, thus unknown to MLRRWD. This has been caused by various NGOs which have supported the initiation of these projects, they include Plan International, Catholic Diocese of Meru, NCCCK, Methodist church, etc.

- * Community water projects suffer from organizational and management deficiencies. All community water supplies are managed by water committees, whose membership range from 7-13 members. Most of the officials were men, registration with MOCSS had been done and all committees had operational bank accounts. One of the major problems is double membership, which is done so as to safeguard against water rationing which is commonly practiced in the study area. The occupation of those on the committee ranges from teachers, farmers and retired personnel.
- * All projects initiated by the local community do not charge for water, therefore

the schemes are not managed and operated effectively. They lack training in O/M and do not have any effective tariff structures. Funds are collected when the system breaks down. This leads to untimely maintenance operations resulting to wastage from unattended leakage. The projects thus lack funds for expansion and repairs and maintenance is not done in time. On the other hand, community water supplies operated by NGOs and the church mostly in Tigania and Maua charges for water.

- * Water is used for irrigation in Meru, while water is used for domestic purposes in Tigania and Maua. The irrigation in Meru has brought about misuse of water by farmers. In Tigania and Maua water is used for domestic purposes such as drinking, washing clothes and bathing.

Table D5-1 Type of Usage

Area	Type of Usage		
	Domestic	Irrigation	Institutional
Meru	30%	60%	10%
Maua	65%	10%	25%
Tigania	80%	10%	10%

Source Data collection from monitoring of Clup

- * Women are marginalised in the management of water supplies, except where the water project belongs to a women group. This is brought about by women's limited access to education and training and due to lack of appropriate technology to ease their workload at home.

Table D5-2 Women's Participation in CWS

Area	Committee Members	
	Men	Women
Meru	211	34
Maua	71	9
Tigania	-	10

Source: Data collection on CWS

Experience with community water supplies indicate that where women are active members on the water committee, they make special efforts in problem solving,

involving fee collection and financing of repairs. Most of them hold positions of treasurers.

- * Communities lack technical know how to design water schemes. Most of the schemes were designed by MLRRWD. Due to financial constraints and lack of technical know how, the committee alters the designs, ending up with undersized pipes, which result into low pressure experienced by the schemes.
- * Management of community water scheme lacks technical staff to supervise the construction. The committee hires local technicians to construct the schemes but does not hire consultants to supervise the works.
- * In most of the community water scheme, initial investment came from the community themselves through membership fees and harambee contributions. Some projects mainly in Tigania and Maua received Donor funding from Plan International, CARE, Catholic Diocese of Meru and the Methodist church as shown in the table below.

Table D5-3 Contribution

Area	No. of Scheme	Members' contribution	NGOs' contribution
Maua	8	3,000,020	11,000,490
Tigania	8	3,180,000	23,240,000
Meru	22	4,913,000	2,437,000

Source: Data from survey of CWS

- * Water quality is not seen as an important aspect when developing community water supplies. All water schemes do not treat the water, therefore there is need to introduce health education.
- * There was lack of willingness to get connected to MLRRWD water supply system. The main reason was that community water supply systems were set up to provide water for small scale irrigation. Amalgamation of the system with MLRRWD system will introduce regulation that dictate against irrigation (Meru). There also exist fear of loss of control when the MLRRWD is merged with the community water schemes. The community was willing to accept metres or any charges for water, if the management is left in the hands of the

beneficiary community.

