

JAPANESE INTERNATIONAL COOPERATION AGENCY (JICA)

ARUSHA REGIONAL DEVELOPMENT PROJECT

WATER SUPPLY PROJECT

THE FEASIBILITY STUDY
ON
MONDULI TOWN
AND
THE SURROUNDING AREA WATER SUPPLY
IN
ARUSHA REGION

FINAL REPORT

MAIN REPORT

MARCH 1985

GAMAU & MUNDI CONSULTANTS
JAPANESE ENGINEERING CONSULTANTS CO., LTD.

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ARUSHA REGIONAL DEVELOPMENT DIRECTORATE
THE UNITED REPUBLIC OF TANZANIA

**THE FEASIBILITY STUDY
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MONDULI TOWN
AND
THE SURROUNDING AREA WATER SUPPLY
IN
ARUSHA REGION**

FINAL REPORT

MAIN REPORT

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Tsh = Tanzania Shilling

PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a feasibility study on Monduli Town and the Surrounding Area Water Supply in Arusha Region and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team headed by Mr. Kunio Ota, Sanyu Consultants Inc., and composed of staff members of Sanyu Consultants Inc. and Japan Engineering Consultants Co., Ltd., three times between November, 1994 and February, 1996.

The team held discussions with the officials concerned of the Government of Tanzania, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.



Kimio Fujita
President

Japan International Cooperation Agency

March, 1996



March, 1996

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

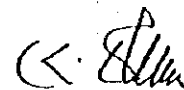
We are pleased to submit to you the feasibility report on the Monduli Town and the Surrounding Area Water Supply in Arusha Region of the United Republic of Tanzania. The report, during the course of the above-mentioned project formulation, has been given due consideration to the advice and suggestions of the authorities concerned of the Government of Japan and your Agency, and to the comments made by the Arusha Regional Development Directorate during technical discussions on the draft final report which were held in Tanzania.

The present production of groundwater could satisfy only 32 percent of the water demand to meet the minimum drinking water of 10 liters per capita per day recommended, for rural water supplies, by WHIO. The proposed projects envisage to meet the water demand for domestic use of 30 liters per capita per day, by the construction of boreholes for Monduli town and small-scale dams for the surrounding area where groundwater is not available.

The primary objective of the proposed projects is designed to supply safe and clean water for the rural people, in accordance with the National Water Policy Directive, 1991. The proposed Monduli Water Supply Project should be recognized as urgent and one of the top priority projects. Development of water resources is not only urgent but also crucial to Monduli town, the development center of the District.

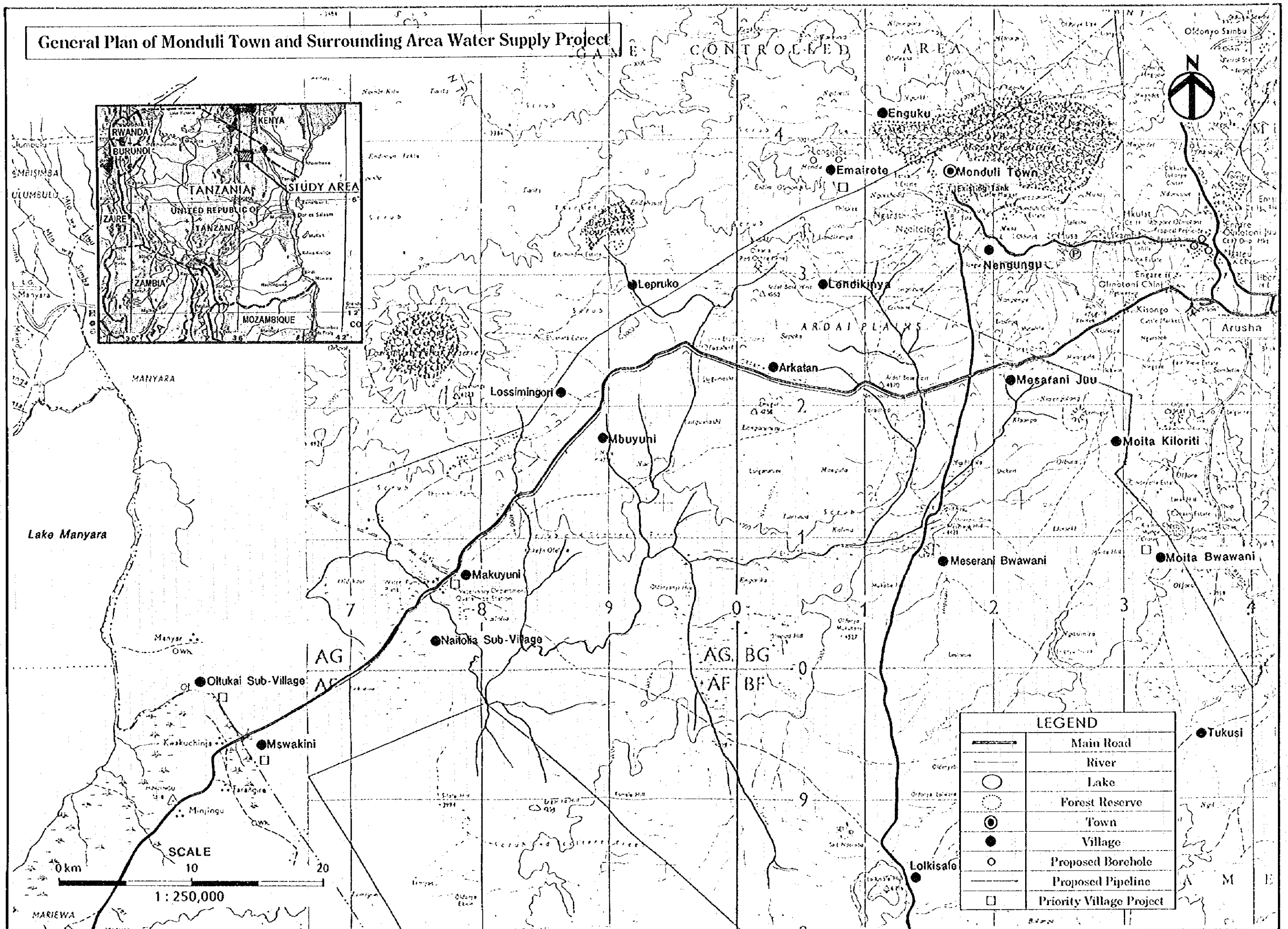
We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs of the Government of Japan. We also wish to express our deep gratitude to the Arusha Regional Development Directorate, the Ministry of Water, Energy and Minerals and other authorities concerned of the Government of the United Republic of Tanzania for the close cooperation and assistance extended to us during our studies.

Very truly yours,



Kunio Ota
Leader of the Study Team

General Plan of Monduli Town and Surrounding Area Water Supply Project



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ABBREVIATIONS AND UNITS

Abbreviations

ARMWP	Arusha Region Water Master Plan
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DWD	District Water Department, Monduli
DWP	Domestic Water Point
EC	Electric Conductivity
EIA	Environmental Impact Assessment
FRP	Fiberglass Reinforced Pipe
GDP	Gross Domestic Product
GS	Galvanized Steel
JICA	Japan International Cooperation Agency
kW	Kilowatt
mamsl	Meter above mean sea level
mbgs	Meter above mean sea level
MCE	Monduli College of Education
MCM	Million Cubic Meter
MTNRE	Ministry of Tourism, Natural Resources and Environment
MWEM	Ministry of Water, Energy and Minerals
NGO	Non Governmental Organization
RDD	Regional Development Directorate, Arusha
RWD	Regional Water Department, Arusha
SWL	Regional Water Department, Arusha
TDS	Total Dissolved Solid
TMA	Tanzania Military Academy
Tsh	Tanzania Shilling
UNDP	United Nations Development Program
UNICEF	United nations Childre's Fund

Units

mm	Millimeter
cm	Centimeter
m	Meter
km	Kilometer
m ²	Square meter
km ²	Square kilometer
ℓ	Liter
m ³	Cubic meter
min.	Minute
hr	Hour
ℓ/min.	Liter per minute
m ³ /hr	Cubic meter per hour
m ³ /day	Cubic meter per day
%	Per cent



SUMMARY AND RECOMMENDATION

1 INTRODUCTION

1-1 Background of the Study

The Government of the United Republic of Tanzania (the Government of Tanzania) is making every endeavor to establish water master plans for regions throughout the country to provide safe drinking water. Monduli district, the second largest district in Arusha region, and its surrounding areas are confronted with serious water shortage problems. The rains in these areas have only a short spell of about four (4) months a year, and springs and the some boreholes are the only available water sources in the dry season.

In accordance with the Scope of Works agreed upon on March 21, 1994 between the Government of Japan represented by Japan International Cooperation Agency (JICA) and the Government of Tanzania represented by Arusha Regional Development Directorate (RDD), JICA commenced the Feasibility Study on Monduli Town and the Surrounding Area Water Supply in Arusha Region (Study) in November, 1994. The feasibility study team (Study Team) is organized by Sanyu Consultants Inc. and Japan Engineering Consultants Co. Ltd.

1-2 National Water Policy

Tanzania's national water policy was formulated in 1991 with the primary objective of making clean and safe water available to all households, urban and rural, within a distance of 400 meters from their households by the year 2002. For rural water supplies, instead of house connection, water will be collected from domestic water points which each serve 200 to 250 people. Water management shall be left to the local people themselves. Cost recovery is emphasized in water management. With the exception of initial cost investment for the water projects, operation and maintenance costs must be recovered.

1-3 Arusha Regional Water Master Plan

Preparation of the Arusha Region Water Master Plan started in 1990 under the United Nations Development Program. The draft report was published in October, 1994. According to the draft report, the study of water resources in Arusha region did not cover all districts completely because some additional surveys, especially for engineering estimates of water supply schemes, are considered necessary.

2 GENERAL DESCRIPTION OF THE STUDY AREA

2-1 Location

The Study Area covers Monduli town, the capital of Monduli district, and its surrounding areas. Monduli district stretches west of Arusha municipality bordering on the Republic of Kenya in the north, Kilimanjaro region in the north east, and Mbulu and Ngorongoro district in the west.

The Study Area with land area of around 2,900 square kilometers occupies about 20 percent of Monduli district which is predominantly inhabited by the Masais who move from one place to another in search of water and pasture land for their animals.

2-2 Administrative Setup

The Study Area administratively consists of Monduli town which is composed of two villages, and 18 villages/Sub-villages in seven (7) wards, as given below:

Villages Selected for the Study			
Ward	Village/Sub-Village	Ward	Village/Sub-Village
Engutoto	Monduli Town	Sepeko	Meserani Bwawani
Monduli Juu	Enguik		Lolkisare
	Emairete		Tukusi
Sepeko	Lendikinya	Makuyuni	Makuyuni
	Arkatan		Naitolia Sub-Village
	Lossimingori		Mbuyuni
	Lepruko		Mswakini
	Meserani Juu	Mt wa Mbu	Oltukai Sub-Village
	Moita Kiloriti	Musa	Nengungu
	Moita Bwawani		

Each village has a village council known as the village government comprising of 25 members. Also, there is a village executive officer appointed by the district executive director to carry out the administrative tasks on behalf of the village government.

2-3 Population

The total population in 1992 was 61,096 according to the database for the study of Arusha Region Water Master Plan (ARWMP), based on which the population in 1994 was estimated at 65,428. The mean annual population growth rates on a village basis are calculated for ARWMP based on the 1988 population census and village population in 1992. The mean annual population growth rate is 3.48 percent over the Study Area.

Population			
Item	Monduli Town	18 Villages	Total
Population in 1992	17,067	44,029	61,096
Population in 1994	18,210	47,218	65,428
Annual Growth Rate(%)	3.30	3.66	3.48

The Study Area with the land area of 2,878 square kilometers had a population of 65,428 distributed among 12,489 households in 1994. The village population size ranges from 4,863 in Makuyuni to 1,541 in Tukusi. The settlement pattern of the Study Area where the Masai are a dominant ethnic group is characterized by its low population densities as given below:

Population Density and Average Family Members		
Item	Population Density (person/km ²)	Average Member of Family
Monduli Town	607	6.4
18 Villages	17	4.9
Overall	23	5.2

2-4 Rural Economy

2-4-1 Economic Activities

The Study Area is predominantly agricultural. Traditionally most of the people are dependent on livestock keeping and agriculture. The livestock sector contributes 66 percent of the regional Gross Domestic Production (GDP) and the agriculture sectors 25 percent.

(Livestock)

More than 86 percent of the population in the District are indigeous Masai pastoralist. Major livestock raised by the people are cattle, goats, sheep and donkeys as follows:

Major Livestock in 1994

Cattle	Goats	Sheep	Donkeys
76,086	74,038	33,223	3,245

The Masai, known as livestock keepers, have been forced to move from good agriculture land to arid or semi-arid areas by the farmers. The harsh climate in semi-arid areas make the Masai are nomadic so that they move from one place to another with their livestock. The animals are overstocked. At present, the Masai are slowly changing toward mixing farming with livestock production.

(Agriculture)

The average farmer cultivates land of between five (5) and ten (10) acres with an average of seven (7) acres, or 2.8 hectares. Main crops are maize, beans, wheat and rice. Agricultural production has steadily increased in recent year; but the productivity in terms of yield per hectare has fluctuated as farming is practiced under rain-fed conditions.

2-4-2 Household Economy

According to the preliminary survey on household income made by the Study Team, the monthly household income ranges from Tanzania Shilling (Tsh) 10,000 to 50,000. The average monthly household income is estimated at Tsh 30,300 in 1995 based on the average rural household income of Tsh 27,482 learnt from the national household economy survey conducted in 1991/1992.

