^VRURAL WATER SUPPLIES PROBLEMS IN KENYA:
A CASE STUDY OF KIPKELION DIVISION,
KERICHO DISTRICT.

' BY

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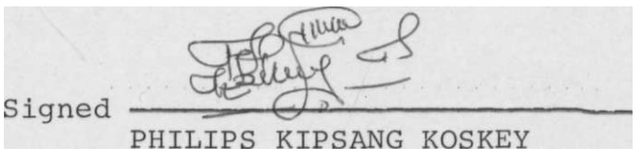
A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF ARTS IN URBAN AND REGIONAL' PLANNING IN THE UNIVERSITY OF NAIROBI

JUNE, 1986.

D E C L A R A T I O N

This thesis is my original work and has not been presented for a degree in any other University.



Signed ——————————

PHILIPS KIPSANG KOSKEY

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This thesis has been submitted for examination with my approval as a University Supervisor.

Signed —

DR. ELIJAH N.D. NDEGWA.

JUNE, 1986.

D E D I C A T I O N

This work is dedicated to my parents
for their truthful love for me.

ACKNOWLEDGEMENT

The outcome of this study has been made possible through the indespensible Co-operation and assistance by many individuals, Government Institutions and parastatal organisations. It is therefore my great pleasure to categorically express my deep gratitude to all those I am indebted to in all the various stages of this research study.

In particular, I express my deep gratitude to my supervisor, Dr. E.N.D. Ndegwa, who beyond his invaluable supervision very closely worked with me in all stages of this study. His valuable criticisms of the preliminary and the final work testified his comittment to the shaping of this study and much of the information herein are the fruits of his unestimated efforts.

I also owe much gratitude to the Chairman of the Department, Mr. Z. Maleche and his team of dedicated lecturers who gave valuable criticisms and suggestions.

My gratitude also is extended to the excellent cooperation that was accorded to me by officers of various Government Ministries and parastatal organisations. In their respective areas of responsibility, they rendered good service without which this study would not have taken shape.

I am grateful to the Government of Kenya which through Nairobi University Administration offered me scholarship and sponsored this research. The materials that are included in this thesis are in fact through its funds.

I also express my sincere appreciation to the inhabitants of Kipkelion Division who gave positive response to the interviews provoked to them . Bv willingly discussing water problems in the area, and by giving their suggestions and views, they infact provided with valuable information presented in this thesis.

I am also grateful to my colleagues in the Department of Urban and Regional Planning who provided me with an academic atmosphere to work in. Similar gratitude, is to Mrs. Sarah Lugusa and Mrs. Mary Muthigo who willingly typed this work.

Lastly, I cannot forget in my gratitude all those whose names remain unmentioned but helped directly or indirectly.

The combined efforts of all the above enabled me to come up with this thesis which can be used as a guide to solving water problem in Kipkelion Division.

ABSTRACT

Throughout the world, there is a conviction that the availability of sufficient quantities of clean, potable, water is one of the ways of improving man's health, hygiene and productivity.

Although both the Government and Local Communities know that without adequate supplies of water it is difficult to develop an area, and although efforts have been made to provide water to rural communities in Kenya, accessibility to potable water supplies is one of the problems experienced in Kipkelion Division of Kericho District. The inhabitants have to walk long distances to fetch water for domestic use and for livestock. The hauling of water from distant sources wastes a lot of man-hours and affects people's health and agricultural productivity.

The current sources of water which include water holes, rivers and unprotected wells are exposed to pollution and thus likely to be infested with water-related diseases. Furthermore, many of the water sources are also unreliable often resulting in water shortages during dry season or during peak hours as in the case of water-holes.

Although piped water is available to urban dwellers of Kipkelion town, the people experience water shortages due to the problems of design,

maintenance and poor management.

The above situation of water in the study area evidently calls for investigations, particularly on the ways and means of solving these problems. Such investigations were done through questionnaire administration and interviewing. The analysis of responses found that the majority of the people spent upto an average of 6.3 hours per day fetching water, that much energy is spent in transporting water to homesteads from far sources of water; that people are infected by water-related diseases because they obtain their water from sources which are exposed to pollution. It is also argued in this study that accessibility to good quality water, within easy reach can contribute to economic, social, health and political benefits to local communities in the study area. Field data shows that access to safe water would release a lot of man-hours currently devoted to fetching water for economic activities. It is also argued that the time released from the drudgery of hauling water from distant sources could be used for leisure and recreation activities. Finally, it is argued that availability of clean water supplies would reduce water-related diseases.

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL INTRODUCTION:

"The thirst of a civilized man is insatiable. The more sophisticated he becomes the thirstier he seems to grow. In the so called developing countries, as little as 12 litres of fresh water sometimes suffice as the daily supply for each person, while in London domestic consumption exceeds 150 litres per head every 2 4 hours. Even this figure is surpassed by the demand in the more prosperous cities of the U.S., where 250 litres per head is typical of the daily domestic demand in urban areas. Yet this is only part of the story; for as man becomes more advanced he needs more and more water for commerce, industry, public institutions like hotels and hospitals, power stations, and many other uses.Added to this unremitting increase in demand is the ceaseless growth in the world's population and we have a glimpse of the extent of the problem it presents, a problem that seems today to be moving slowly but inexorably toward a crisis in more and m^re areas around the world" (Overman, 1976:1).

Water, as summarized above has been from the time life started and will continue to be, one of the roost basic necessities of man's life. As man continues

to be more advanced in his activities, his demand for water increases.

Water's indispensable significance in man's civilization has been underscored by the positive comments by leading scholars of classical, medieval and contemporary times. Biswas (1976 11) , quoting Empedicles (490-430 B.C.) and pindar (5 B.C.) describes water as comprising "one of the four primary elements from which all the materials of the world were constituted". Contemporary thinkers have viewed water as "one of the most precious commodities throughout man's recorded history, without which, life and civilization cannot survive" (Biswas, 1976). Closer home, President Kenyatta (1977), states that water is "one of the most important basic resources indispensible not only for human life but also agricultural and industrial development."

These comments underscore the significant role water has played in man's history, though at the beginning the magnitude and complexity of water resource management was not as complex as it is today due to the small population of the world then and the absence of modern commercial and industrial activities which today call for water management and planning.

In line with the above, East African Governments have identified the importance and need for the management and planning of water resources in the hope that provision of and management of water resources would be a driving force towards better social and economic development. The Kenyan Government in its development plans, for instance, has recognized water development as one of its high priorities, thus allocating 14.6% of its total share of Development Forward Budget, a percentage that ranks third after education's 34% and Agriculture's 18.7% (Dev. Plan 1979/83:107). Further, by recognizing the increasing importance attached to water, the government has made institutional changes particularly by detaching the former water development department from Ministry of Agriculture and making it a full fledged Ministry in 1974 (Dev. Plan 1979/83:201). The Ministry of Water Development is now charged with orverall responsibility for the development, operation and maintainance of water supplies, conservation of the nation's water resources, and more importantly, the making of long range plans of upto 2,000 A.D. for the ultimate provision of water to the majority of Kenya's population. This fact was underscored by the first President of Kenya when he said that:

> "Water must be treated differently from other natural resources such as minerals which could be preserved in the natural form and saved until required, so that if only a little is used in our generation, more will be available in the next." (Kenyatta, 1977).

The Kenya National Development Elans acknowledge water to be essential for personal needs and production activities thus the 1970/74 plan anticipates that "providing water to rural families by conviniently located piped water points is estimated to release from one-half to three quarters of the time now on the task for use in more productive activities" (Dev. Plan 119 70/74:365). In view of this, the government in its subsequent plan stated that "it is the intention of the government to speed up the development of water supplies, particularly in the rural areas of the country and to extend and intensify water conservation measures to ensure the continued availability of raw water in future" (Dev. Plan 1974/78:328). This was reiterated in the 1978/83 Development Plan which emphasized the government's intention to bring to the entire population the benefits of a safe water supply sufficient to their requirements for livestock and domestic consumption by the Year 2,000 A.D. (Dev. plan 1978/83:193).

The significance of water has also attracted the attention of International Communities and as a result international organizations have been formed by the United Nations. Among such organizations include the International Hydrological Decade (I.H.D.) 1964-74 and the International Hydrological Programme (I.H.P.) formed to solve the problem of water availability and supply. The discussions by these organizations have resulted in the assessment of the water stock (both surface and underground) and the need for better management of water resources. The formation of these organizations further led to th, recognition of the extraordinary role that the proviso of water could play in the lives of poor people throughout the world. As a result HABITAT: UN conference on Human Settlements in vancouver, British Columbia (1976) and the World Water Conference in Mar de Plata, Argentina (1977) further urged that United Nations to establish long range water programing with the goal of providing clean drinking water anri sanitation for all (Bourne, 1981:16 ff). These conferences were the brain-child of the declaration of 1980s as the International Drinking Water Supply and Sanitation Decade- I.D.W.-S.S.D. (World Bank, 1980:1) with the main . objective being to satisfy the population of the world with two basic needs - clean water arid sanitary disposal of human wastes.

On the other hand, the Non-Governmental Organisations (NGOs) have also felt the need for improved water supply, a commitment which in 1977 resulted in the formation of the Kenya Water for Health Organization" (K.W.H.O.), with a main aim of extending clean water to the rural areas and hence reduce the woman's burden of collecting water "because it is she, after all, who generally provides for this requirement of her family" (Kengo News Report, 1985:3).

Despite the attention that water has received, particularly on its role in social and economic development, it is a resource that is largely infested by water-borne diseases, unequally distributed over the surface of the earth, its availability at any place varying greatly with time and distance. Thus water scarcity, inaccessibility, are terms- "applied to water situation in most parts of the world. The significance of such problems associated with water are discussed below:

1.2 STATEMENT OF THE PROBLEM

Except for Kipkelion water supply which is gazetted under urban water programme and serving only 300 households (2.7%) the rest of the division's population comprising 10,920 (97.3%) households do not have clean water supplies. (District Development Plan

1983/88; population Census Report 1979). As a result these households rely on raw water supplies from rivers,, water holes, wells, road side ponds and intermittent streams. Some of these sources are temporary since they rely on rain water for replenishment. Thus in dry spells only permanent sources retain water but may be far from most homesteads and women have to walk long distances carrying heavy loads of water. This of course, has side effects since the time and energy they use would otherwise be devoted to such occupations like intensive child care, necessary leisure and income earning activities which can promote human welfare. Long distance to water sources also means that people have little water for hygienic purposes,For instance, Feachem et. al. (1977) in his general study on water-related diseases states that " if people have very little water, either because there is extremely little water available or because it is so far away that the effort to bring much of it to the home is very great, then it may be impossible to maintain reasonable personal hygiene. Because there may be too little water for washing oneself, or food utensils or even clothes. Remaining unwashed not only allows skin infections to develop unchecked but also makes it easier for intestinal infections to spread from one person to another. That the prevention of a water related disease depends on availability, access to good adequate quality and/quantity of domestic water."

Further, water from the few permanent natural sources that resist the dry spells is used not only by a big number of households but also by a large number of animals. Since such sources are often unprotected, they are often contaminated, polluted and cause diseases. In the division, water-related diseases reported monthly by the Health Medical Office include: bilharzia (10%), river blindness (7%), diarrhoeal (20%) and infant mortality (3%) (District Medical office, 1985).

During the dry spell, water from natural holes and pools of standing water which are not adequately replenished has bad taste and smell due to decaying organic and inorganic matter dropped into these water sources. In wet seasons, the situation is no better because of the litter and soils from the upper parts washed into water sources making water unsuitable for man's use. For instance Fair et. al (1958), commenting generally on the type of quality of water for man's use states that:

> "To slake man's thirst for water, it must be wholesome and palatable; it must be free from physiologically undesirable substances, and must be attractive to the senses."

