THE CONTROL OF WATER SHORTAGES FOR IMPROVED LIVELIHOODS
(A CASE STUDY OF NGWATA LOCATION, MAKUENI DISTRICT)

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D E C L A R A T I O N

I Mutinda Felix do hereby declare that this project is my original work and has not been presented for a degree in any university.

SIGNED _____

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DECLARATION OF THE SUPERVISOR

This project has been presented for examination with my approval as university supervisor.

SIGNED _____

SUPERVISOR MR. LUKE OBALA

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DEDICATION

To my beloved Dad, mum and brothers. What you have done to me as far as education is concerned, nobody else could have. Your support would remain fresh in my mind.

TABLE OF CONTENTS PAGE

CHAPTER FOUR

LIST OF TABLES

LIST OF MAPS

LIST OF FIGURES

CHAPTER ONE

1.0 ABSTRACT

All living things for their survival need water. It's a very crucial determinant in the life of all living things. Water is a natural resource and has some tangible practical value. There is no life without water. From an economist view, water is termed, as a scarce commodity hence there's need for proper usage. Human beings need water for cooking, drinking, and accomplishing sanitary purposes and washing. Crops need water for their growth while animals such as livestock require it for drinking. There is great need to ensure sufficient supply of clean and safe water for rural people.

This research is intended to highlight on the possible methods of controlling water shortages for sustainable development especially in Ngwata location in Makueni District. The study focuses also on the results that might occur due to water shortage .The second national Development plan (1970-1974) contributed efforts towards provision of access to safe drinking water for the people living in rural areas.

The supply or control of water shortage requires proper management that looks into the existing water supply infrastructure. Water is a very important aspect of development in most of the rural areas. Water ensures efficient social – economic development of any rural population. If control of water shortages is well ensured in any rural area or even an urban area some benefits are achieved and these are measured in terms of the economic development of such an area.

1.1 PROBLEM STATEMENT

Water is an essential commodity which is closely linked to the social economic development of a country .The residents of Ngwata location have experienced non existence of this development due to the increasing rate of water shortages. There are several problems experienced in Ngwata location due to lack of proper control of water shortages. For example,there's low production in the farming lands.Inadequate control of water shortages in Ngwata location have affected the agricultural yields. The yields of crops are very poor, hence the economies of agriculture is declining.

Secondly the people in Ngwata location almost have to walk for long distances to fetch water from the existing water supply infrastructure. For example, to collect water from the existing wells in Ngwata location, a big percentage of residents have to walk for long distances to such wells. Not all residents of Ngwata location have wells in their homesteads. This habit of travelling for long distances affect the time set for doing other duties hence inefficiency is created.

Thirdly, a large percentage of the residents in Ngwata location consume low quality water. Water found in many areas of Ngwata location is unclean and unsafe for drinking. But due to its scarcity, the residents consume it thus becoming vulnerable to various diseases such as bilharzia and cholera.

The conclusion of the problem statement will be to investigate on what can be done so as to ensure an effective control of water shortages. In other words: how can supply of water be increased with changing population and other subsequent needs.

1.2 HYPOTHESIS

The cause of water shortages in Ngwata location is due to poor management of the existing water supply infrastructure.

1.3 RESEARCH OJECTIVES

1. To identify the possible reasons contributing to water shortages.
2. To identify and document what measures have been undertaken in similar circumstances by other areas facing such problems.
3. To make recommendations/ proposals on possible measures that can enhance proper control of water shortages.

1.4 RESEARCH METHODOLOGY

The study is divided into 4 chapters. Chapter 1 of the study deals with introduction, problem statement, objectives, and organization, of the study, scope, and significance of the study and the methodology used. Chapter 2 only presents the literature review of the existing literature used to conduct the study. Chapter 3 covers the case study and data analysis. Chapter 4 deals with the findings, recommendations and the conclusion of the study.

1.5 SCOPE OF THE STUDY

The study is only focused on the control of water shortages in Ngwata location. This location is one among the locations found in Makueni District with mush problems of

water shortages. Within the data analysis section, the study shows several parts of the location that are affected by this problem of water shortage.

Thus the study is concerned with measures that can be followed by water managers in the area (location) or any other region in the country so that water problem can be fought well. Water is looked at as a central commodity and provider of life in all aspects. The department of water in the region specified will assist the researcher to accomplish his objectives.

1.6 SIGNIFICANCE OF THE STUDY

Water is a prerequisite for survival of both people and livestock in semi-arid areas such as the case study. Therefore a study such as this would highlight water shortages and proposals based in other successful cases in addressing water shortages.

CHAPTER TWO

LITERATURE REVIEW

2.0 DEFINITIONS:

Water

Water is classically termed as "the universal solvent".(Bachner 1991:79) It's a chemical combination of 2 parts hydrogen and part oxygen (H_2O or H-O-H). When pure, water is colorless, odorless and tasteless. Water is required in all aspects of development in the country. Thus it has to be supplied and provided for in sufficient amounts in rural areas as in the case study.

According to Wiener (1972), he states that there is plenty of water round the globe that could inherently meet the human needs present and in the future time. However, due to poor management of the infrastructure sources of water, there arises the problem of water inadequacy for the people in the utilization of water is affected adversely. All the possible means supplying adequate, safe and clean water for [people's consumption should be exploited so as to achieve the possible benefits (Mark, 1977).

Water shortage

Lewis (1973:7) defines water shortage to be an excess of quantity of water demanded over available supply at some given artificial price. Generally, there is no consideration given to allowing a rationing of the limited supply of water by using price mechanism as a rationing device. Water shortage is thus the limited amount of water present in a given area while it is been needed in large amount by the people for their needs.

Cris lewis (1973) is of the view that many of water shortages are artificial and arise from the administrative pricing of available water, and there is nothing different about water that negates the usefulness of sound economic principles. The allegations that a region is suffering from water shortages are often based on non-economic and sometimes emotional grounds that would not stand economic principles. If a more efficient allocation of existing supplies is made, so- called water shortages would disappear.

"Water shortages", in some cases could be alleviated almost immediately by the following:

(i) Raising the price of waters

(ii) Changes in technology and consumer preferences

(iii) Changes in waste control and treatment by industries, municipalities and individuals and

(iv) Changes in consumer income and available leisure time.

According to Lewis (1973), water shortages are caused by several factors that may either be natural or man-made. Such factors may include the following:

(i) Lack of good maintenance programs

(ii) Neglecting the rehabilitation or repair schedules, which have drastically made the issue of water shortages serious and expensive to control.

(iii) Leakages of the existing water mains that have increased the level of water shortages in the country.

2.1 USES AND BENEFITS OF WATER

According to Clocke (1986:70), water is termed as natural resource, which has a number of uses and benefits. In a rural area, water is a necessity in many ways: for e.g. it's used in

food production.it is also used in drinking by both man and livestock .An area with plenty of water would ensure proper survival of animals as they cool their bodies after drinking such water. Man in washing and cleaning also uses water. For example, he uses it in washing his utensils and other facilities. He also uses it in washing his utensils and other household facilities. More over, man uses water in cleaning his house as well as his body. Thus water has a diversity of uses hence should be utilized well.

Man uses water in irrigating his crops and trees especially during dry rainy seasons. Water is used in irrigating thus crops of high economic value to man such as green vegetables (spinach, kales, sukumawiki, e.t.c).

Water may be used in industries as a raw material or cooling machines in such industries.where water is scarce, many of the uses above conflict.

Most of the benefits achieved from water in rural areas include the following:

(i) Increased time for productive work

Sufficient and improved supply of water makes the work of fetching water for various domestic uses convenient and very fast. Hence those individuals allocated with the task of fetching or collecting water would now be having enough time to perform other useful tasks. This is as viewed by Curtis (1986).