2-5 Socio-Culture

The major ethnic groups in Monduli district are the Masai and Waarusha, who to a large extent are pastoralists though they are now practising agriculture. The major religious groups are Roman Catholic, Lutherans and Pagans. These groups are found almost in every village in the Study Area.

The Masai community has a well-knit hierarchical system which vests power to each group in the society and no group can encroach into another's domain. For example, the junior youths ("Morans") are regarded as the defence squad. They are in charge of all property in the village and in times of war or conflict, they have to be in the frontline. They also take charge of the livestock during seasonal migration. The uncircumcised youths look after calves, goats and sheep. They also herd cattle if they are not taken too far from the homesteads.

Men are overall in charge in the family but the overall responsibility of maintaining the family in terms of food provision, caring for the children and building houses is taken by women (wives). Men and women are supposed to sit together in community meetings although generally those meetings are attended by males only. Women have been designated to an inferior status leaving them helpless in terms of decision-making.

2-6 Public Health and Sanitary Education

2-6-1 Health Services and Diseases

In the Study Area, there are one (1) hospital in Monduli town and 12 dispensaries; three (3) in the Town and nine (9) in the surrounding areas. About 48 percent of villagers go to dispensaries and 24 percent to the Traditional Birth Attendant. Villagers who go to hospitals amount to only one (1) percent. Major diseases are malaria, diarrhoea and dysentery, eye disease, skin disease, worms, sexually transmitted diseases, tuberculosis (TB), typhoid and measles. Life expectancy is 55 years, and infant mortality is 75/1,000. Maternal mortality is as high as 1,345/100,000.

2-6-2 Sanitary Education

The Region has attempted to complement health education and a hygiene training program currently being conducted by introducing other programs such as Health Sanitation and Water, and Child Survival, Protection and Development. The programs operate through networking with other organizations and departments addressing the same related sectors such as health, water and community development. It is only in the recent past that subjects known as health education were introduced in schools. The contents of the subject are designed by the Ministry of Health; but most teaching is done by primary school teachers.

With respect to sanitary education for primary schools, seminars for teachers and education trials for pupils were carried out at the selected three (3) primary schools with the education manuals and learning materials prepared by the Study Team. Teachers were asked to evaluate the teachers' sessions as well as pupils trials. Pupils were requested to give written comments on what they would do next in order to meet the objectives of the trials. The exercise was well done and there are great hopes that the sanitary education program which is being designed will be well received by the schools.

2-7 Water Supply and Sanitation

2-7-1 Water Supply

Water Sources

The water sources presently being used are categorized into the following six (6); small scale dams, boreholes, springs, Tanzania Military Academy (TMA) pipelines, shallow wells and rainwater storage tanks.

Water Source			
Source	Nos. of Sources	Source Capacity	Unit
Small Scale Dams	32	5,012	1,000 m ³
Boreholes	2	210	m ³ /day
Springs	7	337	m ³ /day
TMA Pipeline	1	108	m ³ /day
Shallow Wells	2	0	m ³ /day
Rainwater Tanks	1	0	m ³ /day

(Dams)

This is the commonest type of water source facilities and is the most suitable for the village areas because it can be constructed easily by concerted action from the villagers coupled with appropriate technology to be supplied by the government organizations. Small scale dams are found in Monduli town and 16 villages. However, inflow to the reservoirs is available only for several months during the rainy season reflecting the rainfall pattern prevailing in the area. Furthermore, storage water is easily subject to contamination mainly due to the encroachment of animals on the reservoirs.

(Boreholes)

Groundwater development offers a number of advantages. It is characterized by higher quality; except when extraction is made at shallow depths and in polluted areas. In addition, it is better protected from pollution and evaporation, and the resources do not undergo substantial seasonal and long-term fluctuations, being naturally regulated.

Two boreholes are in operation for village water supplies; one borehole in Makuyuni village with a water yield of 135 cubic meters per day; the other in Mswakini village with a water yield of 75 cubic meters per day, totaling 210 cubic meters per day. The other two

boreholes are not working due to mechanical troubles with pumps and engines.

(Springs)

There are seven (7) springs in use for rural water supplies. This type of water source is found in Monduli town and four (4) villages with the total source capacities of 337 cubic meters per day.

(TMA Pipelines)

TMA pipelines collect water at Emaoi spring located at the foothill of Mt. Meru and convey water to Tanzania Military Academy near to Monduli town. TMA pipelines also distribute water for domestic uses of Monduli town and two (2) villages of Meserani Juu and Nengungu.

(Shallow Wells and Rainwater Tanks)

Four (4) villages each have one shallow dug well for domestic use. These shallow wells yield very limited water, so that the villagers collect water by ladling. Two (2) rainwater storage tanks exist at Arkatan village; however, only one rainwater tank is working at present. The quantity of water available for domestic use is also negligibly small.

Water Supply System

There are only two piped water supply systems; for other areas point sources are provided for domestic use.

(Piped Water Supply System)

Monduli water supply system has two (2) types of water sources; TMA pipelines and two springs. Water from the springs is conveyed to the confluence box by gravity, whereas water from TMA pipelines is conveyed by gravity from TMA storage tank to the booster pump station, and then water is pumped up to the tank near to the Monduli College of Education. The booster pump is not operated as originally planned owing to frequent failures of electric power supplies. The water is distributed in Monduli town through the house connections and domestic water points (DWP) with the service population of 26,000 as summarized below:

Service Population of Monduli Water Supply Project

Service Area	House Connection	Public DWP	Total
Monduli Town Lenter	1,000	9,000	10,000
(Ngarashi)	-	12,500	12,500
(Rasharasha)	-	3,500	3,500
Total	1,000	25,000	26,000

Of two (2) boreholes, only one borehole is operated at present at Makuyuni village. Groundwater is pumped up to the elevated storage tank at the village through the pipelines with the length of 4.1 kilometers. Water of 135 cubic meters per day is distributed through three (3) public DWP located in the housing area of the village.

(Point Sources)

For 17 villages, water is provided without water distribution system. The villagers are spending large amounts of time and energy in collecting water for their domestic use.

Present Water Utilization

The survey on water utilization was conducted to establish the water facilities available, how they are utilized, to what extent they can serve the populations, and so on. 550 households were sampled; 100 households for Monduli town and 450 households for 18 villages. Salient features on the current water utilization are summarized as follows:

(Water Consumption Rates)

The average daily water consumption rates are estimated at 9.5 liters per capita for Monduli town and 8.0 liters per capita for the surrounding 18 villages. In case of water shortages, especially in the dry season between July and November, people buy water for drinking. The price is Tsh 1,000 per 200 liters, i.e. Tsh 5.0 per liter.

(Distance to Water Source)

28 percent of the people in Monduli town replied that water sources are available within a distance of 400 meters. The average distances from houses to water sources are around three (3) kilometers for Monduli town whereas most villagers in 18 villages have to walk five (5) to 30 kilometers to collect water.

The number of families involved in collecting adequate water for household use range from one (1) to four (4) persons with an average of 3.3 persons per household. 95 percent of the villagers need three (3) or more hours to collect water from sources and to their carry it to their houses.

(Water Availability and Quality)

15 percent of people said that water was available throughout the year; seven (7) percent for Monduli town; 17 percent for the 18 villages. 18 percent of the people are satisfied with the current water quality.

2-7-2 Sanitation

In Monduli town, 80 percent of households have latrines although they leave much to be desired. Many of the pit latrines have been built by using poles and mud; but thatched with corrugated iron sheets. 20 percent of households have no toilets and have no intention of building toilets.

In the surrounding 18 villages, almost 40 percent of households have toilets. 60 percent of households have no toilets; 55 percent of households defecate anywhere away from the houses; five (5) percent of households go into the bush.

2-7-3 Institution and Organization

The ownership and responsibility for operation and maintenance of rural water supply facilities rest with local government at the village and district level. Monduli District Water Department, one of the functional divisions of Arusha Regional Water Department, is directly responsible for execution of the District Council's water project.

At village level, the water committees are organized with a chairman, a secretary and members of the committee. Most of the village water committees in the Study Area consist of five (5) to eight (8) members. The present responsibility of these committees includes maintenance of water source facilities, control of water quality, petition of rehabilitation works to the government, and collection of funds for operation and maintenance of the facilities.

Monduli water supply project is maintained by Monduli District Water Department that takes charge of providing water and of collecting water revenues. Water is provided through public water taps and house connections as well as commercial connections. Water from public taps is free of charge at this time. Water through house and commercial

connections is charged at a flat monthly rate of Tsh 200 and Tsh 400 respectively. The water revenue collection is low. Water revenue efficiency is 40 percent for domestic users and 70 percent for commercial users.

Basic reasons for low water charge collection efficiencies are; no systematic collection was enforced; and water is not continuously available for 365 days, i.e. non dependability of continuous water supply forced users not to pay the bill.

2-8 Environment

The Government's overall goal of the environmental sector is to achieve sustainable development that maximizes the long-term welfare of both present and future generations of the Tanzanian population. The Ministry of Tourism, Natural Resources and Environment is directly charged with environmental administration. The laws related to environmental conservation are National Parks Ordinance, Forest Ordinance, Grassland and Fire Ordinance, Natural Resources Ordinance and Wildlife Conservation Act.

No officially protected area such as national parks, game reserves, game controlled areas or forest reserves are included in the Study Area. The severe environmental problems in Monduli district are overgrazing and starting desertification of large areas in the north and north-eastern parts, and high competition for scarce water resources among domestic, livestock and irrigation uses.

2-9 Natural Conditions

2-9-1 Topography and Geol use Geology

The Study Area is bordered on the north by three (3) major volcanic mountains of Monduli, Burko and Essimigor, on the east by Arumeru district where a remarkable escarpment extends from a north to south direction, and on the west by Lake Manyara. The physiographic features of Monduli district are mainly related to volcanic activities, and only the southern part of the District is characterized by elevated plateaus of Precambrian rocks.

The plateaus are edged with the tectonic scarps extending in a north to southerly direction. A remarkable fault-scarp from an east to westerly direction exists in the northern edge of the plateaus. A large-scale broad valley was cut at the north of the scarp, that is, the Ardai Basin where a barren land extends between the scarp and the Monduli mountains. The Study Area is underlain with four major geological units; they are the Basement, the Old Extrusives, the Younger Extrusives and the Manyara Lake Beds.

2-9-2 Rainfall and Surface Runoff

The Study Area experiences distinct dry and rainy seasons. The dry season lasts for five (5) months from June to October, and the rainy season for seven (7) months from November to May. Annual rainfall fluctuates considerably between 350 millimeters and 1,600 millimeters with mean annual rainfall of 810 to 860 millimeters. The short rainy period extends from November to December, and the long rainy period lasts for three (3) months from March to May with the peak rainfall in April.

Small rivers and many streams flow southward through the Study Area, all of which are seasonal flowing. No river gauging station is established in the Study Area. River discharge data of two (2) rivers at Mto wa Mbu were evaluated to take a general view of surface water runoff in and around the Study Area. The mean annual river yields are 143 millimeters and 114 millimeters for Simba river at the station with a catchment area of 190 square kilometers and Mto wa Mbu river at the station with the catchment area of 148 square kilometers, respectively.

3 GROUNDWATER RESOURCES

3-1 Hydrogeology

(Monduli Town and Monduli Juu)

Being located in the foothills of Mt. Monduli, Monduli town is underlaid by Colluvial Deposits derived from the Older Extrusive of the Monduli mountain. Unconsolidated colluvial beds of about 40 meters thickness cover fractured volcanic rocks. The former acts as part of the aquifer, but does not have good potential, and the latter contains pressure gas in caverned volcanic rocks. An interpretation of aerial photographs reveals that the depth to the extrusive was thickened abruptly in the south of Monduli mountain due to east-westerly faulting.

The geology of Monduli Juu is characterized by two (2) calderas; inner and outer caldera. In the inner caldera, the upper part consists of the Colluvial Deposits of clayey beds with a thickness of about 70 meters, with the lower part consisting of medium to coarse sand with a thickness of more than 30 meters which acts as an aquifer. In the outer caldera, thick unconsolidated beds of clay with gravels and clayey fragments underlie.

(Surrounding Villages)

Oltukai subvillage is located several kilometers east of Lake Manyara, and is underlain by the Lake Manyara Beds with a thickness of more than 100 meters. The groundwater potential of the Lake Manyara Beds seems excellent; but the water has a high concentration of dissolved solids.

Being located east of Oltukai subvillage, Mswakini village is underlaid by the Lake Manyara Beds. The village is bordered on the east and southeast by the Tarangire National Park and Lolkisare Game Controlled Area which act as a part of recharge areas. Groundwater quality in the Lake Manyara Beds in the southern and eastern parts of the village has been improved with freshwater flowing from the forest-covered land.

Naitolia subvillage is located in the eastern end of the old Lake Manyara depositional plain and is underlaid by the Lake Manyara Beds in the lowland. Major aquifers in the lowland are of sandy materials from the Lake Manyara Beds and water quality of the aquifers is considered as having a high concentration of total dissolved solids.

(Ardai Basin)

The Ardai Basin, which is located south of Monduli town, covers a moderately

sloping alluvial surface and wide valley floor with a total area of about 130 square kilometers. All rivers and streams rising in Monduli and Lendikinya mountain ranges run southwards through the Ardai Basin. Part of the runoff is lost in the Ardai Basin which is bounded on the south by the uplifted lava plateau. There are only two (2) outlets to drain surface runoff from the basin.

Groundwater may be recharged in the basin, transmitted and released in the Colluvial Beds and heavily fractured volcanic rock aquifers in the zone of saturated subsurface.