TABLES

Table D2-1 Community Water Supply Schemes - Meru

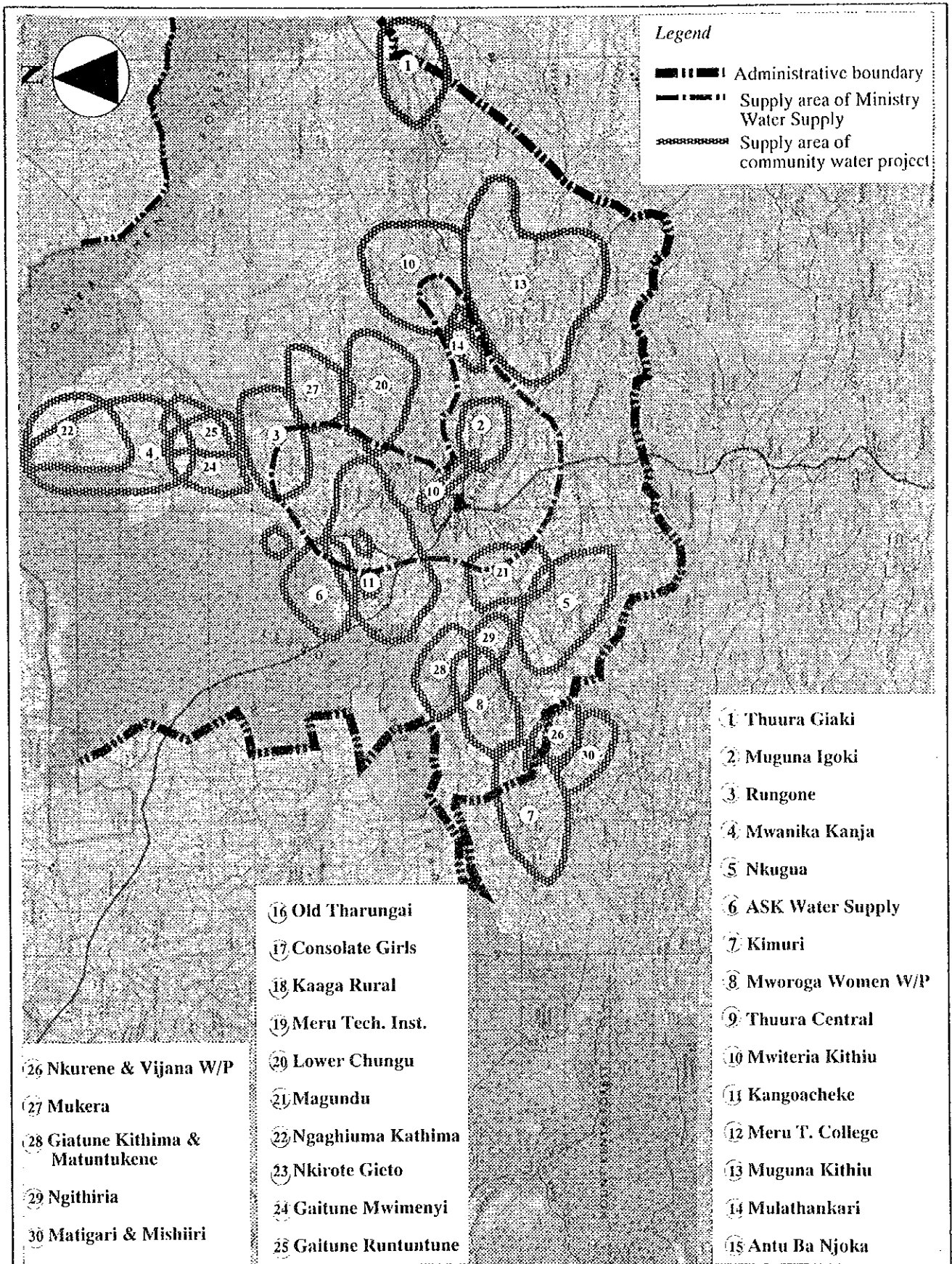
Name of Project	Water Source	Production (m ³ /day)	Supply area (km ²)	Water Consumption %			Households Served	Assistance from MLRRWD		Capital Investment	Year of Construction	Remarks (problems)
				(1)	(2)	(3)		Design	O & M Others			
1 Runogone	Gachiuma river	168	6.0	30	10	60	126	Yes	No	1.8 million	1973	-extension in 1995 -need to improve intake and tanks
2 Lower Chungu	Karumanthi stream	500	24.0	60	30	10	750	Yes	No	460,000	1979	-extension in 1995 but new source required -leadership problems
3 Gaitune Rutuntune	Gieto spring	250	5.0	40	0	60	250	Yes	No	200,000	1985	-frequent pipe burst -improper intake
4 Gaitune Mwimanyi	Gieto spring	34	2.5	70	0	30	60	Yes	No	114,000	1987	-constructed tanks in 1989 -dried up intake and low water pressure
5 Nkirote-Gieto Women Project	Gieto spring	28	2.0	100	0	0	70	Yes	No	100,000	1988	-over exploited intake -weak management
6 Koiro - Ciomburu	Kloru Spring	24	1.0	100	0	0	60	No	No	40,000	1992	-inadequate system -no fund source to expand
7 Nkuguu	Kathita river	667	5.0	30	10	60	500	Yes	No	518,000	1974	-need of new intake and tanks -water wastage
8 Magundu	Kathita river	400	10.0	30	20	50	300	Yes	Yes	250,000	1976	-lack of management -weak pipelines and frequent water shortage
9 Gaitune Kithima	M'mkindia spring	160	2.5	30	0	70	120	Yes	No	410,000	1996	-overlapped supply area and double membership -lack of storage facilities