(ii) Direct economic effects

Sufficient water supply encourages more economic activities in most of the rural areas in Kenya. Such activities may include the following: animal husbandry, small-scale irrigation (Steward, 1978).

(ii) Improved health and labor productivity

Sufficient water supply has the effect of reducing mortality rate in most rural areas as in the case study. Hence, labor from the population could be used as an input in increasing output, earnings and incomes of the people.

Generally, water is a very important aspect in day-to-day functioning of the human body and the related activities outside man. Proper waste disposal requires plenty of water so as to increase health standards hence there is less chances of contracting diseases like bilharzia and cholera. (Saunders et al, 1976)

Various factors influence water usage and utilization. These may include the following: cultural habits, the cost and quality of water, patterns and the standard of the living. (Cairncross, 1990) The government should be very much involved in management of proper and adequate supply of water that should be clean and safe for. Since the rural areas like in the case study, are the prime points where human labor required for use in industries and other crucial places in urban areas, there is need for proper water supply to many rural areas.

2.2 AVAILABLE SOURCES OF WATER

There are a variety of water sources. In his view, Wright (1956) categorizes the general sources of water supply as follows:

(a) Surface water

Surface water is that water found on the surface on the surface of the earth. For example, we may have lakes, rivers, ponds, seas, oceans, streams, e.t.c. Water may be got from rainfall harvesting as Wright (1956) explains. Properly made roofs aid the harvesting of

water in most cases. Such roofs may be made of galvanized iron sheets, tiles, e.t.c. There should be basements or tanks placed under the roofs so as to receive the water. Rainwater should be properly treated for it is not pure due to presence of other elements such as pathogens and harmful gases such as nitrogen and carbon dioxide. Water also found in other said surface sources is impure hence needs proper treatment.

(b) Ground water

The most common sources of ground water especially in rural areas are springs and wells. Wright (1956) properly views this. Groundwater is that water found below the surface of the earth. It is thus accessed through digging of boreholes and wells. Boreholes may be owned communally or individually. Due to high costs of digging and construction, most of the boreholes found in rural areas are communally owned, only few are individually owned. Wells are not as deep as boreholes.

Proper treatment of water got from this source should be made to decrease the level of contracting water- related diseases to man e.g. bilharzia and cholera.

(c) Piped water

Piped water is another source of water for rural areas. In this case water is pumped through pipes made of durable materials. Water distribution areas should be managed well to ensure adequate supply of water for rural residents as in the case study.

(d) Water reclamation as a source

In this case, desalinization and re-use of treated effluent get water. Effluent can be treated so as to derive the available in it for human or animal use. High technology should be imposed in this process of water reclamation so as to ensure tolerable health standards.

2.3 THE WATER CYCLE

Haines et al (1980) is of the view that the water cycle generally affects the presence of water for exploitation from many sources. Water can exist in various states, such as liquid state, solid state and gaseous state, normally called water vapor. The solid state is inform of ice. When heated, ice changes or becomes water, which is in liquid form. Further heating of water results to water vapor and this is usually in the air, mostly as clouds. The figure below shows the general water cycle.

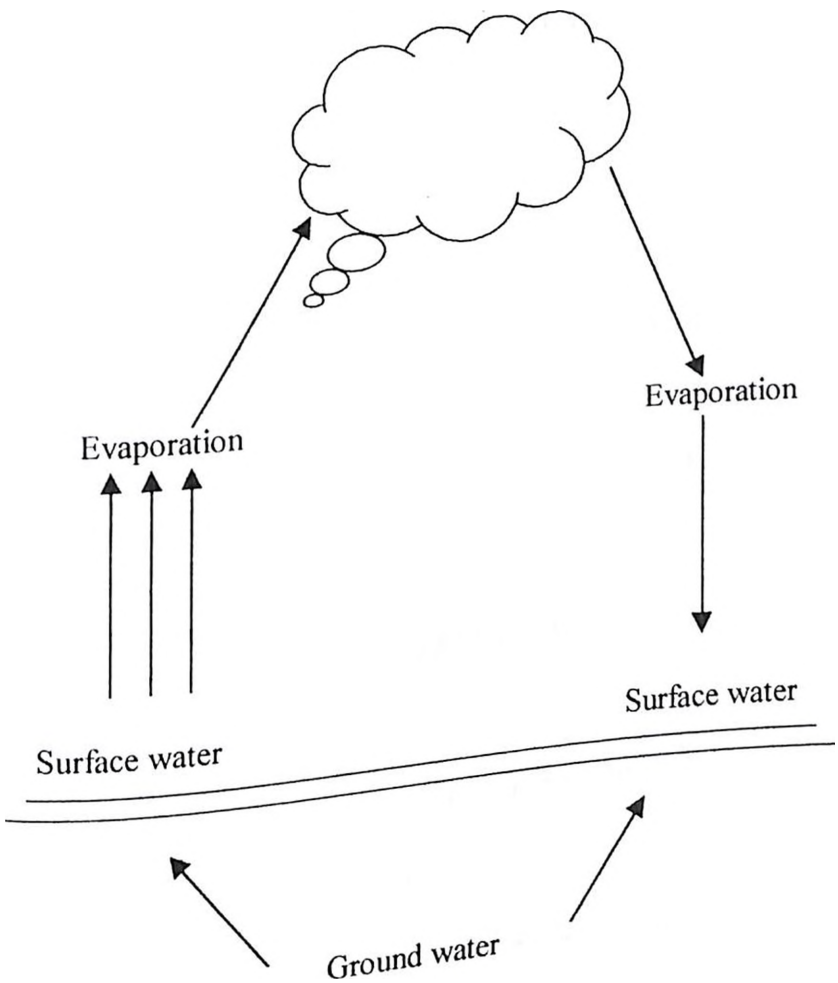


FIG: 1.0 The water cycle

Solar heat causes water to evaporate from the surface of the earth and move to the atmosphere. (Bachner, 1991) There the moisture encounters some dust particles and clings to them, creating droplets. Then rain falls and as it does so, it absorbs gases naturally in the air (oxygen, nitrogen and carbon dioxide) as well as airborne dirt, smoke, fumes, and bacteria and microorganisms. Carbonic acid is increased hence dissolving some minerals and continues to filter through the earth's crust. Ultimately it reaches the sources the sources of our water supply, categorized as surface water and ground water. The figure above clearly shows this phenomenon.

Haines et al (1980) is of the view that the cycle of water generally affects the presence of water for exploitation from the existing sources. Further, he says the sustainability of the general cycle of water is very much dependent on many determinants like wind and heat. Proper and conducive environment would sustain and ensure proper functioning of the water cycle and it's from this cycle that human life is catered for. There should be no artificial interference of the atmosphere as in the case of the scientists who in the most times enhance acid rain. This activity should be abolished because it adversely affects human health.

2.4 THE WATER DISTRIBUTION SYSTEM

Robert (1975) defines water system as all water works' components for the distribution of finished and portable water by means of storage pumps or gravity, through distribution piping networks to customer or other uses.

Distribution system of water is generally divided into either constant or intermittent. In the intermittent category, there is supply of water to people for certain duration in a day. This category of water distribution is merely aimed at avoiding wastage that is associated

with is associated with excess supply of water. (Karanja, 1992) It is aimed at acquiring equity and fair distribution of water especially in most rural areas. This category of water distribution system has a drawback of that it requires the maintenance of very large storage tanks in the house so as to store water especially when the water mains are cut off. The other disadvantage is that there is very high risk of corrosion of the metal water pipes so used.

In the other category of water distribution system i.e. the constant distribution system, the materials so used ensure that there is proper keeping of water in the main at duration of at least one day. The pressure so ensured in the main is quite enough to ensure water reach the top of the highest building. This system has some advantages as stated by Wamwangi (1990). For one, it reduces the chances of pollution. Secondly, it ensures supply of water supply of water to the people if proper maintenance is kept.