3-2 Exploratory Well Drilling

Exploratory well drilling has been carried out to obtain the hydrogeological data, more particularly, to set up hydrogeological units, to obtain vertical/horizontal extent of aquifers, to grasp characteristics and potential of aquifers, and to test groundwater quality. 11 drilling sites were selected over the Study Area after consideration of the results of hydrogeological surveys and resistivity prospecting. After completion of the drilling works, fiberglass reinforced pipe (FRP) casing of 150 millimeters diameter and horizontal slotted screens of FRP with 12 percent openings were installed in the boreholes. The results of test drilling are shown below:

Results of Exploratory Well Drilling					
Well No.	Location	Drilled Depth(m)	Groundwater Level (mbgs)	Water Yield (l/min.)	Remarks
EX-1	Naitolia	76	65	neglig. small	
EX-2	Mbuyuni	64	58	dry	
EX-3	Tukusi	98	55	1.0	
EX-4	Monduli Town	154	129	neglig. small	
EX-5	Lashaine	198	-	dry	gas
EX-6	Lendikinya	250	-	dry	
EX-7	Monduli Juu	102	72	20.7	
EX-8	Monduli Town	126	-	dry	gas
EX-9	Arkatan West	48	-	dry	gas
EX-10	Arkatan East	152	-	dry	gas
EX-11	Monduli Town	150	-	neglig. small	

Of 11 exploratory wells, only two (2) wells have yielded a countable amount of groundwater; EX-3 well and EX-7 well. EX-3 well at Tukusi was drilled in the weathered

gneiss of the Basement Rocks and EX-7 well at Monduli Juu was drilled in the Colluvial Beds in Monduli Juu caldera. The most striking feature of the subsurface of the Ardai Basin is the presence of pressure gas in the cavern volcanic rocks instead of groundwater.

3-3 Evaluation of Potential Well Yield

Based on the specific capacities obtained through the examination of exploratory well drilling and data on the existing wells, the optimum well yields for respective hydrogeological units have been assessed. In the assessment, depths of proposed wells are determined based on the borehole loggings. The optimum well yields are determined on condition that screens of minimum 20 meters be installed, minimum drawdown is 10 meters and pumping is operated for 10 hours a day.

3-3-1 Study Area

(Lake Manyara Beds)

The Lake Manyara Beds overlying the Basement occur in the southern part of the Study Area. Four (4) villages of Oltukai, Mswakini, Naitolia and Makuyuni are situated on the Lake Manyara Beds, of which two (2) villages of Naitolia and Oltukai have no groundwater development potentiality because of a low water yield together with inferior water quality due to high electrical conductivity. The possible well yield for one (1) production well is 135 cubic meters per day for Makuyuni village and 144 cubic meters per day for Mswakini village.

(Colluvial Beds)

Large scale Colluvial Beds underlie the Monduli Juu caldera. The possible groundwater yield of one (1) production well is 36 cubic meters per day. Relatively small quantity of well yield is due to small scale of the recharge area.

(Young Extrusive)

Three (3) major mountains are underlaid by the Younger Extrusive. Test well drilling encountered pressure gas in the cavern lava. There is no potentiality of groundwater development for rural water supplies.

(Plateau Lava)

Most test wells for water development for Monduli water supplies were located to identify aquifers in the Plateau Lava. From the existing data 20 cubic meters per day of water

can be expected; One of the major problems with respect to rural water supplies is deeper static water levels in excess of 100 meters below the ground surface.

(Basement Rocks)

The Basement aquifers extend widely over the southwestern part of the Study Area. ARWMP investigation indicates that the average well yield is 80 cubic meters per day with the average static water level of around 30 meters below the ground surface; however, in the Study Area the potential well yield is as low as 12 cubic meters per day at Naitolia village.

3-3-2 Engare Olmotoni Area

The Engare Olmotoni area extending north of the Arusha Air Field is underlain by Meru volcanic lava and covered by volcanic debris with high potentiality for groundwater development. RDD has made preliminary investigation on groundwater development in Engare Olmotoni area in order to identify water sources for Monduli water supply project. No exploratory well drilling was made in this Study; however, the average well yield of 630 cubic meters per day could be expected, being learnt from the analysis of the existing data on seven (7) test wells. The static water levels are within 30 to 45 meters below the ground surface.

3-4 Water Quality

Water quality analyses have been conducted by means of in-situ tests for 29 samples and laboratory tests for 30 samples including both the surface water and groundwater with the objectives of interpreting hydrochemical evaluation of groundwater, and evaluating surface and groundwater sources for water supply planning. The in-situ test covers the parameters of electrical conductance, pH, water temperature and bacteriological examination, and the laboratory test covers 25 physical and chemical parameters.

3-4-1 Water Quality for Drinking Purposes

The water samples were assessed for drinking purposes based on a maximum permissible level of WHO Drinking Water Standards. The results of tests are summarized as follows:

- Apart from the water sample from Lake Manyara with the pH value of 10.3, all water samples are of pH values within the permissible limit of between 6.5 and 9.2.
- High turbidity values were recorded mostly from water of river surface flows, reservoirs and lakes; however, turbidity is highly susceptible to variations in

rainfall intensity apart in Lake Manyara.

- Four (4) water samples have higher Electric Conductivity which exceeds the limitation of $1,200 \mu S/cm$, including Tukusi spring, Lake Manyara, Mswakini borehole and Burko BH-14 borehole.

3-4-2 Bacteriological Characteristics

All water samples from boreholes were safe from the bacteriological contamination. Other water samples were bacteriologically contaminated. This may be due to contamination from animals and human beings. Most sources are open, i.e. not fenced in therefore access of either people or animals to water sources might be the major cause of pollution.

4 DEVELOPMENT PROPOSAL

4-1 Needs for Development

The existing water supply sources covering about 65,000 residents in the Study Area range from traditional hand dug wells to modern boreholes. Water supplies for the surrounding 18 villages rely mainly on the stored water in small-scale dams. The present production of groundwater is 210 cubic meters per day. This covers only 32 percent of the water demand to meet the minimum drinking water of 10 liters per capita per day recommended for rural water supplies by WIIO. The present daily water consumption level is less than the minimum requirement: 9.5 liters per capita per day for Monduli town and 8.0 liters per capita per day for the surrounding area. Water resources development is essential in order to meet the minimum water requirement both for the time being and later to meet the increasing water demand in the near future.

In many villages where water supplies rely on small scale dams, water is not available in the dry season since proper reservoir operation is not put in practice. As a result of unreliable of water sources, the villagers have to walk long distances in search of water. 95 percent of the households spend three (3) hours a day in collecting water for their families. Women and children undertake the responsibility of water collection, laborious works. For reduction in carrying distance, water source development needs to be distributed throughout the Study Area.

The groundwater development potential in the Study Area is not adequate to fulfill the estimated water demand. The results of exploratory well drilling have revealed less groundwater potential mainly due to complicated geological structures caused by volcanic activities. Accordingly, efforts shall be made to develop surface water resources by means of construction of small dams with well designed water control structures. For stable water supplies throughout the year, water management shall be introduced in operating reservoirs. In conformity with the national water policy, rural water supplies shall be operated and maintained by the villagers and they shall make water charge collections. To this end, the functions of the village water committees shall be strengthened.

4-2 Objectives and Project Components

The main objective of the Project is to provide safe water throughout the year in adequate quantities for drinking, food preparation, and personal hygiene with a target year of 2014. Furthermore, with due consideration of the importance of livestock to the villagers in the Study Area together with contribution of the livestock sector to the regional economy,

water provision for livestock has been proposed as far as water resources are available.

The project proposes to develop water resources including provision of water source facilities and public stand pipes; however, distribution systems with house connections have not been planned with this Project because of the very low population density of around 17 persons per square kilometer in the surrounding villages and economic consideration in keeping with the low economic level of the communities.

To accomplish the above objective, the Project proposes to implement the following projects with the lowest investment cost for serving all villages:

Groundwater Development

1) Monduli Water Supply Project

- Construction of boreholes with power pumps in Engare Olmotoni area, north of the Arusha air field.
- Construction of transmission pipelines with booster pumps from the proposed boreholes to the existing water tank in Monduli town.

2) Existing Village Water Supply Project

- Rehabilitation of Makuyuni water supply project.
- Rehabilitation of Mswakini water supply project.
- Construction of boreholes at Emairete village

Surface Water Development

1) New Construction of Small Scale Dams

- 29 dams in Monduli town and 15 villages.

2) Rehabilitation of Small Scale Dams

- Six (6) dams in Lossimingori and four (4) other villages.

4-3 Projection of Number of Inhabitants and Livestock

4-3-1 Planning Period

The planning period has been fixed at 20 years extending from 1995 to 2014 according to the planning criteria established by the Ministry of Water, Energy and Minerals. The number of inhabitants and livestock will be projected for this planning period.

4-3-2 Population

Projection of population is based on the population in 1994 and the mean annual population growth rates on a village basis. The total population will increase from 65,428 in 1994 to 131,635 in 2014, about double the present population, as given below:

Projection of Population			
Items	1994	2004	2014
Monduli Town	18,210	25,203	34,854
18 Villages	47,218	67,300	96,781
Total	65,428	92,503	131,635

4-3-3 Livestock

While livestock contributes more to the regional economy, there are many bottlenecks for improving livestock production. The number of livestock should be reduced and the quality of livestock should be improved. This is the basic position held by the Planning Commission of Monduli district. Under this situation, the Project assumes that the number of livestock will remain stationary during the planning period owing to scarcity of water and pasture in the dry season. The number of livestock unit is 99,166. One (1) livestock unit is equivalent to one (1) head of cattle, or five (5) goats, or five (5) sheep, or two (2) donkeys.

4-4 Water Demand

The first step in the water supply plan is to provide the people with minimum water of 10 liters per capita per day. Water consumption levels will be increased as water resources are made available and the living standards of the villagers are improved. The Project has estimated that daily water demand for domestic use will increase to 30 liters per capita during the planning period. The water demand for livestock of 25 liters per day per livestock unit has been employed. In the estimate of water demand, 15 percent of loss water is added. The water demand in the planning year of 2014 will amount to 7,905 cubic meters a day.

Water Demand Forecast in 2014 (m³/day)

Items	Domestic	Livestock	Schools/Others	Losses	Total
Monduli Town	1,046	91	78	182	1,397
18 Villages	2,904	2,389	365	850	6,508
Total	3,950	2,480	443	1,032	7,905

4-5 Water Resources Development Planning

4-5-1 Groundwater Development

Groundwater is a most suitable water resources for rural water supplies for its stable water yield and water quality. Development of groundwater resources will be planned according to the following guidelines:

- Facilities for groundwater development consist of boreholes, pumping equipment with drainage facilities to protect wells from surface water infiltration, and storage tanks; distribution systems are not provided.
- Pumping systems are of manual operation when static water levels are less than 30 meters below the ground surface; otherwise power generating systems will be provided.
- Although the daily water consumption of 30 liters per capita is proposed as the target, the consumption level will be modified so as to meet the minimum water requirement only during the initial stage of the Project depending on the capacity of well yields.
- Boreholes will be located within a reasonable distance from the village centers as far as possible.
- Water quality shall be tested to confirm if it meets the requirements of the Drinking Water Standard of the Government.
- Locations of boreholes will be selected within public land, as a rule, such as schools, village offices, dispensaries and others.

4-5-2 Surface Water Development

The water yields of the existing 32 dams expressed in terms of millimeters as the rates of total reservoir capacities to their catchment area averaged to 4.8 millimeters, compared to a mean annual rainfall of 800 millimeters. Topography of the Study Area allows small-scale dams to be built. Development of surface water where groundwater is not available will be planned according to the following guidelines:

- The live storage capacities of dams will be enough to meet water demands during drought conditions with a return period of 10 years.
- The intake facilities and spillways shall be properly located with respect to topographic conditions.
- Where water treatment is necessary, simple processes will be employed to permit village operation of the facilities.

- *Selected materials shall be used for the embankment to cross river channels, and embankment shall be well compacted. Foundation treatment shall be done for the river crossings; failures of the existing dams have mainly taken place at the river crossings.*
- *Reservoir operation rules shall be prepared through an examination of water balance so as to make water available all the year round.*

5 THE PROPOSED PROJECT

5-1 Monduli Water Supply Project

5-1-1 Water Demand

The daily water demand in 2014 will amount to 1,397 cubic meters based on the population projected and water consumption level of 30 liters per capita per day for domestic use and the like.

Daily Water Demand (m³/day)

Item	Water Demand	Remarks
Domestic Water	1,016	34,854 persons
Schools	6	645 pupils
Hospitals	74	840 beds
Public Facilities	4	382 persons
Commercial Use	27	386 persons
Others	58	5 percent
Losses	182	15 percent
Total	1,397	

5-1-2 Water Sources

To meet the estimated water demand in 2014, development of new water resources with a capacity of 1,222 cubic meters is proposed by drilling boreholes in Engare Ohmotoni area.

Proposed Water Sources (m³/day)

Water Source	Capacity	Remarks
Existing Sources		
- Kilimani spring	130	
- TMA pipeline	45	actual supply
New Sources		
- Boreholes	1,222	3 boreholes
Total	1,397	

As mentioned earlier, there are fewer potentialities of developing groundwater in the

Study Area. Alternative sources of water are springs in Mfereji village and groundwater in Engare Olmotoni area; however, according to the preliminary investigation, the surplus water of the spring is estimated at only 60 cubic meters a day, far less than the water demand. Therefore, it is proposed to construct boreholes in Engare Olmotoni area, north of the Arusha air field. The potential well yield is around 40 cubic meters per hour. Construction of three (3) boreholes is planned.