Water problem in the study area has become intensified by the increasing population (1948 (7,010), 1969 (28,940), 1979 (57,590), 1985 (74,161) and 2000 A.D. (92,837))(population census, and population projection by author using C.B.S.'s 3.74.74% Growth rate) due largely to natural increases and immigration into the area following the subdivision of the large farms in the division. This has often resulted in the abandonement and mismanagement of some of the water sources developed during the colonial period, especially when such sources fall within individual's plots of land who are irresponsible. Such sources include wells and dams which have fallen into disrepair or have been drained (dams) to allow for pasture grazing or crop farming by individual farms. ""

EXISTING WATER"PROJECTS;

Examination of the existing water facilities in the district as a whole reveals that water investments have been concentrated in adjacent administrative divisions despite the fact that those divisions have relatively higher rainfall amounts than Kipkelion division. Kipkelion receives 1,000-1,400; sot division 1400-1800 and Buret 1800-2200 each (Meteorogical Dept. Kencho, 1985). As an illustration, while Belgut has

nine water projects, followed by Sot with eight and Buret with three water projects, Kipkelion division has only one water supply project which manages to serve only three hundred urban households, with the entire rural areas' households with no water supply project. (Kericho District Development Plans 1978/83 and 1983/88) Table on appendix A^llustrates comparative distribution of water projects per division in Kericho district.

(a) Kipkelion Urban Water Supply:

It is the only water supply scheme in the division and is gazetted under urban water supply programme with the Ministry of Water Development. It serves only three hundred households out of the eight hundred and eighty nine households living in the town. Currently the scheme is over-utilized (Kericho Development Plan 1983/88 and population Census 1974). Furthermore the project faces a number of problems including frequent breakdown of engine causing water shortages among the consumers; small size of the booster station, lack of water in parts not connected with water pipes, lack of storage tanks and water wastage at consumer points. The above prohlems are worsened by occasional lack of diesel oil for pumping water to the consumers. (Kipkelion) Water Supply Record File, 1985..

(b) Self-Help Rural Water Supplies:

These are four on-going community sponsored water supply projects which are: Chepsir water supply project which by the time of field survey had come to a standstill due to shortage of finances; Kapseger water supply project which when fully implemented isexpected to serve three hundred households, four schools, a rural centre; Fort Ternan which is intended to serve the rural population and its trading centre; and finally, Kimologit which was abandoned due to lack of funds but which the community is willing to start again, (Kericho Development Plan 1983/88). These projects were carried out without proper planning, with insufficient funds and without technical experts. Furthermore, these projects are identified with local political groups which in some cases (eg. Kapseger and Chepsir) has contributed to the slow rate at which they have been implemented (Kericho, Development Plan 1983/88).

From the foregoing, it can be concluded that in the study area, water is still a problem that calls for research. The sources of water are far from homesteads resulting in waste of time and energy; water is infested with water-related diseases, resulting in Poor health, disease and deaths of infants; water is inadequate in some areas causing shortages; and the existing sources of water supply are poorly Managed and have no forecasts for future demand.

This study therefore focuses on the above issues with a view to suggesting ways of overcoming them.

1.3: STUDY JUSTIFICATION:

Drawing from the above discussion on problems associated with lack of adequate supply of safe water, many reasons including health hazard and time waste due to long distances to water sources justified the carrying out of this research in the study area.

Secondly, there is no proper management of the existing water sources (wells, boreholes, dams etc.). Besides, there is no conservation measures practiced in the uses of water. This study will make some suggestions on measures -which if introduced could facilitate water conservation.

Thirdly, Kipkelion township water supply system has not kept pace with the areas' water demand for it serves only 300 households out of 889 households. This study will thus explore possible ways of expanding this system to serve the remaining households and that of the rural outskirts.

Fourthly, it is highly hoped that the recommendations based on findings of this study when implemented will be very useful to the residents of Kipkelion since a

lot of time and energy that were previously spent on hauling water either from sources which are several kilometres away from the homesteads or from the bottom of steep valleys that are difficult to climb will be saved and instead be diverted to economic activities like crop and animal husbandry, together with ample time for child care and necessary leissure and recreation. It is also hoped that improved potable water at individual or communal water points will reduce waterborne diseases in the area thus making people healthy for more useful occupations.

At academic level, the study has been prompted by the desire to investigate the nature and extent of water problem in a rural area with the hope of coming up with a model of water supplies that could be used in tackling problems of water management in rural communities of Kenya.

1.4: STUDY OBJECTIVES:

In view of the above stated problems and in attempt to promote rural development in the study area, the general goal of this study is to suggest ways and means of solving water problems facing the rural communities of Kipkelion division. This general goal would be given focus through the:

(a) assessment of the extent of water problem in the study area.

(b) assessment of the performance and management of the water supply scheme (under urban programme) currently serving only 300 households with a view to:

(i) examining how its planning has taken into account the increasing population, commercial, industrial growth rates in relation to water supplied.

(ii) looking into the possibility of expanding it to serve the immediate, rural communities.

(c) review the current self-help water supply projects (Fort Ternan, Chepsir, Kimologit, Kapseger) in the study area with a view to determine how self-help water projects can be made more effective to enable the government achieve its policy objectives of providing safe and potable water for all by the year 2,000 A.D.

(d) Look into aspects of water storage, together with the examination of the possibility of cleaning and re-use of the sitted wells and disused earthen dams.

(e) assessment of water supply systems (in Belgut division) by various funding agencies - government, religious organisation, community, county councils or international donor agencies with a view to examing which among them has an appropriate approach to water problem in the rural areas.

1.5. SCOPE AND LIMITS;

Due to limitations of finances and time, this study is specifically confined to a single administrative division and 7 sub-locations, all covering an area of 512 km^2.

The areas of enquiry is limited to an assessment of the extent of water problem in the division, assessment of the existing water supply sources with a viaw'to finding how they have solved water problem in the area, and an assessment of water supply schemes (in Belgut division) run by different organizations are examined in order to establish which among them have developed the most satisfactory machinery which could be applied in the study area.

1.6 THESIS ORGANIZATION:

This thesis is divided into five chapters.

Chapter One: This is the introductory chapter which incorporates brief introduction of the importance of water and statement of water problem in the study area, upon which reasons and justifications of the choice of the study are based. It also includes study objectives, scope and limits of the study and thesis organisation.

Chapter Two: This chapter deals with the physical and economic background of the study area, important for reflecting the essential characteristics of the study area and in relating physical, social and economic factors to the provision of water.

Chapter Three: This chapter deals with literature review related to the study carried out. This contributes to theory of the study. It also has study assumptions and operational definitions which indicate the specific manner in which a term or concept had been used, and finally research methodology.

Chapter Four: This chapter is the main body of the thesis dealing with the analysis of water problem with a view to suggesting recommendations and proposals. It focuses mainly on problems associated with long distances to water sources, problems resulting from

drawing water from infested sources; benefits accruing from accessible water supplies, problems facing existing water supply projects, and lastly assessment of water development sponsoring agencies.

CHAPTER Five: This chapter is the conclusion of the main findings and inferences. Based on these findings are given recommendations. It also contains recommendations on related areas for further research

Appendices: The appendices present detailed information which could not be included in the main body of the Thesis which otherwise would have interrupted the flow of the narrative. Included in this section is a list of references used as suitable reading materials on the subject matter of this study

CHAPTER TWO

2.0 PHYSICAL AND HUMAN BACKGROUND INFORMATION OF THE STUDY A:IEA

2.1 INTRODUCTION;

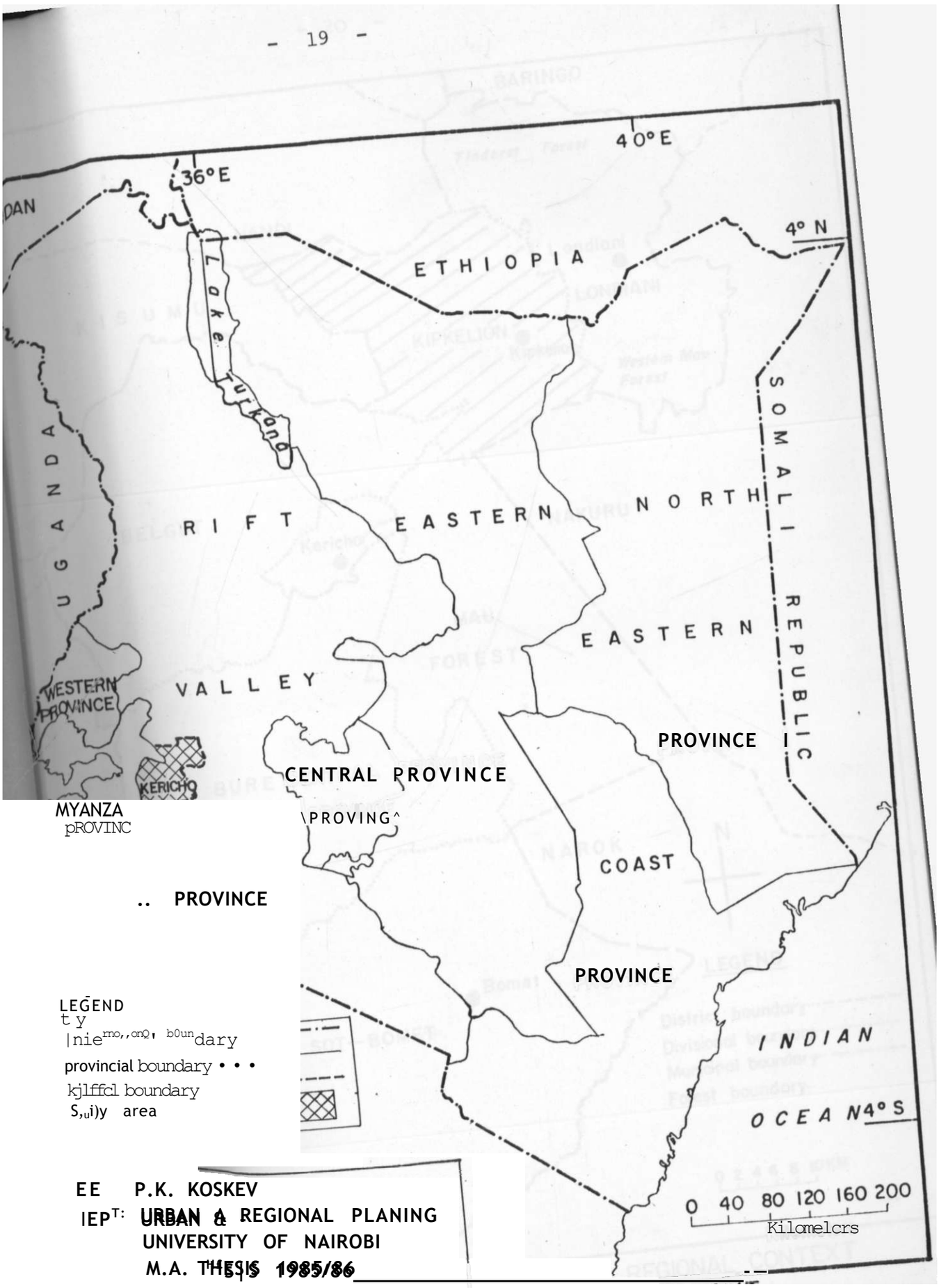
Physical and human resource potentials of the study area comprising relief, geology, soils, climate and drainage, vegetation, demographic, profile, existing service facilities and the major economic activities are presented in this chapter. This gives understanding of the basic resource attributes of the area, for each of these resources is an essential component of an ecological system that has to be considered in the development of the water resource. Hunter, cited by Oloya (1969), observes that:

> " a description of particular issues in any country are unintelligible without reference to surrounding society."