10 Ngithiri	Tributary Kathita	93	2.0	30	10	60	70	Yes	No	70,000	1980	-improper pipe reticulation -lack of storage due to fail in fund raising
11 Mutianthankari Women Project	M'mkindia spring	46	8.0	70	10	20	80	Yes	Yes	267,000	1965	-handed over to women group in 1991 -interference by men -facilities ignored design
12 Thura Giaki	Kathita river	302	20.0	100	0	0	756	Yes	No	400,000	1980	-wangled leadership -poor implementation
13 Nkurene	Muirane stream	53	2.0	30	0	70	40	Yes	No	150,000	1972	-insufficient intake and pipes -weak leadership and double membership
14 Vijana	Nkurune stream	32	0.5	10	0	90	8	No	No	30,000	1992	-no design -shortage of fund
15 Matigari	Kathita Muryui	54	2.0	20	0	80	27	Yes	No	30,000	1987	-limited intake capacity -lack of fund and proper management
16 Karimainga	Koiga spring	137	6.0	70	0	30	240	Yes	No	300,000	1992	-works not consistent with design -doubtful management
17 Mukera	Mukera spring	40	3.0	80	0	20	80	Yes	No	140,000	1987	-low spring yield -facilities ignored design -doubtful committee ability
18 Memeo	Ngachiuma river	160	12.0	90	10	0	360	Yes	Yes	100,000	1964	-weak management -works not consistent with design
19 Ngachiuma Kathima	Ngachiuma river	-	3.0	Under implementation			120	Yes	N/A	1.04 million	1995	-under implementation
20 Mwanika Kanja	tributary Nvachima	-	4.0	Under implementation			200	Yes	N/A	257,000	1996	-under implementation
Total		3,149	120.5				4,217					6,676,000