5-1-3 Proposed Facilities

The Project proposes to provide the following water resources facilities and conveyance pipelines with pumping stations:

1) Boreholes

- Wells : 3 locations
- Pumping equipment : 3 pumps
3 generators

2) Conveyance Pipelines

- Connection pipelines : 2 km, FRP pipe, ϕ 150 mm
- Pipelines : 23 km, Ductile pipe, ϕ 150 mm
- Pumping stations : 2 stations with a relay station
 - 2 pumps each
 - 1 generator each

5-1-4 Staged Construction Plan

The proposed Monduli Water Supply Project will begin with a detailed design in 1996 and provide three (3) boreholes and the conveyance pipelines with a length of 23 kilometers to connect the boreholes with the existing water tank in Monduli town. In view of increasing water demands toward the planning year of 2014, two boreholes will be drilled in 1997 and one borehole in 2005 in conformity with the increasing water demand.

Further consideration is given to installation of pipelines which need large amounts of capital investment in the initial stage of the project with lower water demand, thus the following two (2) alternative construction plans: are selected: case 1 deals with installation of pipelines in 1997-1998, and case 2 deals with transportation of water by water tank trucks for five (5) years and then installation of conveyance pipelines in 2001-2002.

Two (2) cases are compared by means of Economic Internal Rate of Return (EIRR). As a result, the EIRR of case 1 turned out to be 9.9 percent, and case 2 indicated that the EIRR increased to 12.2 percent. Therefore, the Project proposes to implement the case 2 from

the viewpoint of national economy.

Two Alternative Cases

Particulars	Case 1	Case 2
Boreholes: 2 locations	in 1997	in 1997
: 1 location	in 2005	in 2005
Water Tank Truck: (4)	-	in 1997
Pipeline :23 km	in 1997-98	in 2001-02
Cost (Tsh Million)	3,369	3,814
EIRR (%)	9.9	12.2

5-2 Village Water Supply Project

Main sources of water for village water supplies is surface water. Preliminary water balance studies on a monthly basis were made in order to determine the reservoir capacities required for year-round water supplies for domestic and livestock uses. Parameters involved in the studies are inflow converted from minimum monthly rainfall with the return period of 10 years, evaporation losses from the reservoir surface, sedimentation in the reservoirs and water demand. Topographic conditions are based on the topographic maps with a scale of 1:50,000.

5-2-1 Dam Project

Rehabilitation of the following six (6) dams is proposed; they are not now in use due to embankment failures.

- Lossimingori village : Rasharahsa dam
- Meserani Bwawani Village : Meserani dam
- Makuyuni village : JKT No. 3 dam
- Mswakini village : Mswakini No.1 and No.2 dams

New construction of 28 small-scale dams with the combined storage capacities of 3.75 million cubic meters is proposed for village water supplies of 15 villages excluding villages of Arkatan, Meserani Bwawani and Oltukai. Dam heights range from four (4) meters to six (6) meters.

5-2-2 Groundwater Development Project

The project includes rehabilitation of two (2) existing boreholes and new construction of boreholes in Emairete village where groundwater resources are available, as given below:

- Makuyuni village : 1 location, 130 m³/day
replacement of 1 pump and 1 engine
replacement of GS pipe, ϕ 4", 4.1 km
construction of water tank, 91 m³
- Mswakini village : 2 locations, 2 x 7.5 m³/hour
replacement of 2 pumps and 2 engines
replacement of GS pipe, ϕ 3", 4.5 km
construction of 2 water tanks, 91 m³
- Emairete village : 2 locations, 10 (l)/hours each
installation of 2 pumps and 2 engines
installation of GS pipe, ϕ 3", 2.0 km
construction of 2 water tanks, 91 m³

5-3 Priority Project

Six (6) projects have been selected as priority projects to warrant early implementation; they are the Monduli Water Supply Project and five (5) Village Water Supply Projects.

1) Monduli Water Supply Project

The existing Monduli water supply system covers Monduli town, the development center of the District, with the distribution network and public taps. With provision of additional water resources and conveyance pipelines, quick returns from the project investment will be generated.

2) Village Water Supply Project

Among village water supply projects, the first priority will be given to groundwater development projects and second priority to dam projects for Moita Bwawani village and Oltukai village where there are no alternative sources of water.

Groundwater Development Project

- Rehabilitation of Makuyuni village water supply project
- Rehabilitation of Mswakini village water supply project
- Construction of Emairete village water supply project

Dam Project

- Moita Bwawani village water supply project
 - construction of 3 dams with the combined storage of 1.17 million m³
- Oltukai village water supply project
 - rehabilitation of Oltukai dam with a storage capacity of 141,000 m³

6 IMPLEMENTATION AND OPERATION OF THE PROJECT

6-1 Implementation Program

The Regional Water Department of Arusha will be the executing agency responsible for implementing the Monduli Water Supply Project with the assistance and cooperation of the Monduli District Water Department and the village governments concerned in their respective fields. The Monduli District Water Department will be responsible for implementing the Village Water Supply Projects.

The Monduli Water Supply Project will be implemented in two (2) stages as summarized below (Figure 1 and Table 1):

Stage 1: 1996 - detail design

1997 - construction of 2 boreholes

- procurement of 4 water tank trucks of 10 m³ each

1998 - commencement of water services by trucks

Stage 2: 2001 - commencement of conveyance pipelines works

2002 - completion of conveyance pipelines works

2003 - commencement of water services by pipelines

2005 - construction of 1 borehole

The Village Water Supply Projects will be started in 1996 and are due for completion in 2001 so as to begin water services in 2002 as envisaged in the national water policy.

6-2 Operation and Maintenance

In accordance with the provision of the national water policy, the Monduli Water Department will be responsible for looking after the Monduli Water Supply Project, the large water supply project, and the village government will be responsible for the security and protection of water supply points within their villages through establishment of the village water committees.

The proposed Village Water Supply Projects will be operated and maintained by the communities after the completion of project facilities through the establishment of the village water committees.

7 PROJECT COST

The construction works will be implemented on a contract basis under the supervision of the Arusha Regional Water Department for the Monduli Water Supply Project, and Monduli District Water Department for Village Water Supply Projects.

The construction costs include the costs for engineering services of detailed design and supervision of construction works, construction of engineering facilities, procurement of water tank trucks, and right-of-way. 10 percent of physical contingencies are added. Price escalation contingencies are calculated at rates of two (2) percent per year for the foreign currency components and 14.7 percent per year for the local currency components. Foreign exchange rates of US\$ 1.00 = Tsh 600 = Japanese Yen 101.25 are applied.

The construction costs amount to Tsh 4,320 million for the Monduli Water Supply Project and Tsh 7,791 million for Village Water Supply Projects, totaling Tsh 12,111 million as summarized as follows:

Total Project Costs			
Unit: Tsh Million-			
Cost Items	Monduli Project	Village Projects	Total
Right-of-Way	1.3	33.4	34.7
Construction	2,532.5	1,877.3	7,409.8
Water Tank Trucks	404.9		404.9
Engineering Services	529.0	730.2	1,259.2
Physical Contingencies	316.7	561.0	910.7
Base Cost	3,814.4	6,204.9	10,019.3
Price Contingencies	505.3	1,586.5	2,091.8
Total Cost	4,319.7	7,791.4	12,111.1

The operation and maintenance costs of the Monduli Water Supply Project cover the three (3) components: the existing intake facilities from the existing springs, pumping water diversion from TMA pipelines and water supplies from the proposed three (3) boreholes in Emairete Olmotoni area. Annual recurrent costs for operation and maintenance are: Tsh 2.6 million for the existing water intake and distribution facilities, Tsh 0.9 million for diversion from TMA pipelines, water supplies from the proposed boreholes, and Tsh 29.3 million for water transportation by four (4) water tank trucks.

8 PROJECT EVALUATION

8-1 Economic Evaluation

The contribution of the Monduli Water Supply Project to the national economy is evaluated in terms of the EIRR for the project lifespan of 20 years. The resultant EIRR is 12.2 percent, in which economic benefits are derived from the villagers, willingness to pay Tsh 5,000 a month per household of six family members. While the EIRR is not high as the social opportunity cost is around 15 to 20 percent, the project itself has great merit on humanitarian grounds. Water is indispensable for survival and without it, no social and economic development will be made feasible. Furthermore, provision of water is in accordance with the national water policy in 1991.

8-2 Financial Evaluation

The water charge is estimated at Tsh 350 per cubic meters of water, or Tsh 1,890 per household of six to recover the recurrent costs and replacement of pumps, generators and other equipment needed during the project life of 20 years. The water charge of Tsh 1,890 per household will place a 6.2 percent burden per household of monthly household income. The FIRR of net cash flow becomes 33.1 percent with a bill collection efficiency of 100 percent. The figure would be appropriate since the interest rate charged by city banks range between 29 and 30 percent.

Financial environment will be subject to change over time. Factors affecting financial conditions are revenue and cost. Water revenue collection efficiency of 100 percent cannot be maintained over time. Four (4) scenarios to test sensitivity of project finance are examined as follows:

Sensitivity Test

Base condition	: EIRR of 33.1 %
Water revenue 10 % down	: EIRR of 28.1 %
O&M cost 10% up	: EIRR of 28.6 %
2 year delay in construction	: EIRR of 32.9 %
Water revenue 20 % down	: EIRR of 22.7 %

RECOMMENDATION

1. It is recommended that the proposed Monduli Water Supply Project and Village Water Supply Projects should be implemented as closely as possible to the proposed implementation schedule. The primary objective of the proposed project is designed to provide safe and clean water supply for the rural people, in accordance with the National Water Policy Directive, 1991.
2. The Monduli Water Supply Project should be recognized as urgent and one of the top priority rankings in terms of national policy objectives. The Project is formulated with the aim of solving the current inability to supply adequate water. Development of water sources is not only urgent but also crucially vital to the functioning of Monduli town, the development center of the District.

The economic internal rate of return of 11.2 percent is not necessarily higher than the social opportunity cost in Tanzania. Nevertheless, the project should be interpreted as being of highest priority on humanitarian grounds. The project could be maintained by the beneficiaries after the completion of the construction works. Water tariff of 350 Tsh/m³, or Tsh 1,890 a month per household is proposed. This rate would satisfy financial self sustainability in covering O&M costs and some financial risk on one hand, and for water user groups in terms of affordability. Tsh 350/m³ or Tsh 1,890 a month would represent a 6.2 percent burden on household income.

3. The water source capacities of the Monduli can be improved by securing groundwater in the area of Engare Olmotoni. Three (3) boreholes are proposed to meet the water demand in 2014 for the Monduli Water Supply Project. The implementation stages of the project are proposed from the viewpoint of national economy: the first stage is to provide two (2) boreholes and four water tank trucks in 1997, and the second stage is to construct water conveyance pipeline system in 2001 - 2002 and one (1) additional borehole in 2005.

For successful implementation of the project, hydrogeological investigation of Engare Olmotoni area should be continued with the emphasis on evaluation of groundwater potential and an inventory survey of water rights.

4. Water supplies for the villages have the problem of groundwater development. Therefore, construction of small traditional-type dams, has been proposed for the Village Water Supply Project. At present a number of small dams have been utilized

in the villages. However, many of those dams dry up during the dry season, and several dams are not used. The preliminary study on reservoir operation indicates that there would be sufficient water to make the year round water supplies available for people and livestock should dams be properly operated and maintained.

Arusha Regional Development Directorate should be urged to planning of reservoir operation in due consideration of local hydrological conditions.

5. After completion of the Project, the village water committee will be in charge of its management and operation, and be legally, organizationally, managerially and financially as well as technically independent. This vision is consistent with the national water policy.

Arusha Regional Development Directorate together with the Regional Water Department and District Water Department should be encouraged to fully assist newly organized village water committees thus contributing to a successful operations in rural water supply.

CHAPTER 1 INTRODUCTION



CHAPTER 1 INTRODUCTION

1 - 1 Background of the Study

The Government of the United Republic of Tanzania (hereinafter referred to as "The Government of Tanzania") is making every endeavor to draw up water master plans for regions throughout the country to provide safe drinking water which has been recognized as a basic need of society under the twenty year rural water supply program (1970 - 1991). The drawing up of Regional Water Master Plans was initiated in 1971. To date Water Master Plans have already been prepared in 17 regions; preparation of the Arusha Region Water Master Plan is now in the final stages.

Monduli district, the second largest district in Arusha region, and its surrounding areas are confronted with serious problems of water shortages; the rains in these areas have only a short spell of about four months a year; springs and some boreholes are only the available water sources in the dry season. Total supply capacities of two springs in Monduli town are reported to meet only ten percent of the town's water demand.

In the above situation, the Government of Tanzania requested the Government of Japan to extend technical cooperation for the implementation of a feasibility study on water supply for Monduli town and the surrounding areas. In response to the official request from the Government of Tanzania, the Government of Japan sent the preparatory study team through Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programs of the Government of Japan, to Tanzania in March, 1994. The Scope of Works was agreed on March 21, 1994 between JICA and Arusha Regional Development Directorate (hereinafter referred to as "RDD").

In accordance with the Scope of Works, JICA commenced the Feasibility Study on Monduli Town and the Surrounding Area Water Supply in Arusha Region (hereinafter referred to as "Study") in November, 1994, and the feasibility study team composed of Sanyu Consultants Inc. and Japan Engineering Consultants Co., Ltd. was dispatched to Tanzania on November 26, 1994 to conduct the field surveys. The field surveys are carried out in two phases

in close cooperation with the counterpart personnel of Arusha Water Department; phase one from November, 1994 to March, 1995; phase two from June to October, 1995.