2.2 PHYSICAL BACKGROUND

2.2.1 LOCATION AND EXTENT:

Kipkelion division is one of the five administrative divisions of Kericho district that is bounded by Uasin Gishu, Baringo, Nandi, Narok, Nakuru, Kisumu, South Nyanza and Kisii districts(Fig. 2). The district lies within the approximate extent of longitude 35° 02' and 35° 40' East and Latitudes 0° and 1°61' south. The division, namely Kipkelion division covering an area of 512 km^2, is the fourth largest division in the district. It has three administrative locations and seven sub-location.:



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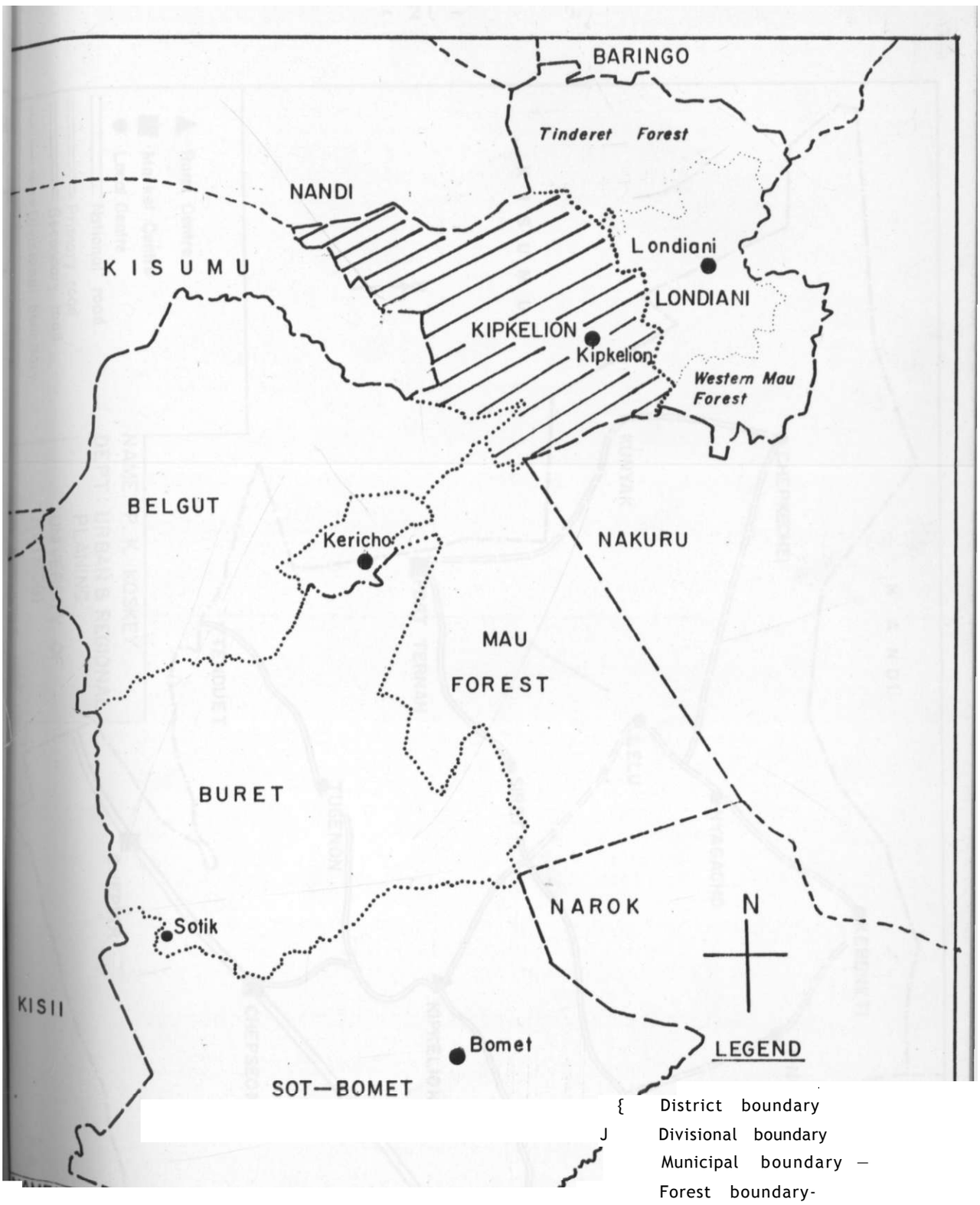

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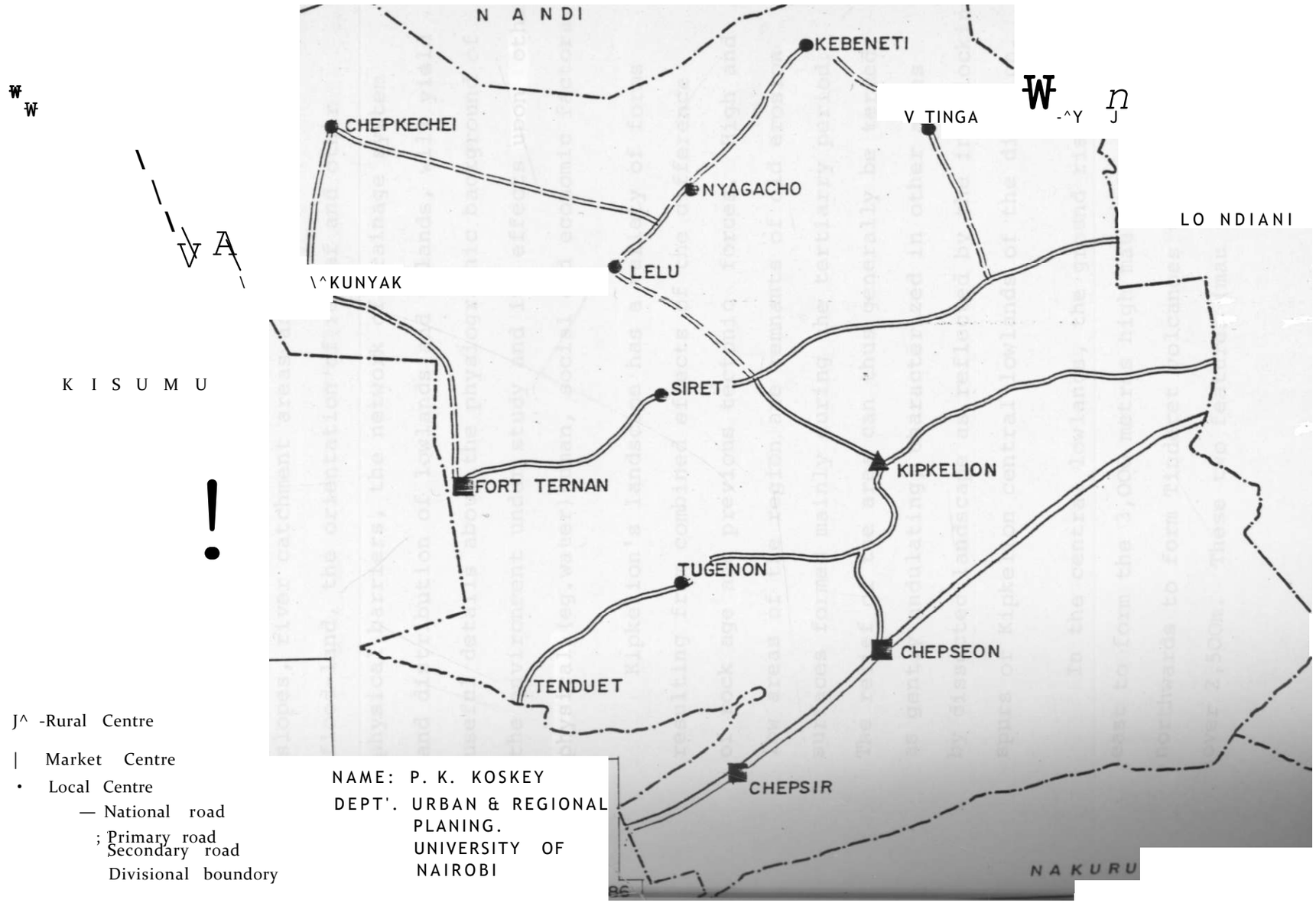
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2.2.2. RELIEF AND DRAINAGE:

The relief of any given area forms an important aspect in the development of water resources. Jackson (1963), states that "the general character of the relief surface and height of the land, the shape and form of hills and valleys, the angles and direction of slopes, river catchment areas and the extent of flood-land, the orientation of relief and other physical barriers, the network of drainage system and distribution of lowlands and uplands, will yield useful details about the physiographic background of the environment under study and its effects upon other physical,(eg.water)human, social and economic factors.

Kipkelion's landscape has a variety of forms resulting from combined effects of the difference of rock age and previous tectonic forces. High and low areas of the region are remnants of old erosion surfaces formed mainly during the tertiarry period. The relief of the area can thus generally be termed as gently undulating, characterized in other areas by dissected landscape as reflected by the interlocking spurs of Kipkelion central lowlands of the division.

In the central lowlands, the ground rises south-east to form the 3,000 metres high mau ridges and northwards to form Tinderet volcanoes that rise to over 2,500m. These two features (mau ridges and

Tinderet volcanoes) which stand out opposite each other are underlain by volcanic rocks of the Rift Valley, and are source of both permanent and intermettent streams which have through time furthered the dissection of the areas' landscape. The two features are also covered by forests of both indegeneous and exotic species, which provide for economic activity in the area. (Fig. 4).

DRAINAGE;