Note:

1) Domestic, (2) Institutional and (3) agricultural water consumption

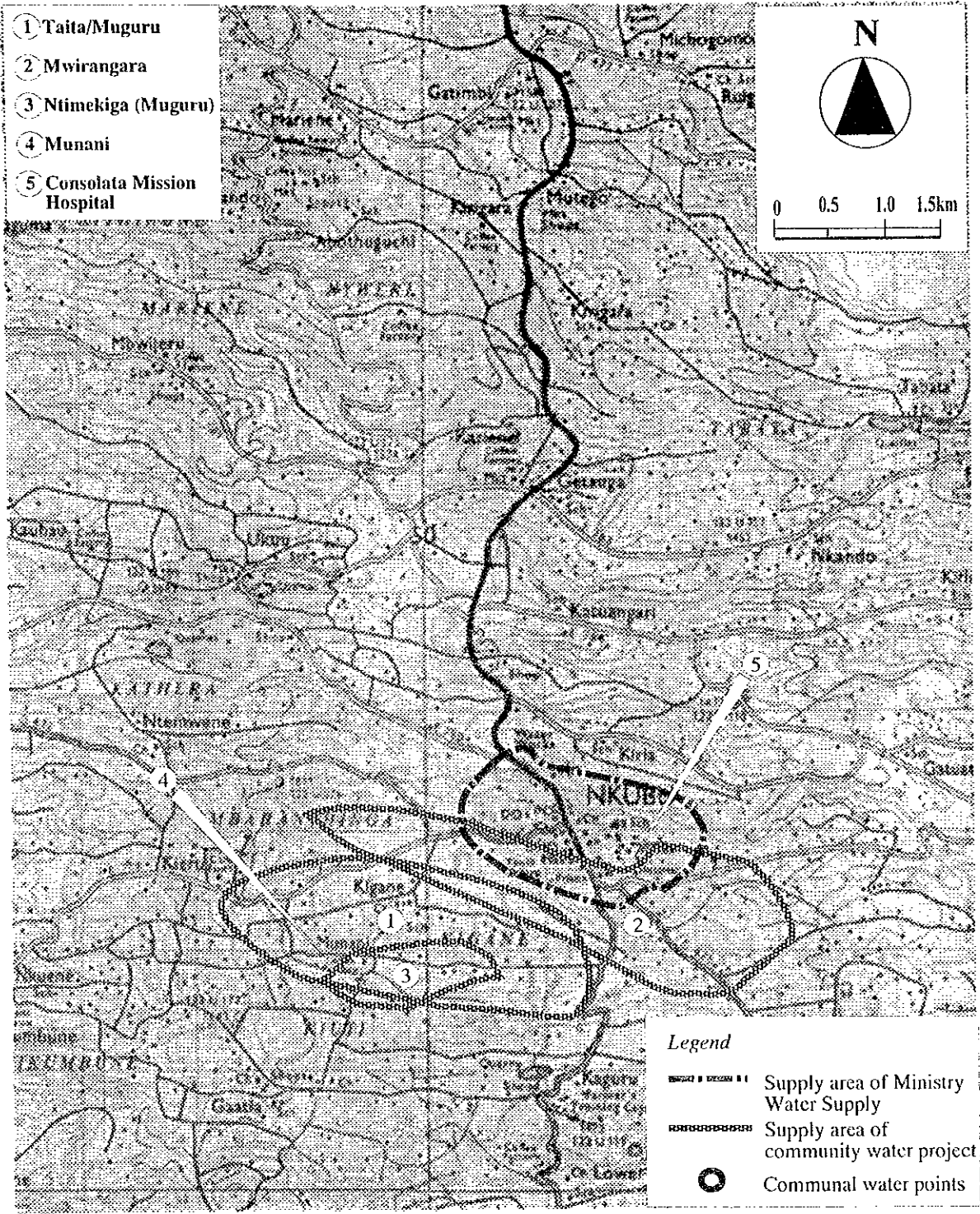
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FIGURES