1 - 2 National Water Policy

Tanzania's national water policy was formulated in 1991 with the primary objectives of making clean and safe water available to all households, urban and rural within a distance of 400 meters from their households by year 2002. Water centers shall be established and be managed by users' groups or the community. For rural water supplies, instead of house connection, water will be collected from domestic water points, each of which will serve 200 to 250 people. This system of providing water to the rural population will continue to receive priority.

Water management shall be left to the local people themselves, recommending the "pay as you go principle" and the self sustainability of operation and maintenance. Cost recovery is emphasized in water resources management. With the exception of initial investment cost for the water project, operation and maintenance costs must be covered and the project must be feasible financially and economically justifiable in the framework of cost benefit analysis.

Since the launching of the national water policy in 1991, the Government of Tanzania has been implementing its water program according to these objectives. So far, since 1971 about 9,710,000 people out of the rural population of 21,110,000, or 46 percent are being served with clean tap water.

1 - 3 Arusha Region Water Master Plan

Efforts to formulate water master plans at the region level under the twenty year rural water supply program was initiated in 1971. Preparation of Arusha Region Water Master Plan (ARWMP) started in 1990 under the United Nations Development Program. The draft final report was published in October, 1994, and the final report is expected to be prepared by 1997.

The approach of ARWMP has five main elements:

- a) Inventory studies of existing data,
- b) Field surveys and identification of potential sources of supply and assessment of demand,
- c) Resources evaluation of potential sources,
- d) Costing of alternative options, and
- e) Preliminary design of proposed schemes.

According to the draft final report, the study of water resources in the Arusha Region does not cover all districts completely because some additional surveys, especially for engineering estimates of water supply schemes, are considered necessary. Studies and planning undertaken mainly by Tanzanian experts are still in progress and not all works could be executed as anticipated due to many constraints to be faced. The draft report of ARWMP does not always fully cover Monduli district; however, it presents data and information useful for the Study.

1 - 4 Scope of the Report

The Study is conducted over a period of two Japanese fiscal years from 1994/95 to 1995/96 in two phases as given below:

- i) **First Year (November, 1994 to March, 1995)**
Phase- Study
 - Preparatory work in Japan.
 - First field survey in Tanzania.
- ii) **Second Year (June, 1995 to March, 1996)**
Phase- Study
 - Second field survey in Tanzania.
 - First period of home work in Japan for preparation of the Draft Final Report.
 - Third field work in Tanzania to present and discuss the Draft Final Report.

- Second period of home work in Japan for preparation of the Final Report.

This Final Report presents development proposals and project formulation for water supplies in Monduli town and the surrounding 18 villages based on the results of technical, economical and financial evaluation. Main surveys and investigations carried out during the field survey periods include:

- Collection and review of existing data, information and previous studies related to the Study.
- Hydrogeological investigations and water quality analysis on existing wells and surface water.
- Geophysical prospecting.
- Test well drilling at the selected 11 locations.
- Inventory surveys of the existing water sources.
- Sample surveys on present water utilization and villagers' willingness of water supply provision.
- Survey on present educational program for sanitation.
- Sanitary education trials at three selected primary schools.

CHAPTER 2 GENERAL DESCRIPTION OF THE STUDY AREA



CHAPTER 2 GENERAL DESCRIPTION OF THE STUDY AREA

2 - 1 Location and Land Area

The Study Area includes Monduli town, the capital town of Monduli district, and its surrounding 18 villages and sub-villages. Monduli district is one of nine districts in Arusha region, being the third largest district in the Region. The Study Area is located between Longitude 35 °55' E and 36°40' E and Latitude 3°15' S and 3 °55' S in the northern highlands of Tanzania.

Monduli district stretches west of Arusha municipality bordering on the Republic of Kenya in the north, Kilimanjaro region in the north east, Mbulu and Ngorongoro district in the west, Babati district in the south east and Kiteto and Simanjaro districts in the south.

The area of the Study Area is around 2,900 km², occupying about 20 percent of the land area of Monduli district which is predominantly inhabited by Masais who move from one place to another in search of water and pasture land for their animals. The Masai land covers most of the Monduli, Kiteto, Simanjaro and Ngorongoro districts which are mainly vast and semi-arid flatlands of approximately 60,000 km² of which 14,200 km² comprise Monduli district.

2 - 2 Administrative Setup

Districts are administratively divided into divisions, wards and villages. Monduli district comprises of three divisions namely Kisongo, Longido and Manyara, which are split into 12 wards and 49 villages. Furthermore, each village is sub-divided into a number of sub-villages according to the size and density of population.

The Study Area covers Monduli town and 18 villages and sub-villages as given below (see Figure 2-1):

Villages Selected for the Study

Ward	Village/Sub-Village	Ward	Village/Sub-Village
Engutoto	Monduli Town	Sepeko	Meserani Bwawani
Monduli Juu	Enguik	Makuyuni	Lolkisale
Sepeko	Emairete	Mt Wa Mbu	Tukusi
	Lendikinya	Musa	Makuyuni
	Arkatan		Naitolia Sub-Village
	Lossimngori		Mbuyuni
	Lepurko		Mswakini
	Meserani Juu		Oltukai Sub-Village
	Moita Kiloriti		Nengungu
	Moita Bwawani		

Each village has a village council commonly known as village government comprised of 25 members, i.e. the village chairman and 24 village council members elected by the Assembly for a tenure of five years. Also, there is a village executive officer appointed by the district executive director to carry out the administrative tasks on behalf of the village government. This is an ex-officio member of the village government.

2 - 3 Population

The population estimate of the Study Area was based on the population database available in the office of Arusha Water Department (Idara Ya Maji, Arusha), which is prepared for the study of Arusha Region Water Master Plan (ARWMP). The population of the Study Area in 1994 was estimated by multiplying the population in 1992 by the mean annual population growth rates as presented in the database. The mean annual population growth rates were estimated for each village from the 1988 population census and the population data in 1992 obtained from the village offices.

The total population of the Study Area in 1992 was 61,096. The population in 1994 was estimated to be 65,428, of which 18,210 lived in Monduli town and 47,218 in the 18 villages and sub-villages (Table 2-1) as summarized below:

Population of Study Area

Item	Monduli Town	Villages	Total
Population in 1992	17,067	44,029	61,096
Population in 1994	18,210	47,218	65,428
Annual Growth Rates (%)	3.30	3.56	3.48

According the population census, the population of Monduli district increased from 68,366 in 1978 to 109,292 in 1988.

Population of Monduli District

Year	Males	Females	Total
1978	35,470	32,896	68,366
1988	54,562	54,730	109,292

Monduli district had a mean annual population growth rate of 4.8 percent surpassing the national growth rate of 2.8 percent and Arusha region's growth rate of 3.8 percent. At the end of 1992 the District had a total population of 110,292 residents.

The Study Area which comprises Monduli town and the 18 surrounding villages and sub-villages with the land area of 2,878 square kilometers had a population of 65,428 distributed among 12,489 households in 1994. The average number of family members per household was 5.2 persons and the population density was 22.7 persons per square kilometer as given below;

Family Members and Population Densities

Items	Population Density (person/km ²)	Average Member of Family
Monduli Town	607	6.4
Villages	17	4.9
Overall	23	5.2

The population size and numbers of households per village differ (Table 2-2). The village population size ranges from 4,863 at Makuyuni to 1,541 at

Tukusi, and the numbers of households per village from 1,221 at Makuyuni to 190 at Tukusi.

The population of the Study Area and the District has been rising year to year; however data on registering any migration are not available despite the severe effects of drought.

2 - 4 Rural Economy

2 - 4 - 1 Economic Activity

(1) General

The Study Area is predominantly agricultural. The general situation in the District could represent the situation in the Study Area. The average farmer cultivates land of between five and ten acres with the average of seven acres, or 2.8 hectares.

(2) Livestock

Major economic activity in the District is livestock production. More than 86 percent of the population in the District are indigenous Masai pastoralist. It was estimated that 66 percent of the regional GDP is based on livestock production.

The Masais, known as the livestock keeper have been forced to move from good agricultural land to arid or semi-arid areas by the farmers. The harsh climate in semi-arid areas makes the Masais nomadic so that they move from one place to another with their livestock in search of pasture and water.

The survey of livestock was made during the study period. Numbers of major livestock raised in 1994 are as follows:

Livestock in the Study Area

Cattle	Goats	Sheep	Donkeys
76,086	74,038	33,223	3,245

The Masais are constantly faced with serious shortages of grazing land with an average of 1.9 hectares per animal. The situation is far from satisfactory in terms of livestock production. The ideal grazing land per animal is six hectares per animal. Hence, the animals are overstocked. At present, the Masais are slowly changing toward mixing farming with livestock production.

Furthermore, lack of veterinary drugs, tools and equipment for livestock, lack of water, poor infrastructure, conflicting land use between farmers and livestock keepers, and poor marketing facilities, all these make the livestock sector at a subsistence level. Although in the past, the Masais used to depend entirely on livestock by-products such as milk and raw blood; nowadays they have adopted farming practices for their daily subsistence.

The strategies for commercializing the livestock sector are being discussed in the District Office. The following areas need improvement:

- infrastructure such as veterinary centers, slaughter slabs, dips, etc.
- range management and pasture
- control over animal diseases
- provision of water for livestock
- demarcation of village boundaries

(3) Agriculture

Farming contributes to 25 percent of regional GDP, compared with 66 percent contribution made by livestock husbandry. Total arable land of the District is 247,600 hectares out of which 90,700 hectares (36.6 %) is under cultivation. Forested areas constitute 48,900 hectares (19.7 %).

Agricultural production in the District has steadily increased in recent years. The following is a table of major crop production of the District:

Major Crop Production in Tons

Crop	1989/90	1990/91	1991/92	1992/93	1993/94
Maize	7,595	6,626	7,374	3,250	10,720
Beans	8,830	2,165	10,500	2,660	11,400
Wheat	850	252	700	560	936
Rice	1,350	1,890	3,400	2,500	3,200
Coffee	160	205	1,200	1,200	1,200

Inhabitants of the Study Area are mainly engaged in growing maize and beans as major food crops to supplement cattle milk; a combination of which produces a type of food/dish known as "Loshoroo" in the Masai language. This type of food is delicious and appealing to the majority of Masai and Waarusha ethnic groups. Moreover, barley, peas, sorghum and others are grown to lesser extent.

(4) Forestry and Beekeeping/Fisheries

The majority of the households in the Study Area have not taken up the activity of tree planting although vast areas are affected by gullies and constant droughts. Beekeeping is done on an individual basis and fisheries are not conducted due to unavailability of rivers and lakes for fisheries in the Study Area.

(5) Other Industries

There are approximately 90 small grain grinding mills and oil pressing and extracting mills in the District. The tourism industry was estimated to contribute five percent of GDP to the regional economy. One of the attractions is Oldonyolengai Crater together with wild safari trips. Mining of rubies has been reported, but no economic data is available at this time.

2 - 4 - 2 Rural Economy

Monduli is predominantly agricultural. The average farmer cultivates land between five and ten acres. According to the preliminary survey on household income made by the Study Team, the monthly household income ranges from Tsh 30,000 to 50,000. The most comprehensive household monthly

expenditure survey was conducted in 1991/92 in Tanzania. The average rural family expenditures was Tsh 27,482 for a family of six. Assume that the average household income increased at the rate of three percent per year, it was estimated that in 1995 the average rural family household income was Tsh 30,348 per month.

Under the situation that detailed and accurate data on household income are not yet available in the Study Area, the average monthly income of Tsh 30,300 is employed for the Study.

2 - 5 Socio-Cultural Conditions

2 - 5 - 1 General

The major ethnic groups in Monduli district are Masai and Waarush, who to a large extent are pastoralists though they are now practicing agriculture. The other tribes are Chagga, Rangi, Nyature, Iraqw (Mbulu), Pare, Nyiramba, Shamba, Gogo, Meru, Mbugwe and Somali. Also, there are few people belonging to the following tribes: Rundi, Hehe, Sukuma, Sandawi, Nyamwezi, Luguru and Ngoi. The majority of the tribes mentioned above are found in Lolkisale, Makuyuni, Tukusi, Mto wa Mbu and Monduli town.

The Masai and Waarusha who keep large herds of cattle face the problem of acute water shortage for their animals during the dry season. As a result, they are forced to migrate to other parts of Monduli district and outside in search of green pastureland and water for their livestock. It is the exclusive task of the circumcised youth ("Morans"), known as warriors, who take charge of the livestock during seasonal migration.

The major religious groups are Roman Catholics, Lutherans and Pagans. These groups are found almost in every villages in the Study Area.

2 - 5 - 2 Customs

The Masai community has a well-knit hierarchical system which vests power to each group in the society so that no group can encroach into another's domain. For example, there are senior elders, junior elders, senior youths, junior

youths (Morans) and uncircumcised teenagers ("Laiyons"). Each group has been assigned special tasks. The Morans are regarded as the defense squad. They are in charge of all property in the village and in times of war or conflict, they have to be in the front line. The uncircumcised youth look after calves, goats and sheep. They also herd cattle if they are not taken too far from the homesteads.

Men are in overall charge in the family but the overall responsibility of maintaining the family in terms of food provision, caring for the children and building houses is born by women (wives). Men and women are supposed to sit together in community meetings although generally these meetings are attended by males only. Women have been designated to an inferior status leaving them helpless in terms of decision-making.

Women are not allowed to attend traditional gatherings even where land issues are discussed. Males usually assume the role of speaking for the women. This seems to be the pattern as regards all pastoralist and semi-pastoralist societies.

According to Masai tradition, which resembles a military hierarchy, those in the upper positions give orders and do not accommodate the views of those in the lower positions, even if the views are worth heeding.