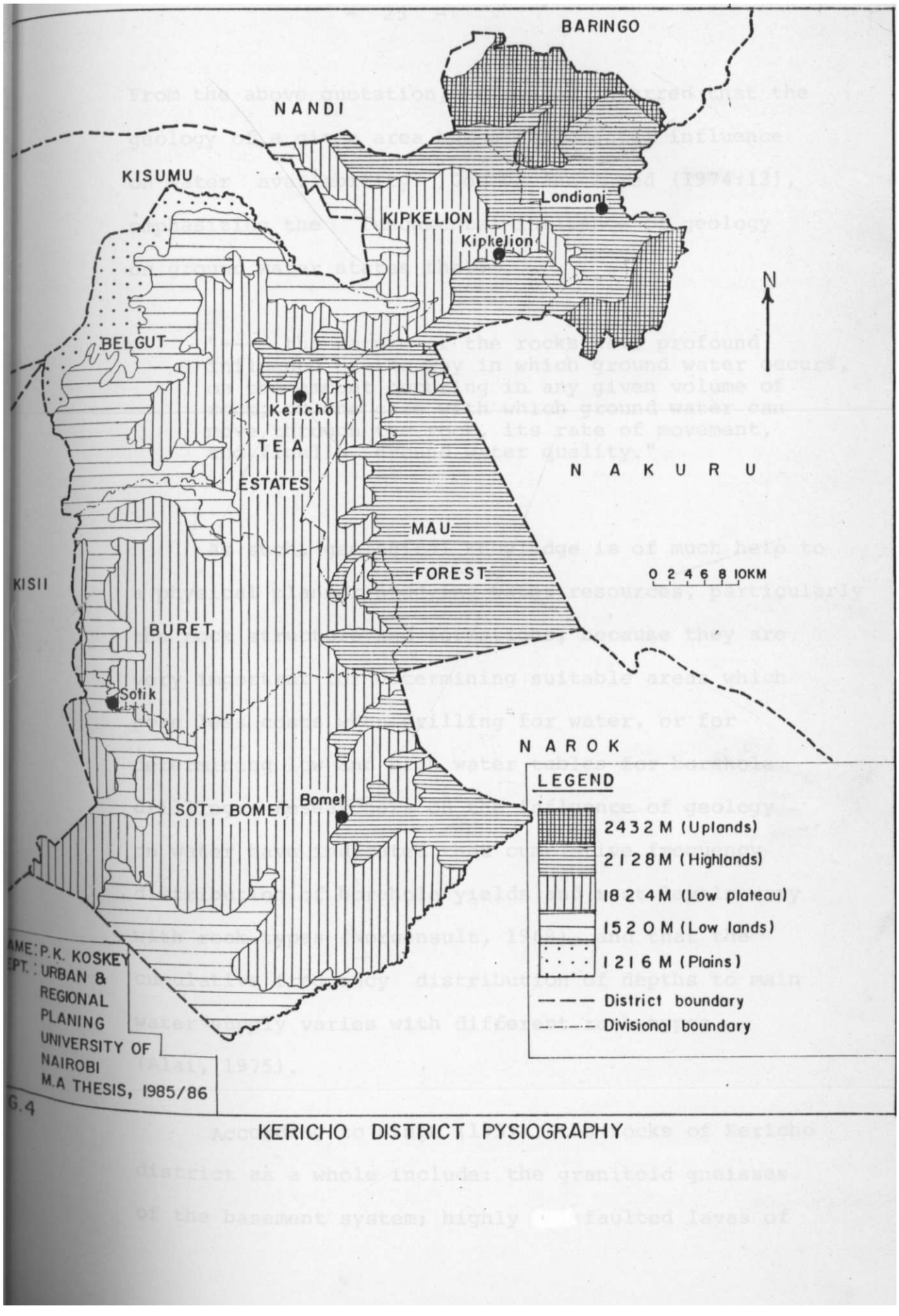
The overall drainage in the division is generally from east to west into Lake Victoria drainage basic. The main river of the area which can be tapped for water provision throughout all seasons is Nyando which enters Lake Victoria at the head of Kavirondo gulf.

Nyando is a young river (Binge, 1962) fed from the Tinderet ridges on the north by several streams some of which are permanent and can be tapped (eg. Kimologit). The main tributaries are Ainomutua which drains Tinderet ridges, flowing along Nyando fault zone, and to the south is Kipchorian river which cuts through Kipkelion township, a source of water for Kipkelion water supply.

2.2.3. GEOLOGY AND SOILS

The geology of an area, like its relief, has a considerable influence on the availability of water, Particularly ground water. Alai (1975:9) observes that:

> "— it controls the rate of seepage, thereby regulating the amount of water available for crops and plants within the soil zone; regulates the amount of ground water, since its framework forms a medium through which ground water moves or is barred from movement."



KERICHO DISTRICT PYSIOGRAPHY

From the above quotation, it can be inferred that the geology of a given area has a fundamental influence on water availability. Coombs and Ahmed (1974:13) emphasizing the fundamental influence of geology on ground water states that:

> "the nature of the rocks have profound influence on the way in which ground water occurs, on the amount occuring in any given volume of rock, on the case with which ground water can move through the rock, its rate of movement, and finally, ground water quality."

As such, geological knowledge is of much help to a physical planned studying water resources, particularly the rock structure and formations, because they are very important for determining suitable areas which pose less costs when drilling for water, or for determining low and high water tables for borehole drilling. Researchers on the influence of geology on water have indicated that cumulative frequency distribution of borehole yields and rest levels vary with rock types (Norconsult, 1969), and that the cumulative frequency distribution of depths to main water supply varies with different rock types (Alai, 1975).

According to Binge (1957), the rocks of Kericho district as a whole include: the granitoid gneisses of the basement system; highly faulted lavas of

the Nyanzian (pre-cambrian), the Kisii series, lower miocene sediments (the Koru beds), the Londiani rocks, which consists mainly of pyroclastics.

The geology of Kipkelion division include the basement system, which as stated by Binge, covers the north-west of the division. It covers isolated ridges standing conspicuously from the plain west of songhor continuing northwards past the equator - with a notable charasteristic of granitic appearance and the frequent occurence of coarse grained pegmatic \eins aligned with the foliation.

Another rock represented in Kipkelion, especially along the valleys near Kipkelion township is the tertiary sediments which are characterized by isolated exposures and consisting of miocene limestones and bedded tuffs resting on gneisses of the submiocene peneplain.

Another rock is the tertiary volcanics represented in the Tinderet suite of pyroclostic rocks and nephelites and the Kipkelion - Londiani suite, which consists mainly of pyroclastic rocks with intercalated flows of phonolitic nephlenite and phonolite.

Lastly, the quartenerv sediments, found in most areas in the west bordering the kano plains. These sediments were formed by the deposition of silts and muds, under lacustrine conditions prior to the retreat of Lake Victoria in the early pleistocene.

Other areas where these sediments are found include valleys that extend eastwards in the vicinity of Kipkelion township (Binge, 1957). Figure 5 illustrates the above geology.

As was mentioned above, these rock types and inclinations have great influence to the occurence and distribution of water sources in the division.

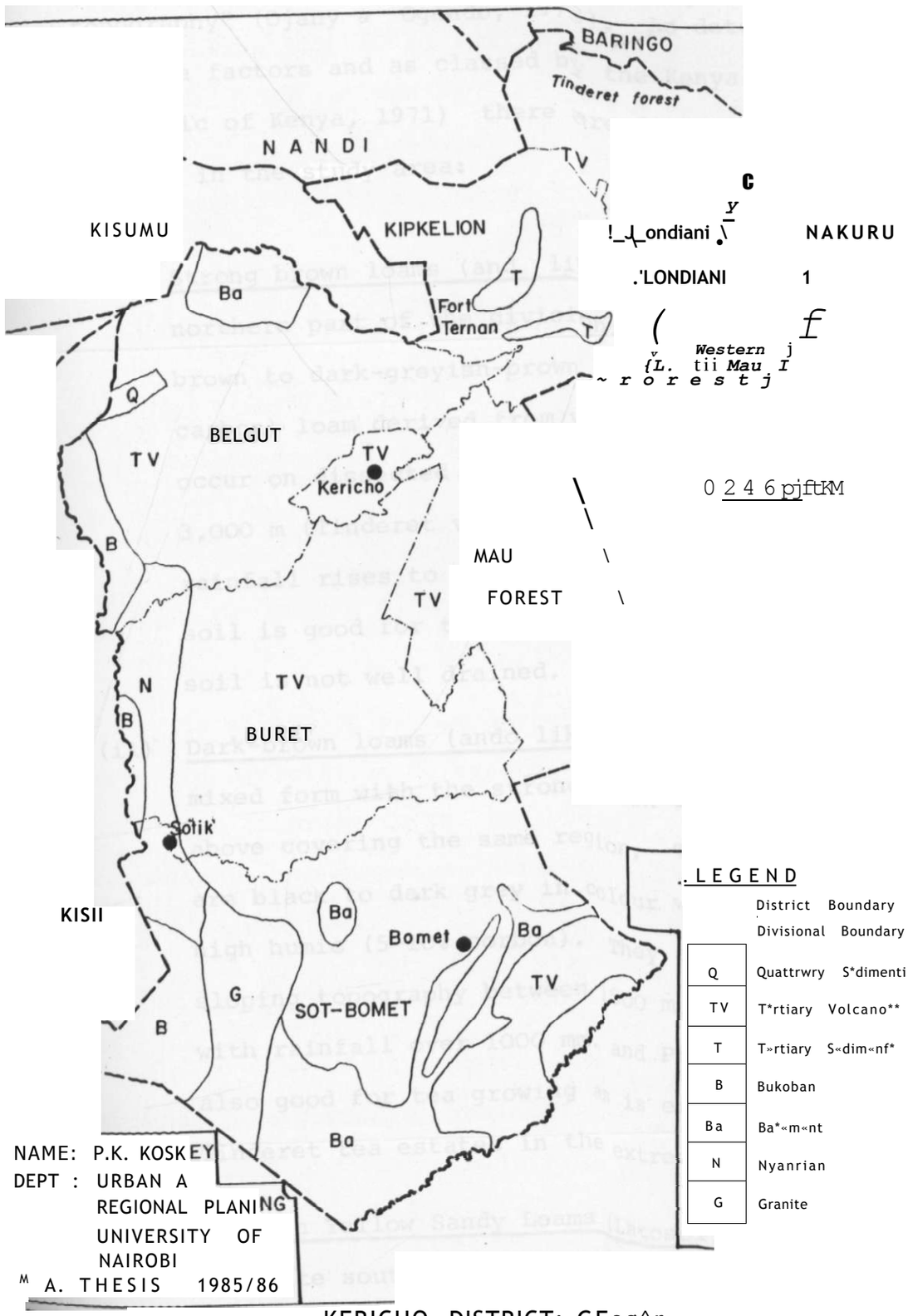
SOILS;

The economic goals of the supply of water to the rural communities cannot be realized without soil as one of the complementaries, which together with water and labour can provide for successful agriculture. The importance of soils is emphasized by Thornbury (1954) when he states that:

> " soil is one of the resources on which terrestrial ecology depends. Without available good soils, successful use of water is reduced to its minimum level.— th&t soils are next to water, man's vital natural resource."

Drawing from the foregoing quotation, it can be concluded that the economic use of water for agriculture can only be realized with the availability of good soil as a complementary package.

The soils of the study area (Kipkelion) like the Boils of any other given locality, vary in types, principally due to soil forming factors which include:



KERICHO DISTRICT: GEog^r

"climate, living organisms, parent material, time and topography" (Ojany & Ogendo, 1973). As determined by these factors and as classed by the Kenya Atlas, (Republic of Kenya, 1971) there are five types of soil in the study area:

(i) Strong brown loams (and like soils): dominate northern part of the division. It is dark-brown to dark-greyish-brown high humic (5-10% carbon) loam derived from volcanic ash. They occur on dissected topography between 1,500-3,000 m (Tinderet volcanoes) and where rainfall rises to over 1500 mm, with P.H 5-4. This soil is good for tea growing except where the soil is not well drained.

(ii) Dark-brown loams (ando like soils): appear in mixed form with the strong brown loams mentioned above covering the same region. These soils are black to dark grey in colour with deep and high humic (5-10% corbon). They occur in gently sloping topography between 1500 m and 2450 m with rainfall over 1000 mm. and PH 7-55 and are also good for tea growing as is exemplified in Tinderet tea estates in the extreme north.

(iii) Reddish Yellow Sandy Loams (Latosolic Soils): dominate south and south eastern parts of the division. The colour of the soil ranges from

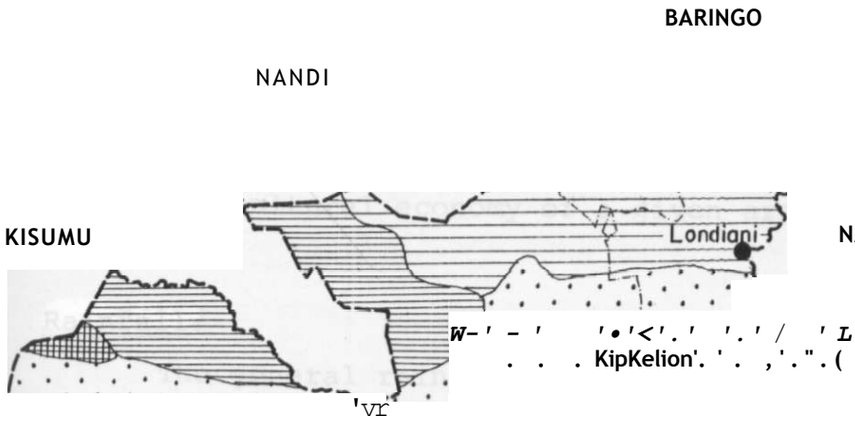
very dark-grey to dark-brown with high humic (3-10% carbon). They occur in a topography between 1000 m. to 2500 m. with rainfall of over 1000 mm. and PH 5-4. These soils are good for maize growing and tea in areas where rainfall is high enough.