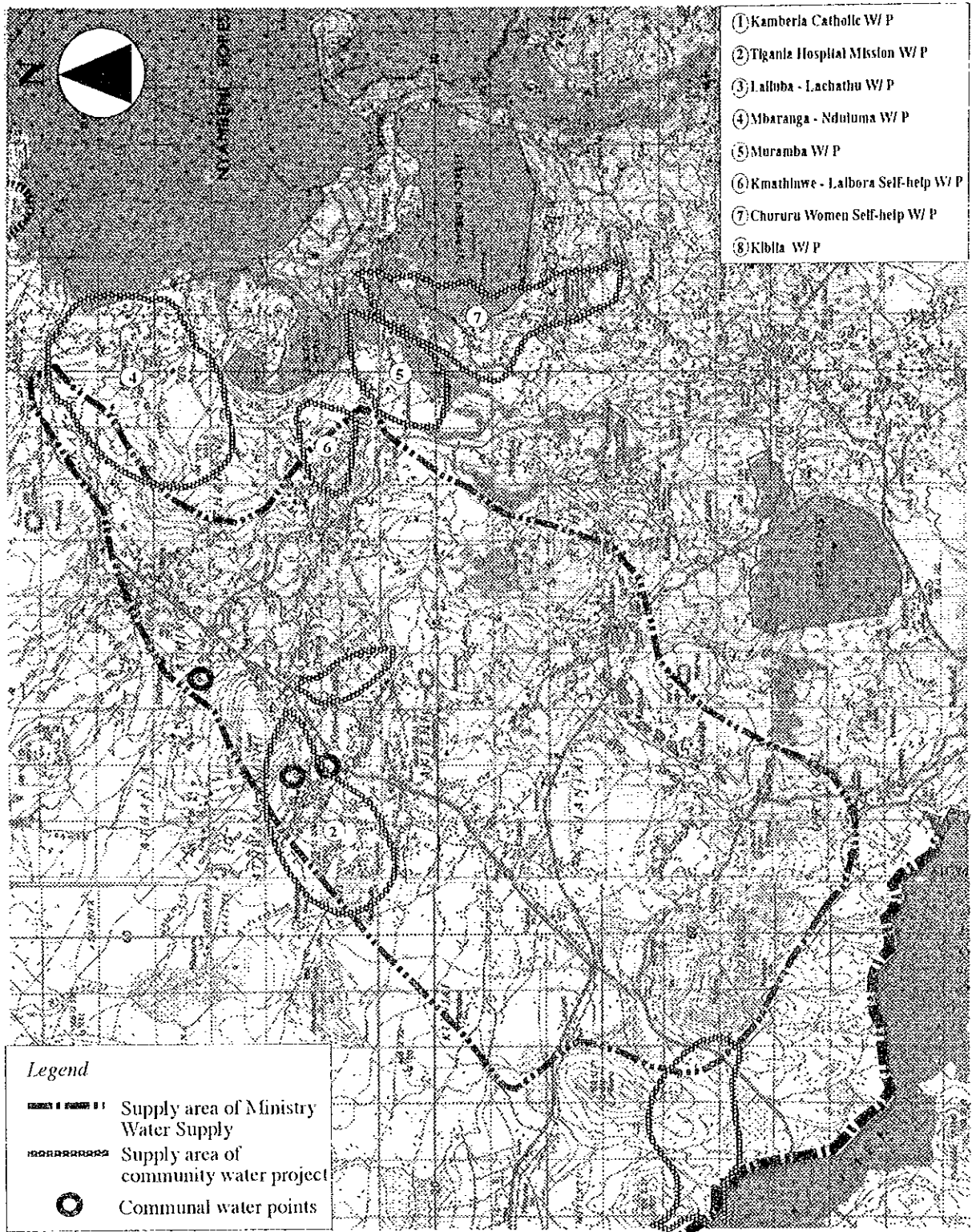
THE STUDY ON
 THE WATER SUPPLY FOR SEVEN TOWNS
 IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA
 JAPAN INTERNATIONAL COOPERATION AGENCY

Figure D2-1
 Supply Area of Ministry and
 Community W/S, Meru



THE STUDY ON
 THE WATER SUPPLY FOR SEVEN TOWNS
 IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA
 JAPAN INTERNATIONAL COOPERATION AGENCY