2.5 WATER PRICING

Biswas (1977) is of the view that water has an essentials social utility hence need for pricing so as to regulate the usage. After independence, the government of Kenya saw the need for proper provision of enough water especially to the rural areas. Thus the trend was aimed at improving rural development.

Water resources and the production of water services are essential natural monopolies. As a government operation, some services are marketable and may be treated as the outputs of a public utility, but others are non-marketable and even an administered price cannot be levied on individual beneficiaries. Costs chargeable to these services are usually considered public costs to be defrayed from taxes. Which tax jurisdiction should pay and the amount of payment become important questions of water management policy.

The charges of water are typically that necessary to cover costs of facilities required to make its exploitation possible. Under pressures for efficiency of water use, concern is now expressed about "wastage" in municipal, industrial and agricultural use. Warford (1976) that if water price more nearly according to its value in use, losses and inefficiencies would be reduced argues it. Such a pricing policy may be an important element in water management. The application of such a policy will require institutional innovations.

A proper water pricing system should encourage development of sustainable water utilization pattern, which achieve abundant supply of revenue to the present authorities of water management so as to correctly manage the existing water infrastructure.

Warford (1976) argues that the pricing of water generally reflects the utility of water. For example, a high amount of money is charged to those people requiring piped water for many domestic uses. Such uses may include: watering vegetables, cleaning and washing chores, e.t.c

Aaron (1972) is of the view that high consumption of water is directly proportional to the increase in income of the people. As the income of the rural people increase, they would tend to utilize much water. Hence the pricing of water should be progressive based on the level of utility and the income of the people.

2.6 WATER RESOURCE PLANNING

Lewis (1973) suggests that the council of water resources should set or start a broader set of guidelines for use in evaluating proposed water resource investments. He goes further to say that the overall purpose of water and land resource planning is to reflect the society's preferences for attainment of the objectives defined below. These include:

(1) To enhance national development by increasing the value of a nation's output of goods and services and improving national economic efficiency.

(2) To enhance the quality of environment by the management, conservation, preservation, creation, restoration or the quality improvement of certain natural and cultural resources and ecological systems.

(3) To enhance regional development through increases in a region's income, increases in employment; distribution of population within and among regions. There should also be improvements of the region's economic base, educational, cultural and enhancement of its environment.

2.7 THE QUALITY OF WATER

Many of the rural people don't term or take water quality, as an essential determinant even when there is plenty of water. Nowadays, health campaigns are stating that many of the health diseases like typhoid and bilharzia are brought about due to low quality water. Therefore, there is need for proper concern on the quality of water so as to escape such fatal diseases for now and in future.

Cairncross (1980) defines water quality as a measure of its safety for human consumption. Generally, the presence of harmful microorganisms or pathogens and other elements lower the quality of water. The quality of water should be free from pollution and contamination. Wright (1969) describes pollution to mean any unwanted or undesirable quality of water other than contamination. For example, odour acidity dirt and silt may be a cause of water pollution. Hence these should be kept at a minimal state so as to raise the quality of water for human consumption.

The basic requirements for drinking water are that it should be: free from disease-causing organisms, not saline, containing no compounds that have bad effects on human health and fairly clear as having low turbidity and little odour or bad taste.

2.8 TIME PREFERENCE FOR WATER

Wiener (1972) states that the selection of water resources management policy and the approach we take to water conservation will to no small degree be determined by the time preference for water related to specific uses. This time preference is dependent on the anticipated utility of water in specific context and time.

Unlike money, which within a specific time and in a specific context is usually assumed to have constant utility. The utility of water will greatly depend on the overall development context. In some cases, the "absorptive capacity" (Wiener, 1972: 370) for water beyond a specific level of use will within a specific resource base and at a specific point of time be extremely limited. The availability of water beyond such a demand limit will be of no use and since water is here assumed to have no alternative uses, its utility beyond the above limit would be very low to nil. In such a case, time preference for water above that limit would cease to be meaningful.

2.9 WATER TREATMENT

Water is a basic need for human consumption. It should thus be treated well so as to be pure, clean and safe from pathogens or disease- causing organisms. The treatment of water is undertaken through various processes. These include: filtration, sterilization and softening. (Denzil, 1963)

Filtration

Filtration of water may be done through sand, either by simple percolation (slow filter) or under pressure (rapid filter). This is addressed well by Denzil (1963). It may be necessary to add some small amount of chemical such as alumina to assist the process of filtration. The filters become clogged in time, and havé to be washed back with clean water. This process usually removes suspended matter from the water.

Sterilization

Destroying bacteria involves special plant, which demands good housing and ventilation. Chlorine gas is almost universally used, although a solution of sodium hypochlorite is sometimes employed. Ammonia or dechlorinating agent is used as treatment agent i.e. to remove the excess chlorine hence odour is removed from the water. Rural people should employ this method for efficient water treatment.

Softening

Domestic water softeners are base exchangers. In this case water is passed through a medium called "zeolite" (Denzil, 1963:171), which converts the calcium salts in the water to sodium salts. From time to time, the zeolite medium requires regenerating by passing through it strong brine. Synthetic resins are used nowadays instead of zeolite, which is very expensive.

2.10 WATER RESOURCE MANAGEMENT AND ALLOCATION

Proper water resource management should be well facilitated in most of the rural areas so as to enhance provision of fresh water to the residents who utilize it in various ways. Water resource management covers all phases of water storage, treatment and distribution. This activity can only be enhanced by giving it the first priority as part of

economic system, a natural resource and social and economic good, whose quality and quantity determine the manner of its use. This is well stated by Mcrae (1992).

Water resource management is very essential for various reasons as stated by Clocke (1986). They include the following:

(I) In most of the cases, water is available in limited quantities yet demand for it continues to rise.

(II) Water may be most readily available in areas far from the main centers of demand

(III) Water is required for a variety of purposes, only some of which are compatible with one another so that the allocation of available resources between competing claimants becomes essential

(IV) Recycling of water and also the development of new reserves of water are very important.

(V) Management of sufficient quantities for water of suitable quality is available at appropriate times in correct places in order to meet the demands of water users.

The diagram below shows the water resource management system:

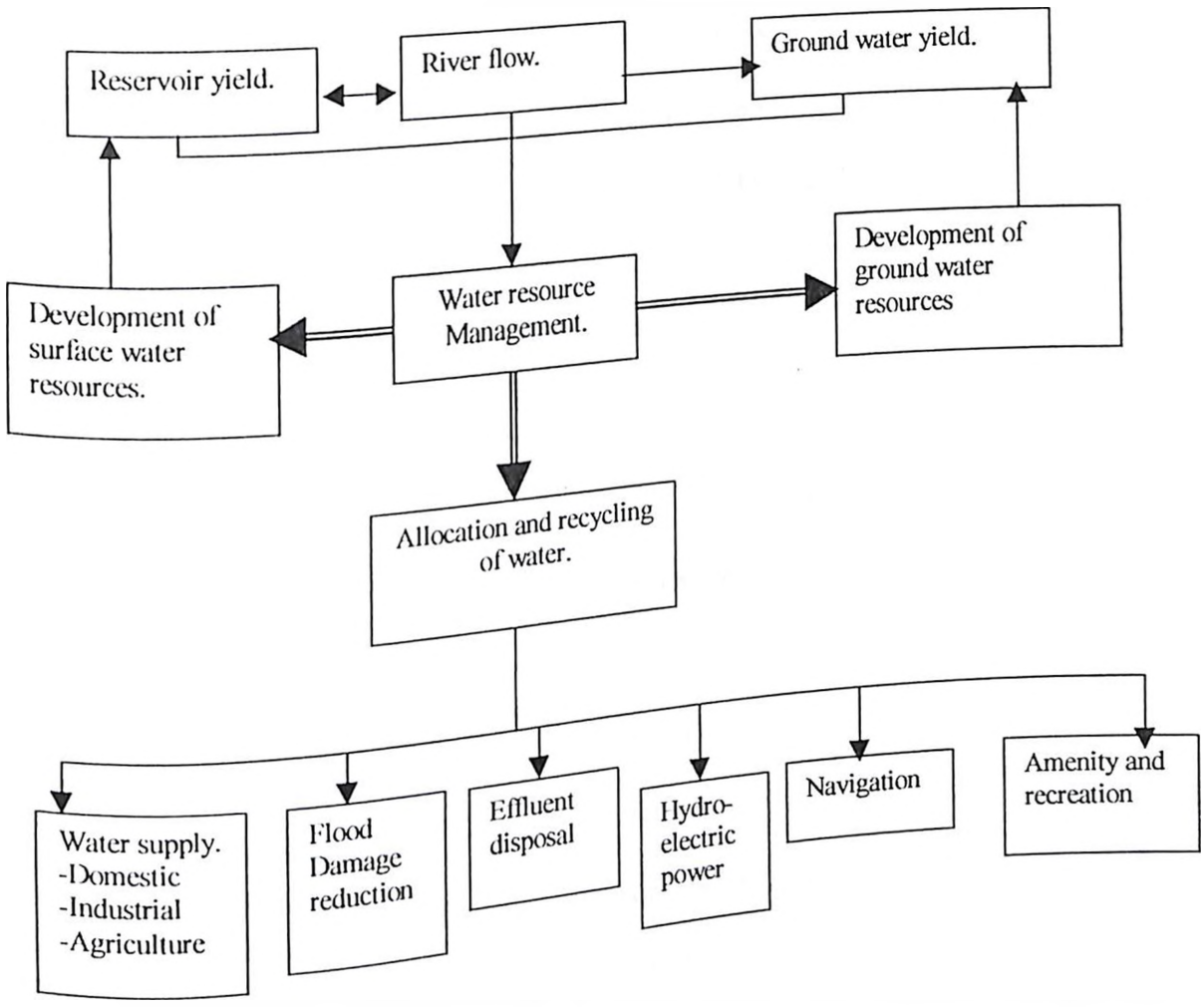


Fig.1.1 The water resource management system

Source: after E. Porter, water management in England and Wales (Cambridge University press, London, 1978:4)

Water supply to agriculture, industry and domestic uses is a central service of the water industry. The other main services are flood damage reduction, effluent disposal, navigation, generation of hydroelectric power, amenity and recreational use of waterways

and water lands. Water resource management can have great significance to rural people management for two main reasons, which include:

(1) Direct impact of water resource activities such as reservoir construction and related developments on other issues such as landscape, recreation and amenity opportunities, and land availability for other uses such like agriculture or forestry.

(2) The second reason relates to the unity of drainage basins in general, and of the water cycle in particular. (Clocke, 1986)

Land within the catchment area of water supply schemes in the countryside can often not be used in ways, which must be incompatible with the main objective of water collection. Many forms of land use reduce the water quality hence there is great need of purification of such water.

The association between water resource management in the countryside also arises through the inadvertent impact of various forms of land use on quality and quantity. Purposeful management of water resources influences the countryside in many ways such as via dam construction. Water resource management should thus be planned well. Whilst resource-using activities such as agriculture and forestry have significant effects on water quality and quantity, and on sediment yields from catchments, national and local policies tend to ignore the wider environmental impacts of large scale drainage, planning and land management. If the water resource base is to be conserved for optimum use in the future, rural planning and environmental management must recognize the significance and widespread systems, along with side effects of water resource management policies. These may include reservoir development, inter-base water transfers and rural development.

CHAPTER THREE

3.0 INTRODUCTION

The chapter covers the case study, data analysis and presentation. The case study, which is Ngwata location, is in Makueni district. The study area is described adequately in this chapter. Various variables concerning the study area are used to give a clear picture to any interested analyst. Such variables are like topography, location, size, social-economic practices, e.t.c

The data so collected from various sources is carefully discussed in this chapter. This facilitates the work of data analysis and presentation to be tackled well. The data is thus discussed under various sub-titles.

This chapter is very vital because it helps in investigating the problem of water shortage. Various methods of data collection have been used. These methods of data collection assist one in analyzing the water crisis or water shortage in the case study. This chapter is a basic prerequisite for making conclusion and recommendations in the next (last) chapter. The recommendations will be of great importance in the sense that the government of Kenya could apply them to fight water crisis/shortage in the case study, Ngwata location or any other affected area in the country.

3.1.0 THE STUDY AREA

The information about the study area is clearly discussed under the below sub-headings.

3.1.1 BACKGROUND OF THE STUDY AREA

3.1.1 (i) Location

Ngwata location is found in Mtito-Andei division in Makueni district. It lies between latitude $0^{o}31^{1}$ and $0^{o}31^{1}$ south and longitude $34^{o}\ 42^{1}$ and $35^{o}\ 05^{1}$ east. The Nairobi-

Mombasa road on the western side borders it. The location has such road as a boundary and it is located. It is on the left-hand side as you move from Nairobi to Mombasa. The case study has got four (4) administrative neighboring locations, which include the following: Kinyambu, Kibwezi, Molemuni, and Utithi locations. Ngwata location has only one sub-location, which is called Mukaange. The sub-location is further divided into two (2) parts, part A and B. Part A of the sub-location has got 26 villages while part B has got only four (4) villages. These parts are as shown in maps 3.1 and 3.2 respectively.

3.1.1 (ii) Size of the case study

Ngwata location covers an area of about 32.8 square kilometers (km^2).