(v) Red-friable clays (Latosolic soils): Occur in the same area as Dark-red-friable clays (south-west), with dark-reddish brown and a humic of 1.5-3%) carbon. Derived from both volcanic and basement complex rocks, favours undulationg ridge topography between 500 m to 2,000 m, with rainfall of 750 mm. to 1400 mm. and PH 5-6.5 Figure 6 show soil distribution in the area.

In all, most of the division's soils are fertile with few limitations to agriculture, thus the provision of water to the inhabitants is hoped to boost animal and crop husbandry which in turn will improve people's welfare!

2.2.4: CLIMATE:

The climate of a given locality comprises of rainfall, temparature, humidity winds and sunshine. A discussion of climate addressing itself to water study is important as climatic factors are of the greatest economic significance as far as water availability and agricultural activities of a given locality are concerned. Alai (1975) observes that:



KOSKEY
URBAN a
REGIONAL PLANING^—
UNIVERSITY OF NAIROBI
M A. THESIS,
'985/86

KERICHO DISTRICT SOILS

" favourable temparature conditions, well distributed seasonal rainfall, moisture ladden prevailing winds and all-the-year-round ample sunshine are climatic assets which form part of the physical resources that are vital in the agricultural economy of a given area"

Rainfall*

The general rainfall pattern in the division follows that of altitude and decreases from 2,000 m in the mau ridges (3,000 m) to approximately 1000 mm. in the central lowlands of Kipkelion. Its distribution throughout the year is such that the long rains start from April through September so that only one crop (maize) a year can be grown under natural rainfall conditions. However, short rains extends September to December.

According to the amount of rainfall received, four district rainfall zones can be recognized: the zone with the highest rainfall amount (over 1800 mm) covering the mau forest ridges from which water sources can be tapped for distribution; the area with 1400-1800 mm covering the Tinderet volcanoes forest which also has permanent water sources that can be tapped; the areas with 1000-1400mm covering most parts of Kipkelion uplands and the areas with less than 1000 mm covering the central lowlands towards Fort Ternan in the west.

In all, rainfall intensity, distribution and reliability is lower than that of other parts of the district though it still provides for the minimum requirements for agriculture. However, moisture amount in the division has through time conditioned farmers to crowd in favourable zones (mau and Tinderet zones), which guarantee an annual rainfall reliability. They include such areas as Chepseon, Chepkechei and Kebeneti. Figure 7 shows mean annual rainfall in the area.

Temperature:

Mean annual temparatures of the division are closely related to ground elevation and rainfall distribution. As the height along Kisumu border in the west (Fort Ternan) is low, temparatures also are relatively high reaching 28°c. though this is normally reduced during the rainy seasons. As a result evaporation on water surfaces is also high. At high elevations particularly the mau ridges and Tinderet volcanoes, temparatures are relatively low with 20° c due to high altitude and the presence of constant moisture released by forests covering the areas. Temparatures in the division rise during December to March due to the absence of rain.

Humidity:

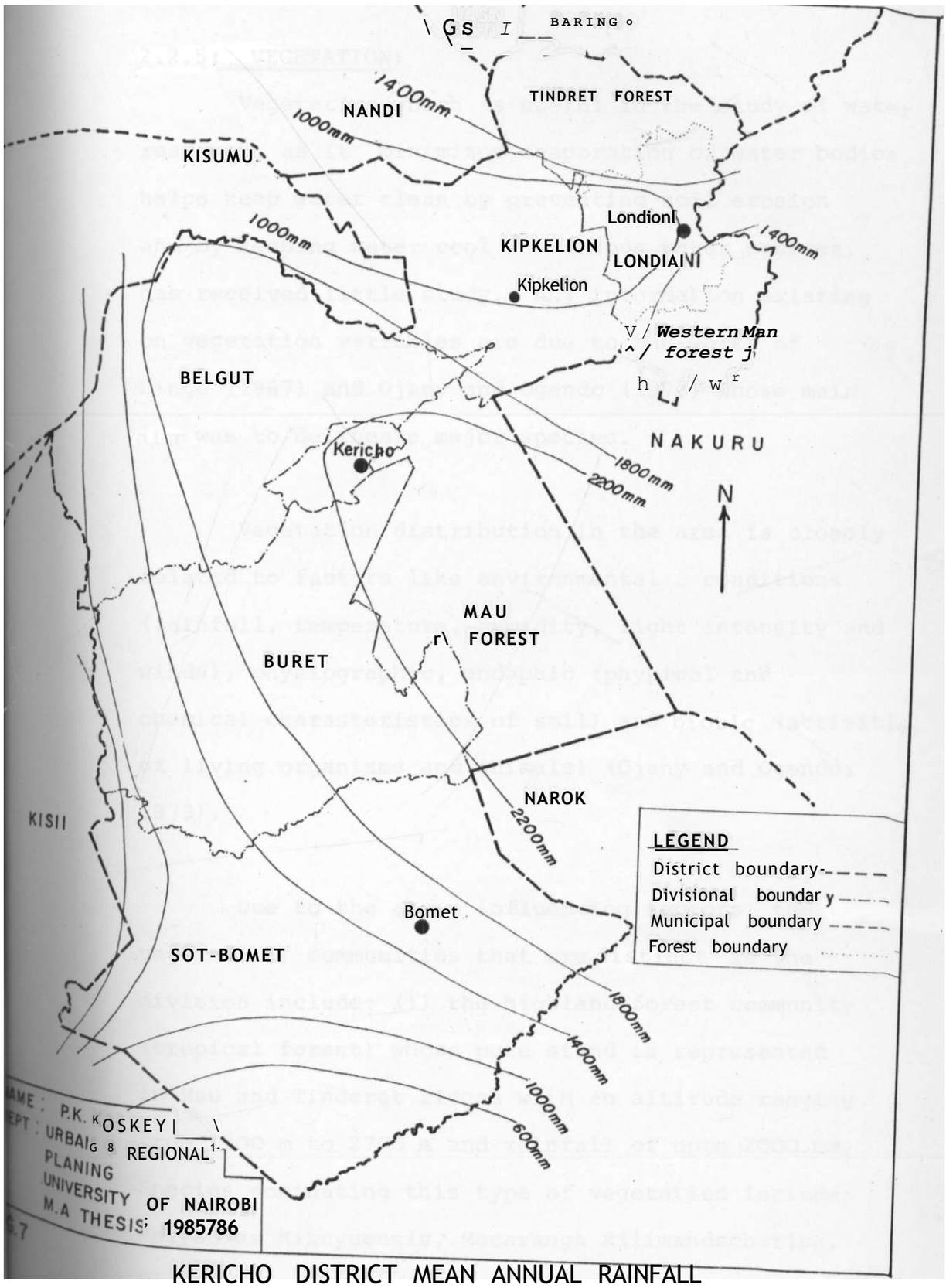
Relative humidity for the division is moderately low averaging 50%. The low humidity persists westwards towards the low areas along Kisumu border giving rise to a dry and clear environment. Mean diurnal range in relative humidity is about 13 to 15%. Areas with high elevations and adjacent to mau and Tinderet ridges have high humidities slightly above 50%.

Winds and sunshine:

The winds of the division which influence climatic conditions and evaporation of water bodies blow from Lake Victoria surface. The wind from the east carries no moisture and it prevails in the dry months of December to March.

The area experiences adequate sunshine all the year round except for rainy months of July and August when rain prevails over it for much of the days. The adequacy of sunshine in the area provides for conducive climatic conditions for economic activities.

In the study area, areas which have high rainfall such as Chepsir and Chepkechei have constant water supplies throughout the year as opposed to the rest of the division. High temparatures on the other hand increases evaporation rates as in the case of Fort Ternan zone where the temperatures are high.



KERICHO DISTRICT MEAN ANNUAL RAINFALL

2.2.5; VEGETATION:

Vegetation which is useful in the study of wate resource, as it minimizes evaporation of water bodies helps keep water clean by preventing soil erosion and by keeping water cool in various water sources, has received little study. Any information existing on vegetation variables are due to the works of Binge (1967) and Ojany and Ogendo (1973) whose main ainB was to delineate major species.

Vegetation distribution in the area is closely related to factors like environmental conditions (rainfall, temperature, humidity, light intensity and winds), physiographic, endaphic (physical and chemical charasteristics of soil) and biotic (activiti of living organisms and animals) (Ojany and Ogendo, 1973).

Due to the above influencing factors, the vegetation communities that are distinct in the division include: (i) the highland forest community (tropical forest) whose pure stand is represented in Mau and Tinderet ridges with an altitude ranging from 1900 m to 2 700 m and rainfall of upto 2000 mm. Species dominating this type of vegetation include: Polyscias Kikuyuensis, Macaranga Kilimandscharica, Olea hochstetteri, casearia battisocombei and fagara (satin wood). (Ojany and Ogendo, 1973).

"Where rainfall decreases with altitude, especially along the western edge of the south-west mau, there is a savannah (scattered -tree-grassland) zone of accacia, well typified at Londiani, Kedowa and Kipkelion vicinities^Topographically, it corresponds with the outcrop of later lavas, ashes and tuffs —" (Binge, 1957).

(ii) Highland grassland (grasses) which achieve a measure of dominance in open areas, usually indicate past fire or waterlogged condition of soil at some season of the year or even forest clearance by man. These highland grasses include: Themada triandra (red oat grass), pennisetum schimperi (the wire grass), pennisetum clandestinum (Kikuyu grass) and the Trifolium semipilosum (the Kenya white clover). (Ojany and Ogendo 1973).

2.3 HUMAN BACKGROUND:

2.3.1: ADMINISTRATIVE ORGANISATION:

(i) Administrative set-up:

For administrative purposes the division has three locations (Kipkelion, Lelu and Chilchillah) and seven sub-locations, which judging from its total area and the current rate of population due to immigrants encouraged by sub-division of settlement farms, makes the administration difficult especially in terms of rural resource development. Its local authority affairs is run by the County Council of Kipsigis,

2.3.2: DEMOGRAPHIC PROFILE:

Population distribution in the area corresponds with rainfall distribution, intensity and reliability, together with soils and temperatures which are Controller by altitude. Thus areas with scarce rainfall and do not allow for a variety of farming activities are sparsely inhabited.

Population distribution by census and projections per Administrative locations and sub-locations of Kjpkelion Division (1979-2006 A.D.)

Population distribution per administrative location/sub-location in the division depends on rainfall amount and reliability such that a sub-i$_{oca}$tion like Chepseon (Kipkelion south) is densely populated with **11,518** people and with an area of **82** km^2 compared to Lelu location with **14,398**, and an area of **12o** km^.

The divisions population figure for 1979 population census was 57,590 and 1986 population projection figure is 76,925 which represents a percentage increase of 33.6%. With the division's growth rate of 3.74% (C.B.S. projection rate for Kericho District) this figure is expected to rise to 82,985 in 1988, 99,911 in 1993, 120,045 (1998), 144,237 (2003) and 161,033 in 2006 A.D.