Figure D2-2
 Supply Area of Ministry
 and Community W/S, Nkubu



Legend

--- Supply area of Ministry Water Supply

..... Supply area of community water project

○ Communal water points

- ① Kamberia Catholic W/P
- ② Tiganza Hospital Mission W/P
- ③ Lalluba - Lachathu W/P
- ④ Mbaranga - Nduluma W/P
- ⑤ Muramba W/P
- ⑥ Kmathluwe - Lalbora Self-help W/P
- ⑦ Chururu Women Self-help W/P
- ⑧ Kiblla W/P

THE STUDY ON
 THE WATER SUPPLY FOR SEVEN TOWNS
 IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA
 JAPAN INTERNATIONAL COOPERATION AGENCY

Figure D2-5
 Supply Area of Ministry and
 Community W/S, Tignia

ATTACHMENT

Results of Water Quality Analysis (1)

Parameter	Unit	Thura Giaki CWSS		Muguna Igoki CWSS		Runogone CWSS		Nkugua CWSS	
		Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap
Date Sampled		21/Feb/97	21/Feb/97	21/Feb/97	21/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97
pH		7.89	7.79	7.78	7.78	7.92	7.98	7.92	7.95
Apparent Colour	degree	<5	<5	<5	<5	<5	<5	<5	<5
True Colour	degree	<5	<5	<5	<5	<5	<5	<5	<5
Conductivity	µmho/cm	126	113	99	100	110	199	102	103
Turbidity	FTU	1.5	1.5	1.0	1.1	2.1	2.5	0.6	0.7
Calcium Hardness	mg/l	2	2	4	2	6	6	4	4
Total Hardness	mg/l	10	10	24	14	32	30	18	14
Total Alkalinity	mg/l	54	53	83	65	96	52	53	73
Carbonate Alkalinity	mg/l	0	0	0	0	0	0	0	0
Iron	mg/l	0.02	0.02	0.04	0.03	0.01	0.01	0.03	0.03
Fluorides	mg/l	0.35	0.35	0.37	0.38	0.41	0.41	0.62	0.60
Sulphates	mg/l	57	58	66	70	84	85	44	46
Phosphates	mg/l	0.04	0.03	0.00	0.00	0.02	0.02	0.01	0.01
Silica	mg/l	66	60	71	70	44	44	35	30
DO	ppm	5.7	5.4	6	6	5.9	5.6	6	5.8
Nitrates	mg/l	0.01	0	0.02	0.02	0	0	0.01	0.01
Manganese	mg/l	0	0	0	0	0	0	0	0
Chlorides	mg/l	22	26	20	21	23	25	25	19
Chromium	mg/l	0.02	0.01	0.01	0.02	0.02	0.01	0.03	0.01
Copper	mg/l	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00
Total Coliform	/100ml	180	150	80	80	80	78	92	60
Total Faecal Coliform	/100ml	40	38	22	20	18	12	10	5
Dissolved Solids	mg/l	142	197	220	205	224	181	132	149
Suspended Solids	mg/l	5	0	0	0	15	0	0	0
Total Solids	mg/l	147	197	220	205	239	181	132	149
BOD	mg/l	0	0	2	0	2	2	2	2
COD	mg/l	4	4	6	4	8	8	6	6

Source: JICA Study Team, 1997

Results of Water Quality Analysis (2)