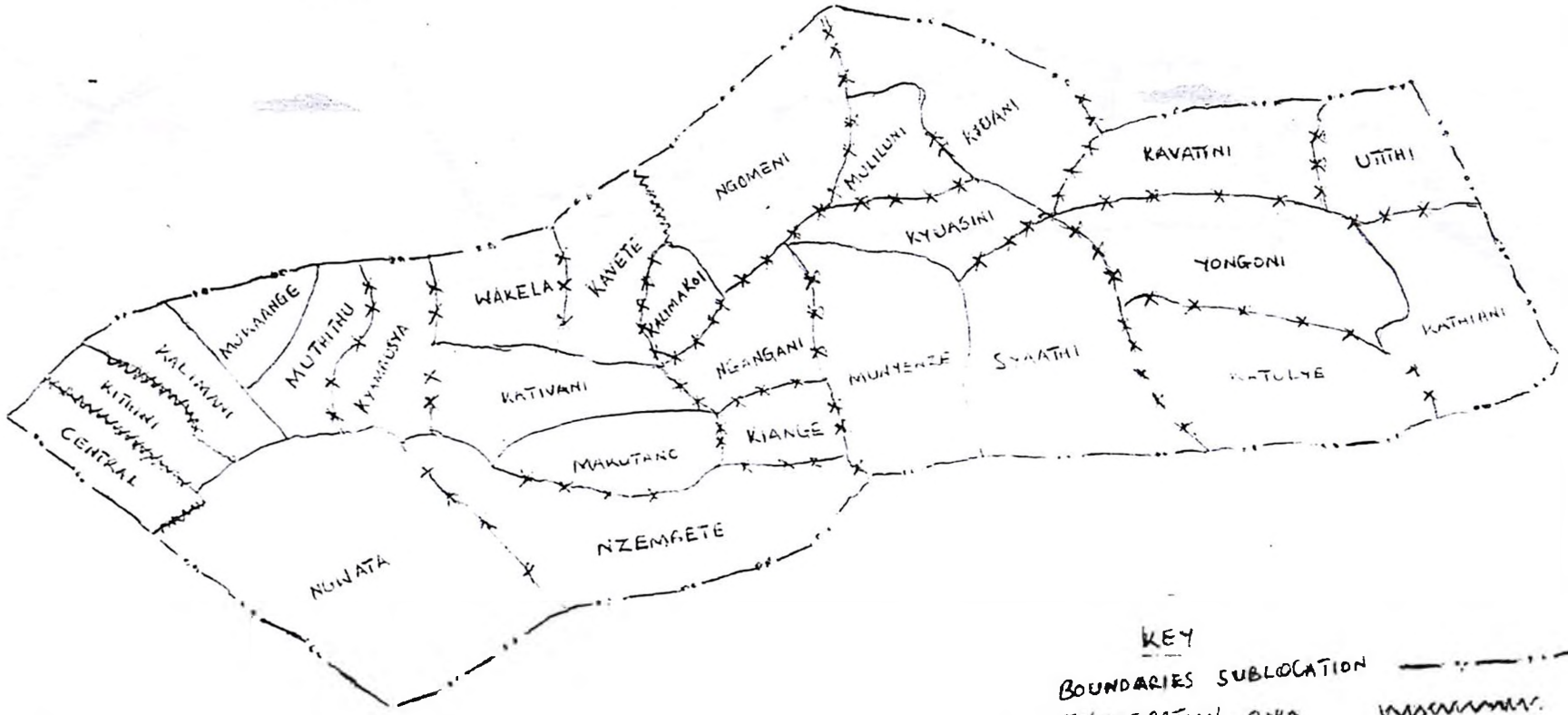
3.1.1 (iii) Population

The location having an area of 32.8 km^2 has a total population of 20,992 during the 1999 population census. This gives an average population density of 640 persons per square kilometer. The population is almost consisting of kamba people.

3.1.1 (iv) Topography and geology of the area

In any area, topographical features generally play a dominant role in its development. The topography is a major determinant of water infrastructure, land patterns and transportation routes. Two rivers, Thange and Athi serve the location. River Thange flows eastwards. Athi river is found on the east side edge the location hence the residents do not maximumly utilize its benefits because of long distance traveled to the river.

MAP 3.1 : MUKAANGE SUBLOCATION PART 'A'



KEY

BOUNDARIES SUBLOCATION

ENUMERATION ONES

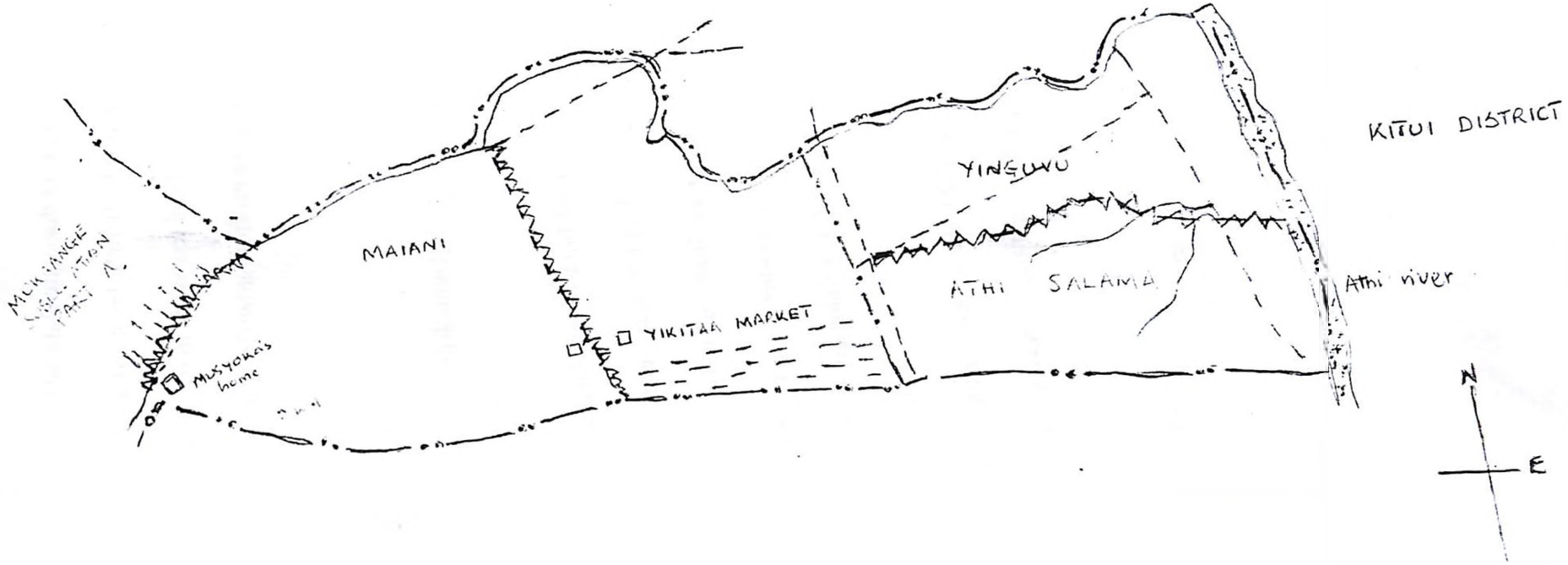
village boundaries

SCALE:

NOT DRAWN TO SCALE

SOURCE : chief's office, Ngiwata Location.

MAP 3.2 MUKAANGE SUBLOCATION PART 'B'



KEY

Boundaries Sublocation
Village
Enumeration area
Permanent Settlement
River/Dam
Swamp
Market
Foot path
Track
Road
Bridge

SCALE:
NOT DRAWN TO SCALE

A small percentage of the study area has valleys. The Mukaange sub-location part A has areas, which lie between 1100 m –1250 m above sea level. Part B of Mukaange sub-location consists of areas lying between 950 m –1020 m above sea level.

The types of rocks found in the location include the following: tuff rocks, granite rocks and igneous rocks.

3.1.1 (v) Soils, Vegetation and Wild animals

Most of the parts in the case study have brown and silt-loomed clay soils. The soils are not so nutritious in many of the parts.

Grasslands are found in most parts. These grasslands act as food for the existing wild animals and livestock. The trees found in the Ngwata location include the following: cactus, baobab, euphorbia, acacia, jacaranda and other hardwood trees. The big percentage of the trees is drought resistances hence have various adaptations so as to overcome these phenomena. For example, the leaves are small and the stems of the trees are fleshy hence storing much water for their growth.

There are various kinds of wild animals in the area. Such would include dick dicks, gazelles, porcupines, lions, hyenas, mongooses, elephants, warthogs wild pigs giraffes and some small rodents.

3.1.1 (vi) Social-economic practices and land use

The main land uses in the location include:

(a) Commercial land use,

(b) Agricultural use, and

(c) Transport and communication.

There also minor land uses like forestry and quarry. Farming of crops is a major socio-economic activity in the area. These crops include food crops, horticultural crops and cash crops. Commercial activities are found in all market centers with retail shops being spread evenly in the whole location. Most of the centers have market days when farmers market their agricultural produce.

Most of the land is allocated for agricultural activities. The main cash crops grown include the following: sun flower, cotton and oil-caster seed crops. More over, the food crops grown include maize, beans, cowpeas, pegionpeas, sorghum, millet, wimbi, green grams, cassava, pawpaws, avocado, and sweet potatoes. Large-scale farming of few food crops like maize and beans is only rare and if present, it is only practiced by the more fortunate group of people in the society. The horticultural crops grown include sukumawiki, kales, carrots, onions, tomatoes, and bridges.

Fishing is also practiced in the loation1 especially in the few rivers and streams present in the location.