Derived from 19 79 population census, its rural population is 53,878 representing 93.6% of the total population. The above statistics are represented in Table 1 below.

2.3.3. SOCIO-ECONOMIC INSTITUTIONS;

The objective of this section is to highlight the socio-economic infrastructural set-up of the area with particular reference to sectors that have direct and indirect use of water resource. Bias is on major infrastructures that include: Educational, health institutions, commercial and administrative centres, and agro-based industries.

2.3.3.1. EDUCATIONAL INSTITUTIONS:

The overall enrolment in educational establishments in the division has trebbled over recent years necessitating the increase in the number of schools. The number of primary schools increased form 15 in 1975 to 53 by July 1985, while that of secondary schools has increased from 1 to 7 over the same period, and that of nursery schools increased from 3 to 73. This increase is expected to continue

TABLE: 1 POPULATION CENSUS AND PROJECTIONS FOR ADMINISTRATIVE UNITS FOR THE DIVISION 1979-2006 A.D.

ADMINISTRATIVE UNIT	AREA SQ/KM	CENSUS	PROJECTIONS					
		1979	1983	1988	1993	1998	2003	2006
CHILCHILLAH L.	179	20,156	24,090	29,044	34,968	42,015	50,482	56,361
Kunyak S/L	71	8,062	9,635	11,617	13,987	16,806	20,192	22,544
Kokwet S/L	63	7,055	8,432	10,166	12,240	14,706	17,670	19,727
Fort Ternan S/L	45	5,039	6,022	7,261	8,742	10,503	12,620	14,090
KIPKELION L.	205	23,036	27,532	33,194	39,964	48,018	57,695	64,413
Kipkelion S. S/L	82	11,518	13,766	16,597	19,982	24,009	28,847	32,207
Kiokelion N. S/L	72	6,911	8,260	9,958	11,990	14,406	17,309	19,324
Barsielle S/L	51	4,607	5,506	6,639	9,993	9,603	11,539	12,882
KIPCHORIAN L.	128	14,398	17,208	20,747	24,978	30,012	36,060	40,259
Lelu S/L	128	14,398	17,208	20,747	24,978	30,012	36,060	40,259
KIPKELION DIVISION	512	57,590	68,829	82,985	99,911	120,045	144,237	161,033

Source: Population projections for Kenya,1983-2000 (C.B.S. Report).

* **Projections based on assumptions of constant levels of mortality and** ***fertility.***

* **3.14 Growth. Rate considered.**

as the number of large farms continue to be subdivided resulting from the movement of more families into the area.students enrollment is shown in the table below.

2.3.3.2. HEALTH INSTITUTIONS

Health service is a sub-sector that determines the people's ability to implement rural development - oriented programmes like water programmes. In the division, there are six health institutions categorized as health centres, (Kipkelion and St. Francis), and dispensaries (Fort Ternan, two mobile clinics (Mercy and Chepseon) operating from Kipchimchim Mission hospital in Belgut division.

Of the health institutions mentioned above the average out patients per day is 350 and the in-patients (in St. Francis) are 70 in number. The dispensaries on the other hand have an average of 150 out patients per day. Except for Kipkelion and St Francis health centres, the rest of the health institutions have no potable water supply.

2.3.3.3. SERVICE CENTRES:

Kipkelion division,being a typical rural area has no significant commercial centres which provide for trade and industry for the local population, except for the designated urban centre of Kipkelion which is the administrative headquarters for the division.

ADMINISTRATION LOCATION AND TYPE OF SCHOOL	NUMBER OF SCHOOLS	STUDENTS PER SEX			TEACHERS PER SEX		
		BOYS	GIRLS	TOTAL	MALE	FEMALE	TOTAL
KIPKERION							
Nursery	48	1,015	1,055	2 ,070	-	48	48
Primary	25	4,802	4,302	9,104	194	84	278
Secondary	5	305	243	548	22	7	29
Grand Total	78	6,122	5,600	11,722	216	139	355
CHILCHILLAH							
Nursery	15	325	315	640	-	15	15
Primary	20	3,188	2 ,825	6,013	137	12	149
Secondary	1	55	9	64	3	1	4
GRAND TOTAL	36	3,568	3,149	6,717	140		168
KIPCHORIAN							
Nursery	10	270	250	520	-	10	10
Primary	8	1,973	1,748	3,721	75	12	87
Secondary	1	80	39	119	1	6	7
GRAND TOTAL	19	2 ,323	2,037	4, 360	76	28	104
Division G. Total	133	12,013	10,786	22,799	432	195	627

Source: Division (assistant) Education Office (Kipkelion, Sept. 1985)

to

BYl
1i

By July 1985 there were 45 service centres categorized as follows: urban centre (1), rural centres (2) and market centres (42), the majority of which are individual farm canteens.

The type of businesses which enterpreneurs of these service centres engage in range from: Retail 352, caterers/'Hotels (105), Butcheries (75) posho mills (48), tailoring (13), carpentry (8), manufacturing/bakeries etc (8), boarding/lodging (8), wholesale (5), shoe repair (5), motor vehicle repair (3), herbalists (3), hair dressing (3), blacksmitsh (3), knitting (3), hides and skins (1). (District Trade Development Office, Kericho, July 1955^

The above list of businesses within Kipkelion division is expected to increase due to the increasing population number causing more demand for water supplies.

2.3.3.4. LIGHT INDUSTRIES:

Though Kipkelion division is predominantly an agricultural area, most of its agricultural products including tea, milk, pyrethrum, wheat, maize, sugarcane are processed outside the division. However, there are nine coffee factories which serve coffee farmers in the division. With the increasing parcelling of large

scale co-operative farms, more arid more coffee will be planted necessitating the addition of coffee processing factories. There are also five saw mills in the division, all of which will require water supplies.

2.4 THE ECONOMY

2.4.1 INTRODUCTION:

Generally, the division has favourable conditions for a variety of economic activities. One historian, sutton (1973) describing the conditions of this area as favouring diverse economic activities observes that:

> " To the hunting and gathering communities of the past, both the forests and the grasslands with their former herds of game (still plentiful at the beginning of this country) would have proved attractive. For food producing communities of more recent times, the wooded areas with their high rainfall and rich soils make, when cleared, fine agricultural country, while the natural grasslands recommend themselves for pasture".

With the attainment of independence (1963), the inhabitants of the area have taken to modern farming both in crop and animal husbandry.

2.4.2.: CROP FARMING

Crop farming in the division falls into two parts: cash crop oriented and food crop oriented.

(a) Cash crop oriented pattern of farming: include the production of the- following;

(i) Tea Production:

Tea production does well in areas adjacent to Nandi (Tinderet and Chepkechei) and Mau (Chepsir) hills v/here there is high rainfall (over 1,400 mm) cool conditions (16.5°c) and deep well drained soils. Tea in the division is in the hands of small scale owners with a total acreage of 502 acre's. The processing of tea is done by Kenya Tea Development Authority (K.T.D.A.). Due to the good returns from tea, this crop has attractedmany farmers, especially as tea growers are initially paid a gross payment of 1.50/- per kilogramme per month, and at the end of every year, farmers receive an annual payment (bonus) of which the amount depends on the quality and quantity of tea sold by individual tea farmers throughout the year. (District Agricultural Annual Report, 1985).

(ii) Coffee production:

In the division, coffee production prosper well in Fort-Ternan, Lelu,Kokwet, Kunyak sub-locations. The crop has the capacity to resist dry seasons than tea though prolonged dry spells affect coffee yields. By 1985, the acreage under coffee was 2,741. 85 which gave a yield of 544,705.5 kilogrammes. As noted above, the division has 9 coffee factories that need much water for processing. (District Agricultural Annual Report, 1985).

(iii) Pyrethrum production;

Pyrethrum is a crop that grows in all parts of the division, and is grown by many small farmers. However, due to unstable world market its production has not been regular and has led farmers to neglect it.

(iv) Sugar cane production;

Sugar cane production in the division is grown in areas adjacent to Kisumu district, stretching from Songhor in the north-west through Fort Ternan to Kaitui-Sondu area. By 1985 there were 3,473 acres land under sugarcane plantation.

(b) FOod-crop Oriented Farming;

(i) Maize production:

Maize cultivation in the division is grown by each and every family. Though the crop is purposely cultivated for food sustenance, it ranks very high as an income earner. This is because the division has not only met its internal requirements but has through time had substantial surpluses to sell to the public stores (National Cereals Board). By 1985, the acreage under production of maize was 44,350 acres, with an average yield of 20-25 bags per acrea (District Agricultural Annual Report, 1985).

(ii) Finger Millet:

Finger millet does well in zones of low altitude (Fort Ternan, Lelu, Kokwet, Siret) and often in mixed stand with maize. It is grown mainly for subsistence though surpluses are sold. In 1985, there were 7,670 acres of land under finger miller with each acrea producing an average of 13 bags. (District Agricultural Annual Report, 1985).

(iii) Potato production:

This crop is relatively new in the division prosper well in high altitudes where conditions are relatively cool (Chepseor, Chepsir, Chepkechei Kebeneti). The acreage under potato growing was 2,530 acres of land by 1985 with a total yield production of 284,520 bags. (District Agricultural Annual Report, 1985).

2.4.3 LIVESTOCK FARMING:

Livestock farming in the division include the rearing of cattle (grade and mixed breed) goats an^ sheep. The industry as a whole is market oriented^

(i) Grade Cows:

They are reared by farmers for the production of milk for both subsistence and sale. Unlike the zeb-u cows, grade cattle do not thrive well where there is insufficient water for drinking and poor manag^ . .

In Kipkelion division they are found in Chepsir, Sitian, Kaplaba, Tinga, and Kebeneti. These are the areas which have relatively high rainfall, thereby guaranteeing reliable supplies of water. By 1985 the number of grade cows was 44,658 the majority of which were of Frieshan, Ayrshires, jersey and guernseys breeds (Divisional Livestock Department, Kipkelion, 1985).

(ii) Mixed Breed Cows;

These are mixed breeds of the zebu and grade cows. They are characterized by their moderate size and relative resistance to dry conditions. They are reared mostly in Chepseon, Tugenon, Kimugul, Tuiyobei and Nyando. By 1985, the number was 69,198.

(iii) Sheep and Goats Production:

Sheep and goats production in the district has not taken lead in agricultural industry because there is great pressure for dairy and cash crop farming , sheep dominantes the high altitude areas (Barschelle, Chepseon, Kebeneti) while goats do very well along the valleys, where low altitudes provides for warmer temperatures and where the indegenous scatted bush provides for nutrious leaves. By 1985, there were a total of 76,229 sheep and goats in the division (Divisional Livestock Department Kipkelion, 1985). Livestock type and population is illustrated in the Table below:

TABLE 3 KIPKELION'S DIVISIONAL LIVESTOCK TYPE AND POPULATION"

GRADE CATTLE	POPULATION NUMBER
Frieshans	11,865
Ayrshieres	16,160
Jersey	6,982
Guernseys	6,651
TOTAL GRADE COWS	44,658
Mixed Breed	69,168
Grand total	103,826
Sheep	26,311
Goats	49,918

Source: Divisional Livestock Department Kipkelion, July, 1985.

2.4.4. FORESTRY:

Forest reserves in the division are widely distributed on the higher areas along the borders with Nandi and Nakuru Districts, especially on the Nandi and mau escarpments. The presence of these forests has supported a timber and saw milling industry, covering an area stretching from Chepsir-kedowa and Chepkechei-Kebeniti areas. These occupations earn, people some income in the division.