Parameter	ASK CWSS		Magundu CWSS		Mwiteria Kithiu CWSS		Kongoacheke CWSS		Meru Teachers CW	
	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap
Date Sampled	19/Feb/97	19/Feb/97	20/Feb/97	20/Feb/97	21/Feb/97	21/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97
pH	6.92	7.03	7.75	7.81	7.81	7.79	6.47	6.52	6.72	6.65
Apparent Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
True Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Conductivity	149	149	99	99	100	101	222	204	210	210
Turbidity	0.4	0.4	0.7	0.8	1.0	0.9	0.9	0.2	0.2	0.2
Calcium Hardness	6	6	6	4	4	4	8	8	8	8
Total Hardness	26	28	22	16	16	12	36	36	34	38
Total Alkalinity	73	73	47	47	47	51	85	88	97	96
Carbonate Alkalinity	0	0	0	0	0	0	0	0	0	0
Iron	0.04	0.01	0.03	0.03	0.02	0.02	0.01	0.00	0.02	0.02
Fluorides	0.25	0.26	0.51	0.50	0.71	0.74	0.33	0.30	0.28	0.31
Sulphates	33	34	56	58	49	44	27	30	33	30
Phosphates	0.03	0.02	0.05	0.05	0.00	0.00	0.03	0.03	0.02	0.02
Silica	88	86	71	71	62	62	27	25	37	36
DO	5.1	5.2	6.2	6	5.9	6	5.3	5.1	5.6	5.5
Nitrates	0.02	0.02	0.03	0.03	0.01	0	0.04	0.03	0.02	0.02
Manganese	0	0	0	0	0	0	0	0	0	0
Chlorides	25	30	23	26	22	32	16	27	38	21
Chromium	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02
Copper	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.01
Total Coliform	72	96	110	64	86	140	212	172	88	114
Total Faecal Coliform	10	7	15	0	6	15	5	0	0	8
Dissolved Solids	197	134	126	131	158	127	155	170	205	183
Suspended Solids	0	0	0	0	0	0	0	0	0	0
Total Solids	197	134	126	131	158	127	155	170	205	183
BOD	0	2	2	2	2	0	0	0	2	2
COD	4	4	6	6	8	6	6	6	6	6

Source: JICA Study Team, 1997

Results of Water Quality Analysis (3)

Parameter	Muguna Kiithu CWSS		Muladhankari Women		Consolata Sis. & School		Kaaga Rural Training		Meru Technical	
	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap
Date Sampled	22/Feb/97	22/Feb/97	21/Feb/97	21/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97	20/Feb/97	19/Feb/97	19/Feb/97
pH	7.08	7.72	6.08	6.45	6.36	6.93	7.76	7.78	6.48	6.59
Apparent Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
True Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Conductivity	191	175	200	202	235	207	214	757	204	206
Turbidity	0.2	0.4	2.2	0.3	0.2	0.3	0.4	1.5	2.0	0.2
Calcium Hardness	6	6	14	8	6	10	10	12	10	8
Total Hardness	32	32	76	38	32	40	42	72	44	38
Total Alkalinity	91	87	52	55	88	90	93	372	90	94
Carbonate Alkalinity	0	0	0	0	0	0	0	0	0	0
Iron	0.02	0.02	0.00	0.03	0.03	0.01	0.01	0.02	0.03	0.04
Fluorides	0.29	2.30	0.84	0.80	0.11	0.10	0.35	0.35	0.27	0.29
Sulphates	47	46	28	30	33	33	49	50	66	68
Phosphates	1.04	0.04	0.07	0.05	0.00	0.00	0.01	0.00	0.04	0.04
Silica	42	40	37	37	40	40	61	61	49	49
DO	6.1	6	5.2	5	5.8	5.5	5.3	5	5.5	5.4
Nitrates	0	0	0.01	0.01	0	0	0.02	0.02	0.01	0.01
Manganese	0	0	0	0	0	0	0	0	0	0
Chlorides	30	30	45	49	40	35	30	30	30	32
Chromium	0.02	0.01	0.01	0.02	0.02	0.01	0.03	0.03	0.02	0.01
Copper	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.01	0.00
Total Coliform	46	48	240	52	30	18	115	28	56	210
Total Faecal Coliform	0	0	15	0	0	0	0	0	5	5
Dissolved Solids	180	163	141	134	121	118	172	170	205	202
Suspended Solids	5	5	0	0	0	0	70	50	0	0
Total Solids	185	168	141	134	121	118	242	220	205	202
BOD	2	2	0	0	0	0	4	4	2	2
COD	8	6	4	4	4	8	8	8	6	6

Source: JICA Study Team, 1997

Results of Water Quality Analysis (4)