Livestock keeping is also practiced in the location. The types of animals kept include the following: cattle, sheep, goats, poultry, pigs, donkeys, and rabbits. The milk got from the cows is either consumed locally or sold outside the location. The donkeys provide farm power.

Utility facilities are also found within the location. These include schools, and dispensaries. Various social groups really exist in the location. These groups are aimed at income redistribution throughout the location. For example, there are women groups and other community based organizations (CBOs). These groups are also aimed at ensuring sustainable economic development.

3.1.1 (vii) Climate

Ngwata location is a semi-arid area. The location experiences two (2) rainy seasons. The long rains start at around November to February in every year. The short rains start at around April to late May. The two rainy periods are not reliable hence droughts are very popular in the location. In some seasons, the long rains start in December to mid-January while the short rains might fall within only 20-25 days in the month of April. The location experiences an annual rainfall between 700 mm–800 mm per year and an average annual rainfall of about 750mm.

During the dry seasons, temperatures range from 12°c to 16°c and 14°c to18°c at daytime and nighttime, respectively. On the other hand, temperatures range from 18°c to 21°c and 15°c to16°c during the dry periods in daytime and night time, respectively. (District Agriculture Extension Office-Mtito-Andei Division 2003)

The altitude in the location ranges from 1100 -1200 meters above sea level whereby most of the parts in the case study lie above 1220 meters above sea level (District Agriculture Extension Office-Mtito-Andei Division)

3.2.0 DATA ANALYSIS AND PRESENTATION

3.2.1 DATA COLLECTION

A field survey was carried out throughout Ngwata location. The researcher had to visit various areas in the location to conduct a visual survey. Since Ngwata location has a total number of 30 villages (26 villages from Mukaange sub- location part A and 4 villages from Mukaange sub-location part B), only one resident from every village was selected and issued with a questionnaire to answer the questions concerning various

aspects of water. Hence the total questionnaires issued to the residents were 30. Amref officials/workers were also issued with questionnaires. The total number of questionnaires given to the Amref officials/ workers was six (6).

Various offices, for example, of the chief of the location, were centers of essential information for the research to succeed. A map of the location was obtained from this chief. Various schools in the location were also visited for data collection.

3.2.2 DATA ANALYSIS AND PRESENTATION

The responses of the residents and Amref officials/workers found in Ngwata location of the questionnaires were analyzed on the basis of some sub-titles or sub-topics that touch various aspects of water. Thus the data so collected from the field was analyzed and presented under the below sub-titles.

(A): -AVAILABLE SOURCES OF WATER SUPPLY

The survey conducted facilitated collection of information from the residents on the available sources of water supply in the location. Table 3.1 generally presents for the number of various sources of water supply in the location during dry and rainy season.

Table 3.1: Distribution of the available sources of water Supply during dry and rainy seasons in the location

SOURCE	*DRY SEASON*	*RAINY SEASON*
Boreholes	0	0
Wells	22	14
Streams	0	9
Rivers	2	1
Dams	0	18
Piped water	7	3
Springs	0	2
Lakes	0	0

SOURCE: Field survey, 2003

In the dry season, the people of Ngwata location have to collect water from the 22 available wells. During the rainy season there are other increasing sources of water supply like dams hence the people visit only 14 wells. During the dry season, the population has to visit the only 2 existing rivers in the location so as to collect water for domestic use. Due to the long distance covered to reach river Athi, the population reject it hence visit the other river called Thange. This happens during during rainy season. Boreholes lack in the location.

(B): - WATER STORAGE FACILITIES

From the field study carried out in the location, it was revealed that the highest number of the population uses plastic jerricans to store water. Few people also use drums. Water tanks are used by a small number of the population because of their high cost. Table 3.2 presents the data of the population percentage distribution using different storage facilities in the location

Table 3.2: Percentage Distribution of population using Different storage facilities in the location

Facility	*Population percentage (%)*
Pots	8
Jerricans	70
Drums	17
Tanks	3
Gourds	2

SOURCE: Field survey, 2003

The field study reveals that about 70% of the population use plastic jerricans to have their water stored. About 20% of the population use drums to store water in their homes. About 3% of the population use water tanks. More over, only 8% and 2% of the population use pots and gourds respectively to have their water stored.

(C): -TIME TAKEN IN WATER COLLECTION

The field survey carried out indicated that a large number of the population in the location spent most of their time to collect water for their use. Table 3.3 presents data for the time spent by the residents in a day to collect water from the available water supply at different periods of a year (wet and dry season)

Table 3.3: Distribution of time allocated by the residents in a day to collect water during wet and dry season in different villages of the location

Resident of different village below	*Time (hours) spent during dry period*	*Time (hours) spent during rainy period*
Nzembete	2	0.75
Wakela	1.5	0.5
Yongoni	2	1
Katulye	6	1.35
Maiani	4	1.2
Yikitaa	8	2
Kavatini	3	0.75
Kathiani	8	3
Kalimakoi	5	1
Muliluni	7.5	2
Kativani	7	0.75

SOURCE: Field Survey 2003

The field study tells us that some of the residents from various villages in the location spent most of their time in searching and collection of water. For example, the residents from villages called Yikitaa and Kathiani spent 8 hours in a day to search and collection

of water during dry period from the available sources of supply. However, during the rainy season, the residents spend less time in water collection.

(D): -DISTANCES TRAVELLED TO THE WATER SOURCES

The field survey conducted made a confirmation of that the residents in the location have to cover very long distances in search of water. Table 3.4 presents of the various distances traveled by the residents from different villages in the location during dry and wet season.

Table 3.4: Distribution of distances covered by the residents to the Water sources during dry and rainy season in the Location

Village with water Source	*Distance traveled (km) during dry period*	*Distance traveled (km) during wet season*
Kalimakoi	6	3
Muliluni	14	1.5
Maiani	5	1.3
Kathiani	18	2
Kavatini	6	0.8
Kativani	9	1
Kavete	3	0.5

SOURCE: Field survey, 2003

In the dry season, the residents of the villages in the location travel far distances to the water sources. For example, the Kathiani village people have to travel 18 kilometers to collect water from the existing sources. This hinder development in the location because other activities are neglected due to the much time spent to the water sources. During the rainy season, short distances are covered because some other sources of water supply like dams, streams and springs do increase.

(E): - WATER TREATMENT

Data was collected on how the residents in the location treat water collected from the available water sources. The data is clearly presented on table 3.5(below)

Table 3.5: percentage distribution of methods applied to treat Water collected from different sources in the location

	No method	*Filtration*	*Boiling*	*Use of chemicals*
Rainwater	97.2	0.0	2.0	0.8
Rivers	29.2	1.0	60.0	9.8
Streams	41.6	24.5	30.4	3.5
Wells	60.4	2.1	27.7	9.8
Springs	98.0	0.0	2.0	0.0
Piped water	48.6	1.8	17.7	31.9
Dams	4.5	8.5	18.9	58.1

SOURCE: Field survey, 2003

The survey revealed that a higher percentage of 97.2% of the population do not treat rainwater after trapping it. 0.8% of the residents use chemicals to treat rainwater. The residents in the location to treat rainwater do not apply the filtration method.

From the survey, it is also revealed that spring water is termed by the residents in the location as free from pathogens hence few treats it. Only 2% of the population boils spring water. About 58.1% of the population in the location use chemicals to treat water collected from dams. This is because such water has many pathogens. The survey also revealed that about 48.6% of the population in the location does not treat piped water. Only 1.8%, 17.7%, and 31.9% of the population treat water by application of filtration, boiling and use of chemicals respectively.

About 60.4% of the residents in the location do not treat water got from wells. Only 2.1%, 27.7%, and 9.8% of the population apply methods of filtration, boiling, and use of chemicals respectively so as to treat water got from wells. For the other sources of water supply in the location, their percentage distribution of water treatment methods is as shown on table 3.5 above.