2 - 5 - 3 Traditional Leadership

(1) Traditional Leader ("Laigwanak")

The leader is appointed by the whole tribe while he is still uncircumcised ("Laiyon"). He is assisted by the elders to acquire leadership skills. The leader convenes meetings twice every month and plans the tasks to be performed by the respective groups. Also, he collects money for the various traditional functions, teaches the uncircumcised youth correct manners and how to behave in front of elders.

When his age determines that he is due for circumcision, he collects money from his peers to give the elders "Inaishi Enderiti" something to eat signifying that the teenagers have reached the age to be circumcised; and the elders are requested to allow them to be circumcised. Thereafter, the elders eat "Engebaata" and the teenagers are circumcised and promoted to the status of

Morans (Junior Youth). After circumcision, a special initiation ceremony known as "Eunotu" is performed to promote junior Morans to senior Morans at the age of 15. However, this ceremony cannot be performed without permission of ritual or spiritual leaders.

For senior Morans to be promoted to the rank of Junior Elders, a special ceremony known as "Olung'eshher" is conducted every seven years. Also, minor and informal ceremonies are performed to promote Junior Elders to Senior Elders. Senior Elders are full tribal leaders and the voice of authority among the Masai traditions and customs.

The British authorities in Kenya and eventually in Tanganyika tried to stop Eunotu (initiation ceremony) and Olung'eshher from taking place so as to exercise authority over the Masai and dismantle the Masai system of leaders; but failed. Then, they tried to create chieftainships amongst Masai ritual leadership; but these had no authority either; because when the Masai were asked to appoint a chief, they picked someone who was least qualified and had no followers.

Although, Masai land came under British colonial administration in the mid 1940s, the Masai continued to settle their cases without going to courts, e.g. by paying cows, goats and sheep. They did not apply *lex talionis* (the Jewish-Roman law which required the payment of eye for eye and tooth for tooth).

Modern education was completely rejected by the Masai in Tanganyika, and to a larger extent, by other pastoralists like the Gogos of Dodoma and Kurias of Mara regions. Only a few people took advantage of the opportunity offered by institutions like missions.

(2) Clan Leaders ("Laigwanak")

In case of clashes or murder, the first person to console the wounded or to appease the bereaved is the Clan Leader. For murder, he approaches the bereaved by giving them three cattle; a bull to be slaughtered and two cows to be given to the father and mother of the deceased, respectively.

After three or four years, the Clan Leader convenes a meeting of all members of the lineage of the murderer and fines them 49 head of cattle as

compensation to the relatives of the deceased. This procedure is still being practiced up to now and has been legalized by the Government of Tanzania.

(3) Clan

Within the Masai and Waarusha communities, there are two main Clans: "Laizer" and "Mollel". These are subdivided into two sub-clans, and if two major Clan plan to start a war, the leaders would call their clansmen by the following names: "Orokite" and "Odomonyi" for Lazier and Mollel respectively. By doing so, the clansmen whose clan is planning to start war/conflict will immediately alienate themselves from their present groups and join forces with their clansmen without attracting the attention of other tribes.

(4) Funeral Ceremonies

When an elder dies, it is the clan leader who officiates at the burial and facilitates whatever pertains to the funeral ceremony. After two months a cleansing ceremony is performed as follows:

- All male children of the deceased and all sons-in-laws provide two tins (40 kgs) of local brew each.
- The son-in-law who married the deceased's eldest daughter provides a bull to be slaughtered which is considered as part of dowry.

In case no bull is available from the son-in-law, a bull is taken from the deceased cattle but specifically from the herd of his first wife.

(5) Other Functions

The clan leader has a number of other tasks to perform, such as resolving conflicts between members of a lineage, bequeathing land and other properties, etc. All in all he is a genuine "peacemaker".

2 - 5 - 4 Age Groups

There are four age-groups within Masai society which are still recognized. They are:

- i) Enyangusi (Senior elders)
- ii) Seuri (Junior elders)
- iii) Erkishumu (Senior Morans)
- iv) Ilandisi (Junior Morans)

Those who will be circumcised in 1997 will form the age-group to be known as "Irkishon". The junior Morans are the security guards ensuring that no cattle theft takes place their homestead or the society in general. Also, they play major roles during burial ceremonies, etc.

The age-group system is based on what is regarded as the Ritual and Warfare Model of the Masai organization. Circumcision ritual is normally conducted when boys are initiated to become warriors at the age of 14-18 years. Youths become junior warriors after five months of seclusion. They do not marry until they are promoted to senior warriors, after seven to eight years.

2 - 5 - 5 Medicine Men

When a sick person approaches the medicine man, the latter serves as a diviner in order to determine the type of disease and whether he can treat it.

The medicine men have various types of medicines which are used when bathing, for drinking and for dressing wounds cut by razor blades. Some of these medicines are Enduroto, Engokola, Olokimogi, Osinande, Endabwe and Oromukongora.

2 - 5 - 6 Taboos on Water

From the survey on water utilization at Monduli town, it was established that there are no drinking water taboos amongst the Masai and other ethnic groups residing in Monduli district. 401 (or, 89 %) of 450 respondents had no taboo on drinking water. However, nobody is allowed to bath in or around the water, nobody is allowed to wash in the water source or

around it, nobody should be allowed to conduct a water-related function near a water source.

2 - 5 - 7 Traditional Rituals

Out of 450 respondents who were interviewed, 265 (or, 59 %) agreed that there are traditional rituals related to the availability of rain. They said whenever there is drought, i.e. lack or scarcity of rain, the elders take a black female sheep and go to the mountains or around a shrine tree and slaughter it. It is eaten there and nothing is taken home except a few portions of skin (pieces of which) every individuals wears as a ring for a specified period of time until it is thrown away.

Asked whether such rituals have any positive results; 229 (51 %) said yes by adding that sometimes it rains immediately after departure from the shrine or sometime later.

2 - 6 Public Health and Sanitary Education

2 - 6 - 1 Health Services

(1) Arusha Region

Arusha region has 15 hospitals, 12 health posts and 234 dispensaries. This means that one hospital caters for 108,500 people. One health post serves 135,700 people and each dispensary gives service to 6,960 people. The Region has 1,668 beds, therefore each bed caters for 980 people. The situation measures up against national goals as follows:

Health Services Level

Services	Regional		National	
Beds	1	: 980	1	: 1,000
Health Posts	1	: 135,700	1	: 50,000
Dispensaries	1	: 6,960	1	: 10,000

Looking at the ratio of one bed for 980 people, one discerns that the Region has made some strides as compared to national goals. This situation has come about as a result of many people appreciating health services. However, there are many people who are admitted to hospitals, health posts and dispensaries, but have to sleep on the floor or are forced to share the same bed. This situation is clearly detrimental to good health.

Life expectancy in the Region is 55 years but is expected to reach 60 years by the year 2000. Major indicators on mortality of the Region as compared with the national average are as follows:

<u>Mortality</u>		
Items	Regional	National
Maternal Mortality	1,345/100,000	200-400/100,000
Infant Mortality	75/1,000	100/1,000
Child Mortality	120/1,000	190/1,000

This substantial success was achieved through vaccinations for mothers and children against polio, tetanus, measles, tuberculosis and whooping cough. Also, through practicing family planning, attending clinics, giving birth at hospitals or at any other health facilities and through increasing the number of Traditional Birth Attendants and by mounting seminars on nutrition and environmental sanitation.

Major diseases in the Region and more especially in Monduli district are malaria (about 30% of diseases), diarrhea and dysentery, eye disease, skin disease, worms, sexually transmitted disease (STD), tuberculosis (TB), typhoid and measles. The main reasons for the frequent occurrence of a number of these diseases are unsafe drinking water, poor sanitation and poor nutrition contributing to high rates of maternal morbidity.

(2) Monduli District

Monduli district has a serious lack of health services. This has been identified as a priority development problem. There are five types of services in the District covering the Study Area as summarized below:

- i) Hospital : There is one hospital which is government own and based at Monduli town.
- ii) Health Post : There are two health posts; one based at Longido and one at Mto wa Mbu.
- iii) Dispensary : There are 41 dispensaries in the District administrated as follows:
- Government : 22
 - Church Organizations : 7
 - Parastatal Organizations : 4
 - Private Individuals : 8
 - Total : 41
- iv) MCH & FP : On the side of mother and child, there are 28 Mother and Child Health and Family Planning (MCH & FP) clinics.
- v) Mobile Clinic : Generally it is very taxing on the part of inhabitants of the rural areas whose villages have no health services, because they have to walk between 10-30 km in order to get treatment.

(3) Study Area

There is one hospital at Monduli town as mentioned above and 12 dispensaries; three at Monduli town and nine in the surrounding 18 villages. The survey on health services made during the study period has revealed that out of 305 respondents 145 persons (or, 47.5 %) go to dispensaries and 72 persons to Traditional Birth Attendant as given below:

Health Services

Type of Health Facilities	Nos. of Respondents	Percentage(%)
Dispensary	145	47.5
Traditional Birth Attendant(TBA)	72	23.6
Mother and Child Health Clinic(MCH)	11	3.6
Dispensary and MCH Clinics and TBA	17	5.6
Dispensary and MCH Clinic	15	4.9
Hospital	3	1.0
Others	42	13.8
<u>Total</u>	<u>305</u>	<u>100.0</u>

Clean water is not treated and is in danger of contamination. Prevalent waterborne diseases are diarrhea, dysentery, typhoid, malaria and bilharzia.

2 - 6 - 2 Sanitary Education

(1) General

The Region has attempted to complement health education and hygiene training programme currently being conducted by introducing other programs such as:

- i) Health through Sanitation and Water (HESAWA)**
- ii) Child Survival, Protection and Development (CSPD)**

HESAWA's approach operates through networking with other organizations and departments addressing the same related sectors such as Health, Water and Community Development. HESAWA's main objective is to provide education as regards health education, environmental protection, consumption of clean and safe water, construction of modern houses and how to involve the people in solving their standard of living using the resources available in their own villages. CSPD is addressed to the reduction of maternal mortality, child mortality and under-fives mortality.

The resulting deaths have been caused by waterborne diseases, malnutrition, low level of education and lack of security and protection of children living under very difficult circumstances. This program used to be executed by the Region in conjunction with UNICEF which eventually pulled out at the end of November, 1994 on the understanding that the Region would promote the spirit of networking among NGOs and donor agencies operating in the Region and addressing the same issues.

It is only in the recent past that the subject known as health education was introduced in schools. The contents of the subject are designed by the Ministry of Health; but most of the teaching is done by primary school teachers, some of whom are not well equipped either with lesson content or with the teaching method. There is no clear-cut education program on health and sanitation due to the following reasons:

- i) The Ministry of Education has all along concentrated on teaching domestic science in primary schools and cookery in secondary schools but as an optional subject for the latter.
- ii) The Ministry of Health whose portfolio would have been ideal to deal with the above heading was left out until recently when concerted efforts were needed to sensitize the pupils on the dangers and effects of AIDS on their lives.
- iii) Lack of coordination among different ministries and lack of reliable transport have contributed to the delay in charting out a better program which could involve ministries to cater for the needs of school children by teaching them health and sanitation plus sensitization of pupils to the danger posed by AIDS.

(2) Sanitary Education in Primary Schools

a) General Information on Selected 17 Primary Schools

There are 24 primary schools in the Study Area; three schools at Monduli town and 21 schools in the surrounding villages. Also, there are two secondary schools and a Teachers' College in Monduli town.

17 primary schools have been selected for the survey on the current educational program for health and sanitation. There are 4,729 pupils; 2,586 male pupils and 2,143 female pupils. These pupils are taught by 142 teachers (Table 2-3). Thus, the ratio of teachers to pupils is 1: 33.

The subjects of domestic science, health education and sensitization against AIDS are taught in all primary schools. These subjects are taught in every class i.e. from Standard I to Standard VII. The sessions are distributed to different teachers on request. Each teacher teaches twice daily i.e. 40 minutes per session, totaling 200 minutes a week.

b) Teaching Methods and Material Used

In almost all schools except for three primary schools, Emairete, Lossimigor and Tukusi, teachers use various methods to teach domestic

science, health education and sensitization against AIDS to pupils in Standard I-VII. These include chalkboards, posters, hoes, cookers for boiling water, soap, pots for preserving clean and safe water for human consumption and so on (Table 2-4). Role-plays are practiced at Enguik primary school.

Contents of the subjects taught in health and sanitation education generally include the following:

- Personal hygiene,
- Environmental sanitation,
- Water use and consumption,
- Balanced diet,
- Clean air,
- First aid,
- Boiling water for human consumption, and
- Cookery

The problem with respect to sanitary education is the acute shortage of learning materials especially teachers' guides, textbooks and teaching aids.

c) Impact in Pupils' Homes

According to comments from teachers, the impact of teaching on pupils with regard to health and sanitation in their houses has been remarkable in the sense that pupils boil water/milk for drinking and clean their houses. They have been able to convince some parents to dig pit-latrines and special places for garbage disposal.

Some pupils are now keen to wash their clothes, iron them and comb their hair regularly. They put on shoes, and provide first-aid to people bitten by snakes. They cut grass around their homes in order to get rid of mosquitos.