Parameter	Nkirote Giceto Women		Gaitune Rut. CWSS		Kambakia CWSS		Mwimwenyi CWSS		Kamberia Cath	
	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Tap	Intake	Spring
Date Sampled	19/Feb/97	19/Feb/97	21/Feb/97	21/Feb/97	19/Feb/97	19/Feb/97	21/Feb/97	21/Feb/97	21/Feb/97	28/Mar/97
pH	6.61	6.62	7.54	7.56	6.70	6.90	6.74	6.94	6.94	7.35
Apparent Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
True Colour	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Conductivity	346	341	338	341	182	188	347	343	343	310
Turbidity	0.3	0.2	1.8	0.4	0.3	0.2	0.2	0.3	0.3	0.3
Calcium Hardness	8	8	8	10	6	6	8	8	8	14
Total Hardness	56	58	52	60	30	34	60	58	60	100
Total Alkalinity	146	49	156	152	94	90	150	145	150	226
Carbonate Alkalinity	0	0	0	0	0	0	0	0	0	0
Iron	0.03	0.02	0.01	0.03	0.03	0.02	0.04	0.05	0.04	0.02
Fluorides	0.33	0.37	0.36	0.34	0.41	0.40	0.18	0.20	0.18	0.31
Sulphates	64	59	35	33	80	82	38	37	38	38
Phosphates	0.02	0.02	0.03	0.03	0.02	0.01	0.05	0.03	0.05	0.01
Silica	62	52	94	90	22	20	66	60	66	44
DO	6	6	5.6	5.3	6.1	5.9	5.4	5.2	5.4	5.7
Nitrates	0.02	0.01	0	0.02	0.01	0	0.03	0.02	0.03	0.02
Manganese	0	0	0	0	0	0	0	0	0	0
Chlorides	39	37	32	32	26	26	39	35	39	25
Chromium	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.00
Copper	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00
Total Coliform	46	50	114	48	172	88	240	135	240	0
Total Faecal Coliform	0	0	8	0	0	0	15	10	15	0
Dissolved Solids	269	260	298	292	215	210	254	247	254	310
Suspended Solids	0	0	5	0	0	5	5	0	5	5
Total Solids	269	260	303	292	215	215	259	247	259	315
BOD	0	0	4	2	2	2	0	0	0	0
COD	4	5	14	4	6	14	4	4	4	4

Source: JICA Study Team, 1997

Results of Water Quality Analysis (5)

Parameter	Tigania Hosp.		Maui Methodist Hospital	
	Standpipe	Intake	Standpipe	Tap
Date Sampled	28/Mar/97	28/Mar/97	28/Mar/97	28/Mar/97
pH	7.37	7.87	7.99	7.99
Apparent Colour	<5	<5	<5	<5
True Colour	<5	<5	<5	<5
Conductivity	187	61	60	60
Turbidity	1.0	1.0	1.2	1.2
Calcium Hardness	10	4	4	4
Total Hardness	52	28	26	26
Total Alkalinity	140	56	60	60
Carbonate Alkalinity	0	0	0	0
Iron	0.02	0.02	0.02	0.02
Fluorides	0.30	0.28	0.28	0.28
Sulphates	38	36	37	37
Phosphates	0.01	0.00	0.01	0.01
Silica	46	52	52	52
DO	5.6	5.9	5.6	5.6
Nitrates	0.01	0.01	0.01	0.01
Manganese	0	0	0	0
Chlorides	17	22	15	15
Chromium	0.01	0.00	0.00	0.00
Copper	0.00	0.01	0.01	0.01
Total Coliform	90	195	300	300
Total Faecal Coliform	0	20	40	40
Dissolved Solids	230	180	160	160
Suspended Solids	5	15	15	15
Total Solids	235	195	175	175
BOD	0	0	0	0
COD	2	4	4	4

Source: JICA Study Team, 1997