(F): -TASKS THAT WOULD BE PERFORMED INCASE WATER WAS IN SUFFICIENT SUPPY

The researcher collected information on what tasks would be performed by the residents in the location incase water was in sufficient supply. This means that there would be less time spent to collect water if it would be in sufficient supply. The results of the data are as presented on table 3.6

Table3.6: - Percentage distributions of tasks performed incase water

Would be in sufficient supply

Tasks/ Chores	*Percentage performance*
Agricultural activities	58.4
Commercial activities	30.4
Leisure/ recreation	10.1
Others	1.5

SOURCE: Field survey, 2003

The survey revealed that the residents in the location are in most cases involved in agricultural activities. Hence incase water was in sufficient supply, 58.4% of the residents would perform agricultural activities to earn their living. More over, 30.0% of the residents would be involved in commercial activities like operating retail shops, hotels; bars, e.t.c. The survey also reveals that only 10.1% of the residents in the location would be involved in leisure/ recreational activities incase water was in sufficient supply. Such activities would be like reading novels, magazines, newspapers, watching television, listening to radio programs, swimming, visiting friends and the sick, e.t.c. The survey also reveals that 1.5% of the residents in the location would perform some other activities incase water was in sufficient supply. Such activities may include collecting firewood, washing, cleaning, e.t.c.

Washing, cleaning, e.t.c.

(G): -TRANSPORTATION METHODS IN THE LOCATION

Afield survey was carried out to find out on some aspects like the methods of water transportation from the available sources in the location. The data is as presented on table 3.7.

Table 3.7: Percentage distribution of water transportation methods in the location

Method of water transportation applied	*Percentage usage*
Human's backs	33.2
Donkeys' backs	5.1
Donkeys and carts	6.7
Oxen and carts	4.6
Bicycles	8.3
Vehicles	2.1

SOURCE: Field survey, 2003

The survey reveals that the most common method of water transportation in the location is the use of bicycles and human backs. 33.2% of the residents in the location transport water on their backs. About 48.3% of the population in the location transport water from the available water sources by use of bicycles. It is also revealed that2.1% of the population transport water by use of vehicles. The use of oxen to pull carts is another method predominantly used by the residents in the location to transport water from the

available water sources. Hence this percentage is 4.6. Donkeys are also used to pull carts so as to transport water hence this percentage is 6.7%. 5.1% of the population in the location use donkeys' backs to transport water to their home areas.

(H): -METHODS OF TRAPPING RAINWATER

There are various methods applied by the location's residents to trap rainwater. The data is as presented on table 3.8, below.

Table3.8: Percentage distribution of the methods applied to In the location to trap rainwater

Method used	*Percentage usage*
Use of water gutters	91
Use of sisal strings	3.0
Use of polythene papers	5.0
Nothing	1.0

SOURCE: Field survey, 2003

From the survey, it is revealed that the greatest number of the residents in Ngwata location traps rainwater by using water gutters hence this percentage is 91.1%. About 5.0% of the residents in the location use polythene papers so as to trap rainwater. 3.0% of the population trap rainwater using sisal strings. The sisal strings are fixed on the edges of most of the corrugated iron-roofed houses incases where gutters are not available.

Then some water collection material is placed under such roofs so as to facilitate water collection. Only 1% of the residents in the location do not trap rainwater due to low-income levels/poverty.

(I): - COMMON WATER- BORNE DISEASES

Information on the most common water borne diseases in the location was collected. Table 3.9 below presents data for the most water borne diseases in the location.

Table 3.9: Percentage distribution of water- borne diseases in the Location

Water-borne disease	*Percentage population affected*
Amoebic dysentery	14.6
Bilharzia	32.4
Cholera	2.0
Typhoid	50.0
No disease	1.0

SOURCE: Field survey, 2003

The survey revealed that the location is mostly affected by typhoid disease hence the percentage is 50.0%. Cholera is not so much common in the location although few victims were affected last year. Hence the percentage population affected by cholera was 2.0%. About 32.4% of the residents are affected by bilharzia. 14.6% of the population in

the Ngwata location suffers from amoebic dysentery. Only 1.0% of the population of the location is not affected by any of the water-borne diseases.

(J): - TIME FOR WATER COLLECTION

Afield survey was conducted in the location to know which time/period of the day the residents in the location go to collect water from the available water sources. The data is thus presented on table 3.10.

Table 3.10: Percentage distribution of the time when the residents in the Location collect water

Time /period	*Percentage*
Morning	75.0
Afternoon	5.0
Evening	20.0

SOURCE: Field survey, 2003

The survey revealed that the greatest number of the residents has to go to water sources during morning hence such a percentage is 75.0%. About 20.0% of the population in the location has to go collect water during evening time due to the fact that many of domestic chores are done during afternoon. About 5.0% of the location's population collects water from the available sources during afternoon.

(K): -THE WORKS OF AMFREF OFFICIALS/WORKERS

In the location, there is a group of African, Medical, and Research Foundation officials/workers that plays a vital role of water provision. However, due to high population in the location, the works of Amref officials/ workers inadequately solve the

problem of water shortage. Amref is a useful non- governmental organization in the country. The officials and workers of this organization provide water pumps in the location. Such pumps are fixed on the dug wells in the location. Beside this, Amref provide health care/ medical services to people. Amref is a non- profit making organization hence its role benefits the whole nation.

Amref has donated 15 water pumps in the location. The Amref workers and officials only demand small amount of money from the people so as they fix the water pumps in the wells. The service charges required from the residents are very low hence KShs. 600.00 cts. per well.

The water pumps are donated from abroad countries. For a water pump to be provided in a certain area in the location, the Amref workers/ officials expect a group of about 15-20 people who should be registered in a certain well. Such people would contribute KShs. 10,500.00 cts. So as to be donated with a water pump. This amount is too small to be compared with the open market value, which is KShs. 60,745.00 cts for the same kind of pump. Once the pumps are fixed to the wells, the officials and workers of Amref expect communal use of the water from such well.

Incase the water pumps undergo breakdowns; they are repaired by the Amref workers/ officials together with the beneficiaries.

CHAPTER FOUR

4.0 CONLUSION AND RECOMMENDATIONS

4.0 CONCLUSION

From the study, it is established that water shortage in Ngwata location is brought about due to several factors. For one, there lacks boreholes in the location. In fact boreholes enable reaching the water table even if it is so deep. Many of the parts of Ngwata location have got deep water table hence wells dug usually get dry during the dry period. The location lacks lakes hence the problem of water shortage continues to take its toll. There is no even a single lake in the location. As it concerns rivers, there are only two rivers in the location. One of the rivers, Athi, is situated on the east edge of the location hence far away. The residents find it hard to access this river to collect water. Few villages of the location only utilize the other river, Thange. The biggest number of the villages is located far away from this river hence water shortages are very popular especially during dry periods.

The problem of water shortage in the location is also caused due to poor management of the existing water infrastructure. For example, piped water in the location is not well regulated by the water officials. The pipes sometimes burst and this make the distribution of water to the various water stations in the location difficult. The pipes sometimes experience leakage despite the little attention paid.

There is great evidence that the location suffers from a variety of water- borne diseases. The survey that was conducted in the location indicated that most of the residents do not treat water collected from various sources of supply. Rainwater contains much dust

particles and also harmful gases. Most of the residents do not treat rainwater hence many water- borne diseases are very common.

There is much time spent in water collection from the various sources of supply. Hence other duties are not performed. Such duties may be profitable as in the case of agricultural activities. It is true to indicate that the location's state of economy is declining due to failure of performing other useful activities. This is so because most of the time is spent in water collection. If water was in sufficient supply the location's state of economy and income level would prosper well.