2 - 7 Existing Water Supply and Sanitation Services

2 - 7 - 1 Water Supply

(1) Water Sources

The water sources currently used for water supplies are categorized into the following: small-scale dams, boreholes, springs, Tanzanian Military Academy (TMA) pipeline, shallow wells and rainwater storage. A summary of water sources is given below (refer to Table 2-5 and 2-6):

Summary of Water Sources

Source	Nos. of Source	Source Capacity	Unit
Dams	32	5,012	1,000m ³
Boreholes	2	210	m ³ /day
Springs	7	337	m ³ /day
TMA Pipeline	1	108	m ³ /day
Shallow Wells	2	0	m ³ /day
Rainwater Tank	1	0	m ³ /day

a) Small-Scale Dams

The first dam was constructed in 1941 at Meserani Bwawani village. The former Italian settlers constructed six dams in 1949 at Arkatan village and in 1960s when they left, attempts were made to rehabilitate them but with no success. Nevertheless, in 1994 the Center for Agricultural Mechanization and Rural Technology based at Tengeru in Arumeru district stepped in to rehabilitate two of the six dams.

This is the commonest type of water source facility and is the most suitable for the surrounding village areas; because it can be constructed easily by concerted action from the villagers coupled with appropriate technology to be supplied either by the Government of Tanzania or donor agencies from abroad. This type of water source is found at Monduli town and in 16 villages and sub-villages.

Inflow to reservoirs is available only for several months during the rainy season as a result of the rainfall pattern in the area. Furthermore, storage

water is easily subject to contamination mainly due to the encroachment of animals into the reservoirs.

The inventory survey of existing dams has been made to obtain general information on dams and reservoirs including the coordinates of dams and sizes of dams reservoirs to make a rough estimate of reservoir capacities. The catchment area is measured with planimeters on topographic maps with the scale of 1:50,000 (Table 2-7).

According to the survey, there are 46 small-scale dams and reservoirs, of which 32 dams and reservoirs are in use; 14 dams and reservoirs are not working being in need of rehabilitation works (Table 2-8). The storage capacities range from 5,000 m³ to 2,678,000 m³ of Nanja dam at Arkatan village with the average storage capacity of 75,000 cm³ except for Nanja dam, the principal large reservoir in the Study Area. The heights of most dams fall within two to six meters with the exception of Nongilili No.2 dam at Arkatan village which is one meter and Moita dam at Moita Kiloriti village which is 10 m in height. General information on small-scale dams in use is as follows:

Small-Scale Dams

Village	Nos. of Dams	Storage (1,000 m ³)
Lendikinya	2	157
Enguik	1	51
Arkatan	5	3,070
Lepurko	2	209
Meserani Juu	1	77
Nengungu	3	123
Moita Kiloriti	3	340
Moita Bwawani	2	71
Meserani Bwawani	2	103
Mbuyuni	2	115
Makuyuni	4	179
Naitolia	2	162
Emairete	3	355
Total	32	5,012

b) Boreholes

Two boreholes are in operation for village water supplies; one borehole at Mswakini village with the water yield of 135 m³/day for 10 hours operation;

the other at Mswakini village with the water yield of 75 m³/day, thus totaling 210 m³/day of source capacity.

The borehole located in the Veterinary Department's yard at Makuyuni village was abandoned in 1992 due to a breakdown of pumps. The borehole at Mswakini village is being operated by Minjingu Phosphate Company for 12 hours a week to collect 90,000 liters of industrial water. The villagers receive water during the pump operation. The company renewed the pump and engine and operates it at its own cost including salaries for two operators, fuel and other items.

c) Springs

There are seven springs utilized for water supplies. Spring water is conveyed to villages through pipelines. This type of water source is found at Monduli town and four villages and the total water source capacities come to 337 m³/day as follows:

Springs

Village	No. of Springs	Source Capacity (m ³ /day)
Monduli Town	2	150
Enguik	1	66
Lolkisale	2	104
Tukusi	1	11
Emairete	1	6
Total	7	337

d) TMA Pipelines

TMA pipelines collect water at Emaoi spring located in the foothills of Mt. Meru and convey water to the Tanzania Military Academy near Monduli town, and distribute water for domestic use of Monduli town (45 m³/day) and two villages of Meserani Juu (43 m³/day) and Nengungu village (20 m³/day) with a total source capacity of 108 m³/day.

e) Shallow Wells and Rainwater Tanks

Each of four villages have a single shallow dug well for domestic use; they are the villages of Moita Kiloriti, Lolkisale and Emairete and Oltukai sub-village. These shallow wells yield very limited water so that the villagers collect water by a process of ladling.

Two rainwater storage tanks exist at Arkatan village; however, only one tank is working at present. The quantity of water available for domestic use is negligible.

(2) Water Supply Systems

a) Piped Water Supply System

Monduli Water Supply

Monduli water supply project has two types of water sources: TMA pipelines and the springs of Kilimani and Rasharasha. Water from springs is conveyed to the confluence box by gravity with the different pipeline systems of Kilimani and Rasharasha. Water from TMA pipelines is conveyed by gravity from the TMA storage tank to the booster pump station, and is then pumped up to the MCE (Monduli College of Education) tank. The water conveyance system is given below:

Kilimani pipeline from spring to Monduli town:

- G.S. pipe with diameter of 2"
- Total length of 4.5 km

Rasharasha pipeline from spring to Monduli town:

- G.S. pipe with diameter of 2"
- Total length of 2.9 km

TMA pipeline from TMA storage tank to booster pump station:

- G.S. pipe with diameter of 6"
- Total length of 2.9 km
- Tank capacity of 5,000 gal. (22.7m³) at station

Pipeline from booster pump station to MCE tank:

- G.S. pipe with diameter of 3"
- Total length of 3.1 km

The water conveyed with the system is distributed in Monduli town through the house connections and domestic water points (DWP). The water is also distributed in Ngarash and Rashaine areas through DWP. Total service population is about 26,000 persons as given below:

Monduli Town Center

- House connections : 1,000
- Three DWP : 9,000
- Sub-total 10,000

Ngarashi Area

- Two DWP : 12,500

Rasharasha Area

- One DWP : 3,500
- Total 26,000

The water conveyed from two springs is stored for 12 hours from 6 p.m. to 6 a.m. the next day in two storage tanks built at elevated locations near the Town. The storage capacity is 20,000 gallons (90 m³) each with a total capacity of 180 m³. Rotational water supplies are applied to the project when intake water from springs has been decreased to a certain extent. In case storage tanks become empty, base water flow into the tanks is supplied for designated service areas only. For this purpose, the service areas are divided into the following three blocks:

Monduli Town Block

- District Commissionaire Office, etc. : everyday supplies
- Butcheries : everyday supplies
- Town area : everyday supplies
- Three DWP : everyday supplies

Ngarash Block

- Two DWP : every two days supplies

Lashaine Block

- One DWP : every two days supplies

It is reported that diversion water from TMA pipelines is around 45 m³/day. To make matters worse, the booster pump cannot operate as originally designed owing to the frequent failure of electric power supplies.

Makuyuni Village Water Supply

Of two boreholes, only one borehole is working at present. Groundwater is pumped up to the elevated storage tank through the pipelines with a length of about 4.1 km (G.S pipe of 4" diameter). The pump is operated everyday for seven hours a day from 7 a.m. Water of 135 m³/day is distributed through three DWP located at the housing area of Makuyuni village.

b) Point Sources

For the other 17 villages, water is provided without water distribution systems. The villagers are spending large amounts of time and energy in collecting water.

Lendikinya Village: 2,873 population

There are two small-scale dams as water sources. New Alkaria dam with a long cattle trough was recently constructed just downstream from Alkaria dam that was breached in 1994. The total storage capacities are 167,000 m³; 142,000 m³ for New Alkaria dam and 15,000 m³ for 15,000 m³.

Enguik Village: 4,090 population

Water supplies to the villagers rely on three springs, of which only Oldeani spring has perennial flows. With the existing intake facilities and conveyance pipelines, 66 m³/day of water is supplied for the villagers; however, water supplies might be increased by 20 to 30 percent when the intake facilities have been improved and air valves have been installed to the pipelines.

Storage water of Enguik dam with the capacity of 51,000 m³ is not used by the villagers for domestic purpose, but for livestock use, because livestock encroach on the reservoir, hence causing a deterioration of water quality.

Arkatan Village: 1,895 population

Out of five small scale dams in the Study Area, Nanja dam constructed in 1969 has the largest storage capacity of 2,678,000 m³. The total storage capacities of the five dams amounts to 3,070,000 m³. Two rainwater tanks were

build in the 1960s for private water use, of which one tank with the capacity of 88,000 gallons (400 m³) was fully rehabilitated and the other is not in use.

Lossiminingori Village: 1,720 population

There are two dams of Lossiminingori and Rasharasha with design capacities of 129,000 m³; however, they are not working because of damage to the dam embankment. Urgent rehabilitation work is needed.

Lepurko Village: 3,042 population

There are two dams of Lepurko and Kitasho for domestic and livestock use. The storage capacity of Kitasho dam has been reduced to 40,000 m³ due to failures of embankment. The embankment of Lepurko dam with a storage capacity of 169,000 m³ suffers from frequent breaches, the reason of which may be inadequate design of the spillway; the sill elevation of the spillway is relatively high when compared with the crest elevation of the embankment.

Meserani Juu Village: 2,985 population

The TMA pipeline water is distributed to the villagers through four DWP. The amount of supplied water is estimated at 43 m³/day. The storage water of 77,000 m³ of Ngoi Kumen dam is also utilized for the villagers.

Nengungu Village: 1,586 population

The villagers tap clean water of about 20 m³/day from the TMA stand pipe for their domestic use. The amount of water supplied seems inadequate to meet demand. They use water from three dams with the total storage capacities of 123,000 m³ for both domestic and livestock use.

Moita Kiloriti Village: 1,685 population

Three dams are water sources for the Village. The storage capacities are 178,000 m³, 95,000 m³ and 67,000 m³ for Ektivuk dam, Orngarwa dam and Emao Ektivuk dam respectively, totaling 340,000 m³. Ektivuk dam has the largest storage capacity, but the villagers use the water only for livestock use because the reservoir is thick with algae.

Moita Bwawani Village: 3,934 population

Total storage capacities of two dams are 71,000 m³ only. Water quality of Ndulele dam with a storage capacity of 61,000 m³ is poor, unsuitable for domestic use, due to the encroachment of livestock into the reservoir.

Meserani Bwawani Village: 1,151 population

There exist two dams in operation for domestic water use with the total storage capacities of 103,000 m³; Malarami dam with a storage capacity of 97,000 m³ and Olnjapatwa dam with the storage capacity of 6,000 m³.

Mbuyuni Village: 3,700 population

Two dams are in use for domestic water supplies. The total capacities are 115,000 m³, 102,000 m³ for Mbuyuni No.1 dam and 13,000 m³ for Mbuyuni No.2 dam.

Lolkisale Village: 4,397 population

There are only two springs used for water supplies to meet the water demand of the village whose land area is 608 m², being the largest among the villages in the Study Area. The total source capacities are around 104 m³/day. Villagers living far from the springs take small quantities of water from holes dug along streams.

Tukusi Village: 1,541 population

Water sources of the villagers are four springs located along the Tukusi river. Total water source capacities are around 11 m³/day. In the rainy season, springs are often inundated by floods and the villagers dig shallow holes at elevated locations along the river to obtain percolated water for their domestic use.

Makuyuni Village: 3,604 population

There are two boreholes and four dams. At present one borehole with a source capacity of 135 m³/day is used for water supplies for the villagers in

Makuyuni and neighboring population, and the other is abandoned because of the breakdown of the pump. Total source capacities of the four dams amount to 179,000 m³.

Naitolia Sub-Village: 1,259 population

Two dams are functioning for water supplies. Storage capacities of the dams are being decreased due to heavy siltation, and the present total storage capacities are estimated at 162,000 m³. In case of water shortages, the villagers go to Makuyuni village to buy water.

Oltukai Village: 691 population

The embankment of Oltukai dam is not yet rehabilitated. The villagers now collect water from Oltukai river during the rainy season, though river water is very muddy. During the dry season they dig the river bed to collect water oozing through the river bed. According to villagers, the water is salty.

Mswakini Village: 2,391 population

The borehole being operated by a private company is the only dependable water source for domestic use. The pumping station is operated for 12 hours a week, and the villagers take water from the borehole during pump operation days and from the water storage tank installed at the booster pumping station. The source capacity is 75 m³/day.

Two dams were constructed with total capacities of 66,000 m³. The water from Mswakini No. 2 dam, built near to the main pumping station of the borehole, is used for livestock only. The other dam is not working due to breakdown of the embankment. With renovation of the embankment, the dam may have a storage capacity of about 45,000 m³.

Emairete Village: 4,674 population

One spring with a source capacity of six m³/day and three dams are being used by the villagers. The total storage capacities of the dams amount to 355,000 m³, of which the water from Monduli Juu dam, the largest among the three dams, is used for livestock only.

(3) Water Utilization

The survey on water utilization and villagers' acceptance of water supply provision was conducted to establish the available water facilities, how they are utilized, to what extent they can serve the populations, and other aspects. Furthermore, it was also the aim of the survey to determine water users' perceptions about water utility and its usefulness with regard to their day-to-day activities, consumption and safety. The survey was entrusted to a Tanzanian consulting firm based in Arusha with an implementation period of four months from December, 1994 to March, 1995.

550 households were sampled; 100 households for Monduli town and 450 households for the surrounding 18 villages at the rate of 25 households per village. The survey was carried out by interviews (230 samples) and questionnaire (320 samples) in the following ways:

Monduli Town:

- The survey team approached the authorities at Sinon-Ngarashi and Milimani villages in Monduli town to convene meetings of their sub-villages in order to sample 100 households.
- From the 100 household samples, 50 households were interviewed at their homesteads and the remaining 50 households were surveyed by using questionnaires.

18 Villages:

- The same approach as above was used to obtain 450 household samples, i.e. 25 households from each village.
- 10 household samples in each village were surveyed through interviews and the remaining 15 household samples in each village were surveyed by using questionnaires, totaling 230 samples for interview and 270 samples for questionnaire.