2.5 SUMMARY OF THE CHAPTER:

The foregoing chapter has dealt with the physical, human and economic attributes of the study area.

Among the physical attributes considered are the location and extent of the study area which gives an indication of the size and location of the study area, the relief and drainage which, gives general characteristics of the area as they influence surface water sources; the geology and soils as they influence the availability of ground water and soil productivity, respectively. Climate is also considered in terms of rainfall and as an important factor in replenishing water sources. Climate is also considered in terms of temperatures, humidity and winds which are factors influencing the rate of evaporation.

Secondly, human background was considered in terms of administrative set-up as well as the demographic profile of the division particularly as this information provides the number of people requiring water.

Socio-economic institutions were also considered as they constitute a base for planning for the demand of water supplies in future.

Lastly, the economy of the study area was considered in terms of agriculture and forestry to serve as an indication of the economic need for water and also to indicate the ability of the people to pay for water provision.

CHAPTER THREE

3.0 LITERATURE REVIEW

3.1 REVIEW OF RELATED LITERATURE

(a) GENERAL PROBLEMS OF WATER;

General problems associated with water supplies have been reviewed in this study on global, developing countries, regional (Africa) and national (Kenya) levels.

(1) Global Water Situation:

> [11] Globally, there may be enough water to meet forthcoming needs. But, frustratingly, it tends to be available in wrong places at wrong time, or with the wrong quality. And in one way or another [a]H societies are affected however rich, however poor. "
> (UN WATER CONFERENCE SECRETARIAT, 1978 :)

The above quotation summarizes the premise on whicH this study stands: that despite the fact that there exists in our world a total of about 1.5 billion cubic kilometres (396 billion gallons) (Biswas,1976:221) of water, and of which if distributed equally, each person would have 0.34 cubic kilometres (90 billioa gallons), an amount that is by far beyond an individual's use, it is not evenly distributed in areas where it is wanted and in safe condition. Only 0.003% of this large amount of water is safe for human use and the remaining 99.99 7% is unsafe. With the world population growing rapidly, and the failure of man to deliver it where it is wanted, the admitted inference is that, a water crisis is creeping up and may overtake the advance of man sooner or later.

The number of lives claimed by water infested with water-related diseases is appalling and has raised government's concern. The magnitude is expressed by Bourne (1981:14) in the following terms:

> " it is estimated that 39,000 men, women and especially children die from waterborne diseases every 24 hours."

The above "killer", in average claims 1,250 precious lives every 60 minutes and has raised the concern of many governments especially those of developing countries. Unfortunately the financial capability of developing countries where the problem is most acute are limited. According to world bank's estimates, extending water services can cost from US $ 300 per head, depending on whether the water source to be tapped is near or far away, deep in the ground under layers of rock, or just a few feet below the surface, or on whether a tap is installed (UNICEF, Annual Report, 1983:3). The estimated cost of implementing the water Decade (1980-1990) alone, which focuses its attention mostly on the poorest nations of developing countries amounts to US $ 600 billion (UNICEF, Annual Report, 1983:3). This figure, of course, is enough to detract the sincere efforts of many developing countries and organizations to respond to the challenge of providing safe water to their populations without the financial help from advanced nations.

A part from the deaths caused by unsafe water, it is estimated that of all the sicknesses that are experienced in the world, 80% is attributable to inadequate water and poor sanitation (UNICEF, Annual Report, 1983:3).

In terms of distance to water sources, over 2 billion people of the world, particularly in the rur^ areas, draw their water in sources far from their homes (IDWSSD REPORT, 1981), thus wasting much of their time and energy that would otherwise be used in productive and even recreational activities.

Drawing from the above discussion, it can be concluded that the lack of adequate access to safe w^ and sanitation, long distance to water sources, by and large remain the greatest barriers of good healtk better recreation and prospective economic activities This, of course, calls for a conceptual planning approach that defines a process for diagonising the above problems and suggesting possible solutions.

(ii) Water Situation in Developing Countries:

> " In the developing countries, water is "KING[1],[1] dictating people's lives and touching every aspect of development including the raising of livestock, irrigation of crops, the development of light industry and even production of hydro-electric power".
> (MAZINGIRA: JOURNAL VOL. 5 NO, 4, 1981:16).

Though in developing countries water is "king" and a factor that determines human general development, health and well-being, its situation is critical in that the current pace of providing water supplies where needed is outstripped by the rapidly expanding population. This fact supports McGarry's (1977) arguement that: "though in developing countries' people need and want water, the pace of providing it is miserably slow and where installations have been provided, they have been left with distressing frequency to fall into disrepair and disuse through faulty operation and maintainance. The increasing population in turn increases human waste which aggravate . environmental pollution leading to illnesses, delibity and deaths because of poor water supply and inadequate facilities for the disposal of human excreta."

The magnitude of the problem has been reiterated by organizations of international calibre, For instance of the 15 million children under 5 years dying each year in the world, 29 out of 30 are children from developing countries. Most of these deaths are directly^ or indirectly related to consumption of contaminated water supplies. (I.D.W.S.S.D. Annual Report-in Mazingira/' 1981:14). This finding supports UNICEF'sAnnual Report (1983:3 No. 116) finding that over half of the dealing in developing countries are children dying from a combination of poor drinking water and insanitary living-^ conditions.

On accessibility to safe potable water, estimates from W.H.O. (1975) Annual survey report up dated in 1980 suggests that roughly 3 out of 5 people of the population in developing countries do not have easy access to safe water for drinking.

(iii) Water Situation in Africa:

> "In Africa today, it is estimated that 80% of the women play a major part in the food production, carry 80% of the fuel supplies, and supply the labour for half of the house-building and (yet) have to fit in the water carrying (dominantly faminine) with the rest of the daily work (Focus, 1975, No. 5)
> " usually going for water first thing in the morning and again during tne day" (White, 1977).

Drawing from the above quotation, the already burdensome work done by the African women is made much more difficult by the search for water in far sources first thing in the morning, due to the fact that of the total Africa's water resources, only 2% is exploited, with only 5% of its total population, mainly urban dwellers, receiving safe drinking water (W.H.O. Annual Technical Report 1969, No. 420). From the fact that on 2% of Africa's water is exploited and with only 5% (mainly urban) of its total population receiving safe water, many implications can be drawn. First, of the 95% of the population receiving unsafe drinking water

this population is prone to water-related dis^seg which increase the rate of mortality by both and adults. Secondly, the extensively unexplQ^ted water (98%) means that much time and energy is st m spent in searching and hauling water. It may imply that except in arid areas of Africa, wh^^ a lack of constant reliable water supplies me^ that people live within a narrow margin of disastro^ crop failure, drought and starvation (eg. Eth^^^ non access to safe water cannot be attributed j. water scarcity but sexploitation which may b$ a result of lack of capital and skilled personn^

(iv) National water Situation (Kenya)

> "Less than a quarter of the people in Ketiya have access to clean water women foll^ have to trek miles for hours each day, a^ sometimes at night, in search for water. The situation gets even worse during the dry months" (Daily Nation News, Oct. 198^

The above quotation, made by the Minister£or Water Development to the National Assembly, uiw water problem in Kenya. The number of people Without access to safe piped water is estimated to be0ver 13 million (Daily Nation, Oct. 1985). This Vjter problem has of late been intensified by raDidj^ in population.

Further, water for domestic use for Kenya's population is not readily available near the dwelling (Dev. Plan 1970/74). Thus mucfc time is wasted by women and children in water hatlage from far sources, and diverting energy away from other more productive tasks as cultivation, animal husbandry,, intensive child care and necessary leisure (Dev. Plan 1974/78). Other problems associated with water is the reliance on natural water sources (water holes, streams, springs etc.) which increase the vulnerability of water related diseases to the people.

With the recognition of the above problems, the government's objective since independence has been to provide safe and potable water within reasonable access from the individual households in a community. (Dev. Plans 1966/70, 1970/74, 1174/78, 1978/83, 1983/88). This shows awareness of the water problem in Kenya and the need to supply safe drinking water to the people.

(b) APPROACHES TO WATER SUPPLY PROBLEMS:

Apart from research on the magnitude of water problem, other research v»ork ha® also been done on other water-related studies which include the following:

(i) User-choice approach in planning for rural watpr supplies:

Kirkby (1973), emphasizing on "User-choice approach/' states that if the users' view and decision are not sought, the planned water supplies can be misused or abandoned in favour of impure traditional supplies. That committing the users in initiating rural water projects would make them provide their own frame of reference and criteria for calculating sets of trade-offs.

Hewes (1974), on the other hand, states that an important deficiency in water development planning is the inability to make the user to participate effectively in the policy formulation and decision making process, making the water development agencies to become advocates, judges and juries of the entire process of water management. This leads to lack of the users' support and failure of thewater supply project.

Alai (1975), states that user participation in their water supplies is a pre-requisite for success because they know which source of water within their respective jurisdictions provide good, clean, and palatable water for consumption; is prenial; seasonal; and finally, which periods during theyear the levels of water fluctuate.

Whyte and Burton (1977), states that for water supply project to be accepted, it will have to go through a process of becoming accepted by both the community and the individual. Due to this, a planner must emphasize the need to involve the community in the decision making process, to react to its demands and to respect its reasoning.

(ii) The community's elite approach in rural water supplies planning:

(Segre (1974), emphasizes the role the community's elite plays in the success of a water project and states that through negligence, the engineer and planner often ignore this necessary legitimization process, by-pass the village hierarchy and install the water project. This having not been internalized and accepted by the elite is sooner or later rejected as an imposition, and instead adhere to the old pattern to which the new one was insensitive to.

(iii) Self-help approach in rural water supplies planni^

Nyerere (1969), focusing on self-help water projects states that the application of self-help approach through people's participation in the development of improved rural water supplies ensure that the scarce resources are used to maximize benefit thus cutting down the cost of developing improved rural water supplies.

Donaldson (1977), on the other hand, states that self-help water projects reduce costs by the government because the local people are involved in the provision of cash, labour and materials and also reduces chances of the projects' falling into disrepair as the people are trained to maintain the system and do simple repairs.

(iv) Complementary input approach to rural water supplies planning:

Feachem (1977), stressing on complementary inputs in rural water supplies, states that a water supply development must be accompanied by a carefully defined package of complementary inputs if it is to achieve its stated goals. He divides these into stages: immediate benefit stage complementary inputs include: community participation and support, competent design, adequate facilities for operation and maintainance, and lastly, appropriate technology utilized; stage 1 benefits (saving of time, energy and improved health) complementarities include: new water supply closer to dwelling than the old one, water use pattern and hygience to take advantage of improved quantity, availability and reliability, and water supply should not create new health hazards of mosauito breeding; stage II benefits (labour release, crop innovation, and improvement animal husbandry) complementarities include: the provision

of good advice and extension services on crop and animal husbandry, co-operatives, and credit; and finally stage IV benefits (higher cash incomes, increased and more reliable subsistence, improved health and leissure) whose complementarities demand that water supply development must be just a single component of an integrated rural development programmes with the active support of the local community. Complementary inputs have also been stated by the following scholars .. Carrut'hers (1973) ;Feachem (1973a)'; Saundersand Warford (1974) ; White et al (1972).

Jakobsen et al (1971) states that in order to achieve the benefits of a reticulated water system, it is necessary to introduce other programmes such as provision of extension personnel to educate farmers on how to maximize the economic potential and find ways and means of overcoming the cultural and technical constraints associated with water as a production input.