Lack of enough water tanks to store rainwater or water from any other source of supply, generally increase the level of water shortages in the location. Lastly, but not the least, there lacks electricity in the location. In real terms, electricity is very essential in the facilitation of water distribution and supply, but the location lacks this. Most of the residents in the location are low-income earners. Hence installation/ purchase of water collection facilities is a threat. More over, paying the amount of money required by the Amref officials with the regard of fixation of waster pumps in the wells is a difficult issue to the residents. Most of the residents in the location aren't able to invest in digging wells due to their high poverty levels.

4.2 RECOMMENDATIONS

To curb the problem of water shortages, the following recommendations should be adopted:

(1) The community should be mobilized to take part in development of many water projects in the location. The residents should be educated on the advantages of having

sufficient supply of water. Hence they should be advised to contribute enough money and so as to enhance development of water projects in the location.

(2) The Amref, which is a non- governmental organization (NGO), should be encouraged to assist in intervening the construction and digging of many boreholes. Atleast, about 5 boreholes should be dug in the location so as to facilitate enough supply of water throughout the location. If boreholes were sunk in the location, then piping of water from such boreholes would benefit the whole location and also the neighboring locations.

The government should intervene in digging of boreholes in the location. The local county councils found in the area should initiate this phenomenon to prevail in the location so as to curb the water crisis that has prevailed for many years.

(3) There should be proper management of the ever-existing water infrastructure in the location. The water managers/ workers in the location should ensure proper and continuous maintenance of the water infrastructure facilities such as water pipes that facilitate distribution of water to various parts in the location.

(4) The residents in the location should be well educated on proper usage of the available water. The officials found in the location should conduct seminars touching various aspects of water.

(5) More wells should be sunk so as to facilitate water adequacy. Atleast there should be 2 or 3 wells in every village. The residents in the location should form some communal groups that should be headed by trustworthy chairmen/chairladies so as to direct the ever-contributed funds by the residents to promote enough water supplies.

(6) Water- cathment areas in the location should be maintained and managed well. For example, this may be done through afforestation. The government of Kenya should enhance afforestation in the locations affected with water shortages like the case study.

4.3 AREAS OF FURTHER STUDY

The study isn't conclusive on its own. There are many areas that should have been studied, but due to some limitations, this hasn't been done. However, there should have been areas of further study like the following:

(1) An investigative research on water reclamation could be carried out in the location so as to promote adequate water.

(2) Studies should be done on community participation so as to bring the level of water shortage down.

BIBLIOGRAPHY

1. Aaron Wiener (1972); **The role of water in development; an analysis of the principles of comprehensive planning,** Mcgraw-hill book company, Newyork
2. Cairncross, S. (1980); **Evaluation for village water supply planning book 15,** John Wiley and sons, Geneva
3. Cris Lewis (1973); **Regional growth and water Resource investment,** Lexington books, D.C Health and company, Toronto, London
4. Curtis V (1986); **Women and the transport of water,** Intermediate Technology Publications, London
5. Denzil Nield Ariba (1963); **Mitchells Advanced Building Construction: Components, Services and Finishes,** BT. Batsford limited, London
6. E. Porter (1978); **Water management in England and Wales,** Cambridge University Press, London
7. Ely Richard (1940); **Land economics,** Macmillan company, Newyork
8. Haines, et al (e.d) (1980); **Water and related land resource systems,** Pergamon Press, Oxford
9. John Philip Bachner (1991); **The guide to practical property management,** property management association, Silver spring, Newyork
10. Munyi M. J (2000); **"Causes and consequences of water shortage in Nairobi",** unpublished B.A. Thesis, University of Nairobi
11. Ongeri D (1997); **"Towards an effective water supply in rural settlements",** unpublished B.A Thesis, University of Nairobi

12. Paul J Clocke and Chris C. Park (1986); **Rural resource management**, Croom Helm, London

13. Pierre Laconte (1976); **The environment of human settlements**, University of Louvain, Belgium, Oxford Newyork, Toronto

14. Robert, D. et al (1975); **A system approach to water distribution modeling and control,** D.C. Health and company, Lexington, Massachusetts, Toronto, London

15. Saunders, R.J and Warford; J.J. (1976), **Village water supply economics and policy in the developing world**, the John Hopkins University, Baltimore and London

16. Steward, F. (1978); **Technology and development**, the Macmillan press limited

17. Wright F. B (1956); **Rural water supply and sanitation**, Wiley eastern private limited, New Delhi

APPENDIX I

QUESTIONNAIRE TO THE RESIDENTS

1. Sufficient and improved water supply make the work of collecting/ fetching water for various domestic uses convenient and very fast. Hence there is increased time for productive work. Indicate tasks that you would do during the time allocated for collecting/ fetching water? _____

_____

_____

2. (i) Name or tick the sources from which you get or collect water for use during dry season.

- ☐ Borehole
- ☐ River
- ☐ Lake
- ☐ Well
- ☐ Piped water
- ☐ Dam
- ☐ Stream
- ☐ Ocean
- ☐ Sea
- ☐ Spring

(ii) Name or tick the sources from which you collect water during the rainy season

- ☐ Borehole
- ☐ River
- ☐ Lake
- ☐ Well
- ☐ Piped water
- ☐ Dam
- ☐ Stream
- ☐ Ocean
- ☐ Sea
- ☐ Spring

3. What equipments do you use to fetch/ collect water from the sources you have indicated in question? _____

_____

4. Where do you store or what do you use to store the water you have fetched from a source of supply in your home? _____

_____

5. What do you use to transport such water from that source of supply to your home?

_____

_____

6. Who transports water to your home area? _____

7. What is the distance of water supply you have from your home area? _____

8. How much time do you take to collect water in a day from your sources of supply? _____

9. How many times in a day do you have to go for water from the available sources of supply? _____

10. What time of day or night do you have to go to collect water from the available sources? _____

11. How much water do you have to collect in a day so as to satisfy your needs?

_____

12. (i) Do you have any livestock in your home? _____

(ii) If yes, specify them. _____

(iii) How much water do they consume in a day? _____

(iv) What is the amount of money you allocate to water your livestock?

_____

(v) What is the distance traveled by your livestock to the place of water supply?

_____

(vi) What time of the day or night do you take such livestock to the water areas?

_____

(vii) How many times in a week do you have to water your livestock? _____

13. What problems do you face in storing water at your home? _____

14. (i) Do you treat water at your home? _____

(ii) If yes, which method do you use to make the water safe for consumption?

_____

15. Do you have water tanks at your home? _____

16. What do you think can be done to increase water supply in your home or area or in Ngwata location? _____

17. During the rainy season, how do you trap rainwater especially for your consumption / other uses? _____

18. (i) Do you practice irrigation in dry season? _____

(ii) If yes, where do you get the water from i.e., which is the source? _____

(iii) Which crops / trees do you irrigate? _____

19. (i) Which is the most common water borne disease(s) in your area? _____

(ii) Which time of the year or month is the disease (s) popular? _____

Thank you for your time

APPENDIX II

QUESTIONNAIRE TO AMREF OFFICIALS / WORKERS

1. How many water pumps have you rendered to the residents in the Ngwata location?

_____

2. (i) Dou you charge the residents some amount of money as you fix the water pumps in their wells? Yes ☐ No ☐

(ii) If yes, how much do you charge the residents as you fix the water pumps?

_____

3. Where do get such pumps? i.e. which is the source? _____

_____

4. What measures of maintenance do you advise the residents to take on such pumps?

_____

_____

5. How do the residents treat water in such wells fixed with pumps?

_____

_____

6. Incase the water pumps are damaged or affected with breakdowns, who undergoes the repairs? _____

7. What total amount of money should the residents pay per well as it concerns a water pump? _____

Thank you for your time