General Household Information

The respondents' tribes comprise Masai, Waarusha, Iraqw and another 11, of which Masai and Waarusha are dominant accounting for about 90 percent of the respondents. In the surrounding 18 villages, about 55 percent of the

people are Masai, whereas Waarusha is the largest tribe in Monduli town. The average number of family members is 8.4 persons in Monduli town and 8.8 persons in 18 villages.

Major activities are related to agriculture and livestock keeping. 90 percent of the respondents are engaged in these activities. Nine percent of the respondents are engaged in combined agriculture of crop production and livestock-keeping compared with 67 percent in the 18 villages. The households with a monthly income not exceeding 10,000 Tanzanian Shillings (Tsh) account for an average of 68 percent of the respondents; 39 percent in Monduli town and 75 percent in the 18 villages.

General Information on Households

Items	Monduli Town	18 Villages	Total
<u>Family Members</u>	8.4	8.8	-
<u>Occupation (%)</u>			
- Agriculture	87	23	34
- Agri. cum livestock	9	67	56
- Others	4	10	10
<u>Total</u>	100	100	100
<u>Monthly Income (%)</u>			
- Tsh 10,000 or less	39	75	68
- Tsh. 10,000 - 30,000	23	17	18
- Tsh. 30,000 - 50,000	7	4	5
- Tsh. 50,000 and above	31	4	9
<u>Total</u>	100	100	100

Water Consumption Rate

People consume about 80 liters of water per family of 8.4 persons in Monduli town, and 70 liters per family of 8.8 persons at the surrounding villages. The average daily water consumption rates are estimated at 9.5 liters per capita for Monduli town and 8.0 liters per capita for the surrounding villages. In case of water shortages, especially in the dry season between July and November, people buy drinking water. The price is Tsh 1,000 per 200 liters, i.e. Tsh 5.0 per liter.

Distance to Water Source

28 percent of the respondents in Monduli town, where house connection systems are partially provided, replied that water sources are available within a distance of 400 meters. However, in the surrounding 18 villages, water sources are available within a distance of 400 meters for only 11 percent of the respondents. The average distances from houses to water sources are around three km for Monduli town. Most villagers in the surrounding 18 villages have to walk between five and 30 km to collect water.

Water Collection

The number of people involved in collecting adequate water for household use ranges from one to four with an average of 3.3 persons per household. 95 percent of respondents need three or more hours to collect water from water sources and carry it to homes.

Water Collection

Items	Monduli Town	18 Villages	Total
<u>Nos. of People (%)</u>			
- 1 person	5	6	6
- 2 persons	11	18	17
- 3 persons	73	39	43
- 4 persons	11	37	34
Total	100	100	100
<u>Time to Collect Water (%)</u>			
- 1 hour	20	0	3
- 2 hours	13	2	2
- 3 hours and more	67	98	95
Total	100	100	100

Water Availability and Quality

15 percent of the respondents said that water was available through the year; seven percent for Monduli town and 17 percent for the surrounding 18 villages. 18 percent of the respondents are satisfied with the general water quality.

Water Availability and Quality

Items	Monduli Town	18 Villages	Total
<u>Water Availability (%)</u>			
- Throughout the year	7	17	15
- Limited amount	57	20	27
- Rainy season only	36	63	58
<u>Total</u>	<u>100</u>	<u>100</u>	<u>100</u>
<u>Water Quality (%)</u>			
- Not satisfied	35	56	52
- More or less satisfied	58	24	30
- Satisfied	7	20	18
<u>Total</u>	<u>100</u>	<u>100</u>	<u>100</u>

Monthly Water Charge

An average of 69 percent of respondents paid no water charge; 60 percent for Monduli town and 70 percent for the 18 villages. 21 percent of the respondents in the 18 villages replied that they paid monthly water charges of more than Tsh 1,000.

Monthly Water Charge

Items	Monduli Town	18 Villages	Total
Doesn't pay	60	70	69
Tsh 100 - 1,000	37	9	12
More than Tsh 1,000	3	21	19
<u>Total</u>	<u>100 (%)</u>	<u>100 (%)</u>	<u>100 (%)</u>

2 - 7 - 2 Sanitation

(1) Monduli Town

80 percent of households in Monduli town have latrines although they leave much to be desired. Many of the pit latrines have been built by using poles and mud; but thatched with corrugated iron sheets. In some isolated areas, especially in the center of the Town, the toilets are almost falling down and they are in bad shape. 20 percent of households have no toilets and have no plans to build them.

Lack of village health committees may be the major cause because no one is interested in sensitizing others to build good and stable pit latrines. For those who can afford to install water facilities in their houses, it follows logically that they have septic tanks and can do away with the inconveniences caused by flies and bad smell.

(2) Surrounding 18 Villages

Almost 40 percent of the people have toilet facilities. Toilet types are septic tank toilets (4 %) or pit latrines (96 %). 60 percent of the people have no toilets; 55 percent of people defecate anywhere away from the houses; five percent of people go into the bush. Waste water is poured anywhere around the houses (64 %), in the boreholes (26 %) and anywhere (10 %).

The crucial point is that a number of village executive officers who are expected to be in the front line to motivate villagers to form village health committees to sensitize villagers to build pit latrines themselves have no toilet.

2 - 7 - 3 Institution and Organization

At the national level, the Ministry of Water, Energy and Minerals is the highest government organization concerning water supply projects. The Ministry provides policy direction, special technical expertise, support of planning, design and supply, and procurement of materials and equipment; provision of centrally allocated budgets and others necessary for implementation of water supply projects.

The Regional Water Department represented by the Regional Water Engineer under the control of the Regional Development Directorate gives engineering assistance to local governments for investigations, planning and implementation of rural water supply projects. The Regional Water Department has a hydrology section, hydrogeology section, drilling section, project preparation section, construction section and others related to water supply schemes (Figure 2-2).

The ownership and responsibility for operation and maintenance of rural water supply facilities rest with local governments at village and district level according to the Local Government Act of 1982. The District Council which

is directly under the Prime Minister's Office is the highest policy-making body at the district level.

The Monduli District Water Department, one of the functional divisions of the Regional Water Department is directly responsible for the execution of the District Council's water projects and will represent the Regional Water Engineer for national water supply projects within the District. Organizations of the District Water Department are presented in Figure 2-3.

At the village level, the Water Committees are organized with a chairman, a secretary and committee members. According to the Government's guideline, it is recommended to elect at least six committee members with terms of services of five years. Most of the village committees in the Study Area consist of five to eight members, whereas Lolkisale village and Lendikinya village have 10 members and 11 members respectively.

The present responsibilities of the Village Water Committees differ from village to village as each village has a different type of water supply facilities. They may be outlined as follows:

- Maintenance of water source facilities.
- Control of water quality.
- Petition of rehabilitation works to the government or other agencies.
- Collection of funds for operation and maintenance of water facilities.

2 - 7 - 4 Operation and Maintenance of Monduli Water Supply Project

Monduli Water Supply Project provides water for approximately 26,000 residents. Water is provided through public water taps and house connections as well as commercial connections. Water from public taps is free of charge at this time. Water through house and commercial connections is charged at a flat monthly rate of Tsh 200 and Tsh 400, respectively. Water supply shortage occurs during the dry season between August and October.

Monduli District Water Department is in charge of providing water and of collecting water revenues to its council. The rate of water revenue collection is low. Water revenue efficiency, measured by the ratio of water bills to be collected to the water bills to be paid, is 40 percent for domestic users and 70 percent for commercial users (Table 2-9). Basic reasons for not being able to collect water bills are; no systematic collection was enforced; no billing records were accurately kept; and most importantly, water is not continuously available for 365 days, i.e., non dependability of continuous water supply forced users not to pay the bill.

One serious problem resulting from not rigorously enforcing water bill collection is that water is not available throughout the year. When water is not available, the District Water Department cannot convince its users to pay. The annual budget allocations of salaries and wages, recurrent expenditures, and capital development will be made through the central government. Both recurrent expenditures and capital development budget allocations are not sufficient to cover the basic minimum needs for the maintenance and operation of the project.

The Water Department of Monduli district has a staff of 33 with an annual budget of Tsh 6,157,764 for the fiscal year 1995/96 ending in June, 1996. Recurrent expenditures were Tsh 7.4 million. Water revenue of even 100 percent bill collection efficiency could only satisfy 11.4 percent of total annual budget. It is far from satisfactory in terms of "financial self sufficiency". The annual budget allocation of salaries and wages, recurrent expenditures, and capital development will be made through the central government. Both recurrent and capital budget allocation is not enough to cover the basic minimum costs of operation and maintenance.

2 - 8 Environment

2 - 8 - 1 Environmental Policy

The Government of Tanzania recognizes that it needs to pay attention to the environmental aspects of development in consideration of its frangible natural resources base, a growing population and problems of urbanization and industrial development (RPFB, 1994). The overall goal of the environmental

sector is to achieve sustainable development that maximizes the long term welfare of both present and future generations of the Tanzanian population. The goal embraces the following broad objectives:

- To ensure sustainable and equitable use of sources.
- To prevent and control degradation of land, pollution of water and air.
- To conserve natural and man-made heritage and biological diversity.

2 - 8 - 2 Environmental Administration

(1) Organization

The Ministry of Tourism, Natural Resources and Environment (MTNRE) is directly charged with environmental administration. This Ministry has six departments, among which the three main departments are Tourism, Natural Resources and Environment. Under each of the governmental departments, there is at least one corresponding parastatal organization. Outlines of the work of the three departments are given in Table 2-10.

(2) Laws and Policies on Environment

The following laws related to environmental conservation have been enacted.

- National Parks Ordinance
- Forest Ordinance
- Grassland and Fire Ordinance
- Natural Resources Ordinance
- Wildlife Conservation Act

Since environmental policies are horizontal and cut across the functional and sectoral divisions of responsibilities, each sector addresses the specific policies and strategies related to the environment. Some policies on environmental conservation are as follows:

- Forest Policy
- Agenda 21
- Agenda 21 - National (1993)
- National Conservation Strategy for Sustainable Development
- Environmental Policy

(3) Application of Environmental Impact Assessment

Application of environmental impact assessment (EIA) for matters pertaining to water projects is not yet a legal obligation. However, currently there are only some guidelines for preparation of EIA for any development in the National Parks. Consequently, EIA is occasionally conducted if there is a need, for instance, in case of building infrastructure in the National Parks.

2 - 8 - 3 Ratification of Conventions Concerning Environmental Conservation

The Government of Tanzania has ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention for the Protection of the World Cultural and National Heritage. For the case of Manyara Lake, the Ramsar Convention is in process; but not yet ratified.

In accordance with the provision of CITES, the following wild animals and birds are protected:

Animals:

- Cheetah
- Pangolin
- Rhinoceros
- Black and White Colored Monkey
- Red Colobus Monkey
- Wild Dog
- Bush Baby
- Giraffe

Birds:

- Love Bird (Yellow collared love bird)
- African Gray Parrot
- Whale Headed Stock

The following is a list of endangered species in Tanzania and in view of that a local ban or prohibition of killing has been exhibited:

- Bustard
- Gown Crane
- Saddle Bill Stock
- Secretary Bird
- Gotah Heron
- Peregrine Falcon

2 - 8 - 4 Particular Areas Officially Protected

For reasons of environmental conservation, there are four specified areas which are categorically and officially protected; national parks including Lake Manyara, Arusha, Tarangire, Serengeti, Kilimanjaro and six other national parks; game reserves of Mount Meru, Kilimanjaro and 18 other reserves; game controlled areas; forest reserves.

For environmental conservation of the above specified areas, the Government of Tanzania has control over artificial intervention. Most stringent regulation is applied to national parks, and, for example, people's residence, breeding of animals, game and alteration of flora and geographic features are prohibited (Table 2-11).

2 - 8 - 5 Right of Water Utilization

The right of water utilization is vested by the Government in the Ministry of Water, Energy and Minerals. Water utilization anywhere in Tanzania is acceding to the legal basis of water right as follows:

Water Law (Ordinance)

- i) Act No.42 of 1974 - Water Utilization
(Control and Regulation Act, 1974)
- ii) Act No.10 of 1981 - Water Utilization
(Amendment of Control and Regulation Act, 1981; to be read as the principal act.)

iii) Act No.17 of 1989 - Water Law
(Miscellaneous Amendments No.2)

Main Features of the Acts

i) Act No. 42 of 1974

Section 8 : All water in Tanganyika (Mainland Tanzania) is vested in the United Republic i.e. water is public property.

Section 14 : Subject to the provision of this part and to the provision of Section 53 of Mining Ordinance, no person shall divert, dam, store, abstract or use water or for any such purpose construct or maintain any works, except in accordance with the existing right or with water right granted.

ii) Act No.10 of 1981

Section 15A : Discharge of effluent

Section 18A : Wells and boreholes

2 - 8 - 6 Drinking Water Standards

Quality of drinking water shall conform to all the requirements of the Physical and Chemical Standards established by the Government of Tanzania. Water shall be tested with respect to physical and chemical properties whether substances may affect palatability, or substances may affect human health, or substances may be toxic. Details of the drinking water standards are given in Table 2-12.

According to the Tanzanian Water Health Standards, small scale rural water supplies are subjected to frequent examination of bacteriological water quality. Drinking water should not contain any micro organisms known to be pathogenic. It should also be free from bacteria indicative of excremental pollution. The Tanzanian Water Health Standard Committee has recommended that the Standard will be in use until the circumstances permit the full application of the International Guidelines laid down by the World Health Organization (WHO).