(c) EXPECTED BENEFITS OF WATER PROVISION:

Other studies have focused on expected benefits of good quality water, abundant quantity and within easy reach. These studies include those of:

Klasse-Bosse (1969), who focusing on expected benefits on rural water supply provision, categorizes

the benefits into direct and indirect. Direct benefits include: relief from the labour of hauling water to homes of those people previously carrying water for long distances, availability of more and relatively pure water, and the released time becomes available for application to other pursuits. Indirect benefits (economic) include: adoption or expansion of livestock activities by those farmers who previously felt water to be a constraint, improvement of animal health and welfare where previous sources were far, improvement of crop husbandry. Improved human health welfare by alleviation of water-borne diseases (bilharzia, dysentry, cholera) and by encouragement of better standards of hygiene (cleaner clothes and utensils); intensified child care and increased time for the husbands by the wives; more time for play and school work for the children; and increased formal and informal participation (leisure /recreation,- visiti^ radio and television programmes, meetings and self-help programmes).

Carruthers (1969), states that differential primary benefits may be expected from areas in different ecological zones depending on whether or not they are high or low potential, with predominantly welfare benefi(s being expected from the high and economic benefits from the low potential zones. That in a densely populated area such as the upper cultivated slopes

of Mt. Kenya or the aberdare ranges where family incomes are comparatively high, the main benefit of reticulated water may be social welfare (less work for women and children). But also the small size farms might preclude gains from increased labour availability.

Warner (1975), categorized benefits into social which he divides into health (high frequency of bathing, reduced incidences of diarrhoea) and Education (acquisition of new skills through training on water projects, agricultural programmes and increased school enrolment and attendance); economic (improved crop and animal husbandry, creation and expansion of water using businesses); political (greater local involvement in development projects through self-help, greater sense of collective responsibilities and identification with projects that fulfil government's goals and policies); and finally, modernisation (greater acceptance of new technology and increased rate of modern development).

Carruthers and Browne (1577), elaborating on the above mentioned benefits state that economically the reduced walking distances saves time and energy and releases labour which may be used for productive purposes.

In social benefits, they state that even if the economic value of saved labour is zero, there is a social benefit from the time saved and drudgery eliminated because more time can be spent with the family or on domestic activities and leisure.

On health, they state that the improved quality of water may lead to improved health resulting in lower medical expenditure and an increased sense of well being hence increased productivity in agriculture. That water available in homestead may improve the condition of livestock as they will not walk long distances to water sources.

Republic of Tanzania, 2nd 5 year Dev. Plan (1974), states that the provision of adequate water supplies is of high priority on both economic and social grounds. That economically, water is not only critically an important input into agriculture and livestock industries, but the provision of better domestic water supplies will both release much labour currently consumed in carrying water for other productive purposes and allow a more efficient pattern of settlement. That the provision of better rural domestic water supplies is also a necessity for the achievement of a better quality of rural life, both in health and convinience, which can provide a counter attraction to the convinience of urban living.

The above literature has focused on the magnitude of the water problem globally, regionally and nationally. These studies have indicated th&t there is still need for further research in this sector. The review has also indicated some of the expected directions of research on water supplies.

3.2 STUDY ASSUMPTIONS:

From the foregoing literature review, the following main assumptions of the study were made:

(a) that the provision of good quality water, of abundant quantity and within easy reach is likely to increase agricultural activities due to the time released from hauling water from water sources far from homesteads.

(b) that the provision of such water, man's health will be improved through regular bathing and laundry.

(c) that with proper management of water sources: dams, boreholes, wells and piped water supply schemes, water problem in the study area will be reduced.

3.3 OPERATIONAL DEFINITIONS

Labovitz and Hagedron (1971) states that "t^e role of operational definitions is to indicate the specific manner in which a term or concept is to b_e used." This means that the terms/concepts usedi_n this study do not possess any kind of universal meaning as what they cannote here may be different in anoth_er study. This study used the following terms/concepts.

(i) "Safe water supply"; Defined in the same leaning as W.H.O. (1973) includes "treated waters or untreated but uncontaminated waters such as from protected boreholes, springs and sanitary wells."

(ii) "Wholesome and palatable water;" Defined i_n Fair et al (1966), "Wholesome" water is taken to b_e f_ree from disease organisms, poisonous waters and excessive amounts of minerals and organic i_att_er"

While "palatable" water is taken to be significantly free from colour, turbidity, taste and oobjr and well aerated."

(iii) "Reasonable Access to safe water;" Definej W.H.O. (1973) terms implies that "the houst_Wif_e or members of the family do not have to sp^ _a large part of the day in fetching water."

(iv) "Participant-observation" used in the same meaning as that of the U.N.D.P. Annual Report (INT/81/047, 1983), refers to "a kind of study methodology whereby the researcher establishes residence in the community to be studied and remains there weeks or months, observing and recording the activities and events of daily life."

(v) "Household" , defined in Jorgensen's (1977) terms, is used to refer to "people living together as a family or with a common bond, eating, sleeping and spending free time together under the same roof; and keeping their important belongings in the place called their dwelling."

(vi) "Key-informant-Interviewing" As applied by the UNDP Annual Report (INT/81/047/1983), is used to refer to the "interviewing of people in the study area who are particularly knowledgeable about certain matters relating to the study under review.

3.4 RESEARCH METHODOLOGY;

The main goal of this study was to explore the magnitude of the water problem in the study area and on the basis of this suggest solutions to water problems in the study area.

The realization of this objective came about through the adoption of the herebelow methodology which, of course was influenced by a wide range of factors which include: a vivid understanding of the researched problem and the aims to which the data was intended, research costs, the heterogeneity of ecological zones of the study area, the kind of sample drawn, and in other cases the inavailability of data required.

Nevertheless, the basic procedures that characterize any scientific work were undertaken at various stages as indicated below.

Stage 1:

This involved the specification of the area of interest i.e. Rural water supplies problems Kenya.

Stage 2:

Involved survey of literature relating to the field of study aimed at providing some theoretical frame work within which the water problem analysis could be explained and directed.

Stage 3:

Involved defining and stating the magnitude of the water problem at global, regional, national and local level (study area). The defined problems that this study aimed at suggesting solutions in the study area included: long distance to water sources, infected

water supplies, water shortages.

Stage 4;

Involved the specification of the underlying assumptions of the variables in the study and which form a framework within which results are to be interpreted. In line with this was the definition of operational concepts which indicate the specific manner in which a concept is used in this study.

Stage 5:

Involved the specification of data collection procedures. This was divided into three parts: sampling design, questionnaire construction and the nature of data collected.

(i) Sampling design: involved, first, the definition of the universe (geographical limits)from which the sample was to be drawn. This was first done by identifying the number of farms of each sub-location and their households. This was followed by the computations of the proportions of each farm'shousehold from the total in order to arrive at a weighted number of questions to be administered.

Secondly, the type of sampling to be adopted which allowed the choice of a most representative sampling technique (random sampling).

(ii) Questionnaire construction; Before drawing up questionnaires, a clear idea of the kinds of information required and a plan for the use of each data collected was obtained by preparing a preliminary list of the type of information which was expected to be relevant to the study. This list had to be reviewed from time to time as additional data was collected.

In all, a total of 287 questionnaires were prepared for the following respondents: the rural population 180 questionnaires; the urban population served by Kipkelion water supply (30); the management of the on-going water projects (4); Kipchimchim mission water supply (11); the Kipchimchim self-help community water supply (10); the school going population (30); Sosiot County Council water supply (10); Kipkelion water supply management (1), and finally the district water supply engineer.

(iii) Sources and nature of data collected : Data for this study were from primary and secondary sources.

Primary data, being first hand informa-tion, was derived from three basic kinds of data gathering methods:

participant - observation, questionnaire administration, and key-informant interviews. In participant observation data collection, the researcher established residence in the study area, observing and recording activities and problems relating to water; attending water development meetings and participated in some water holes construction. Questionnaire administration involved the interviewing of the rural and urban population, government officers, committees of water projects, school going children, businessmen etc. The information was useful in determining water problems and requirements as well as water development aspects that can be adopted in rural water planning. While key-informant interviews involved interviewing knowledgeable people in the study area. They included administrative chiefs, councillors, village Aiders, teachers and farm directors.

The second level of data collected was secondary, which furnished the researcher with recorded information from both published and unpublished sources. These included data on the extent and amount of reliable water resources, demographic characteristics, economic base of the study area etc. This was made possible by the visits to libraries, government ministries, private and parastatal organisations and international agencies.

METHODS OF DATA ANALYSIS:

This study adopted two methods of data analysis evaluation of published materials and questionnaire replies. Secondly, computations of percentages and representing them in bar charts. Such data analysis was carried with an aim of identifying problems related to water, and on the basis of this suggest solutions.

CHAPTER FOUR

4.0 DATA ANALYSIS

4.1 INTRODUCTION

This chapter deals with the analysis of data collected in the field on water problem, The methods of data analysis are those cited in the section on research methodology above. The analysis is conducted with a view to suggesting possibly solutions to water problems in the study area.

PART A:

4.2. PROBLEMS ASSOCIATED WITH WATER:

4.2.1 DISTANCES TO SOURCES OF WATER AND IMPLICATIONS

4.2.1.1 SOURCES OF WATER FOR HUMAN USE:

Field survey revealed that the residents in the study area have no treated piped water and as such they fetch their water from rivers, from which 89.1% of the households obtain their water; wells with 7.3%; dams and reservoirs 3.6% and roof catchment tanks. Chart I below illustrates this.

The system of ownership of these water sources also varies from communal to private ownership with much of the water sources owned communally indicated by the following percentages: wells with 25 communal, dams 100% communal, rivers 98.2% communal. It is only roof catchment tanks that are fully owned privately This is illustrated in table 4 below.

TABLE 4: RURAL HOUSEHOLD WATER SOURCE; SYSTEM OF OWNERSHIP AND THEIR PERCENTAGES:

SOURCE OF WATER	PERCENTAGE	PRIVATE SOURCE %	COMMUNAL SOURCE %
Piped safe water	·	-	·
Well	7.3	75	25
Dam	3.6	-	100
Borehole	·	·	·
River & Stream	83.6	1.8	98.2
Roff catchment tanks	5.5	lOO	·

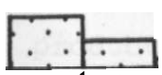
Source: Field Survey, 1985/86.

The sources of water is graphically illustrated by Chart 1 below:

CHART. I. Percentage representation of sources of water

KEY

b/h-•• • borehole
p.s.w • • Piped safe *lter
w .well
r.c.t.. . . roof catchmenif0n|is
D– • •• Dam
r,. . • r.W4r



p.s.w' w ' D ' b/h B ^ R — 1

Source of water *SOURCE! FIELD SURVEY 1985/86*

Drawing from the above analysis on sources of water, the absence of safe piped water implies that the fetched water from the alternative sources, especially from rivers, dams and water holes, may not be safe for human and livestock consumption because such water may be infested by water related diseases. It may also imply that the alternative sources may be unreliable, thus causing much problems to the inhabitants.

It can also be inferred from the above analysis that water sources in the study area are largely owned communally, a factor that must be considered in planning for rural water supplies in the area. This survey found that communal water sources enable the people to meet and engage in various discussions that include water problems, community projects, farming, family planning; and current local affairs.

4.2.1.2. DISTANCE TRAVELLED TO SOURCES OF WATER

On distance travelled to sources of water, it was found that over 72% of the residents travelled over three kilometres to sources of water within the study area water is fetched at varying times of the day with the highest intensity of water fetching being in the morning between 7-9 a.m. and in evening between 4-6 p.m. These are also the hours when productive activities like farming and catering for

the family often require priority attention. Distances travelled to sources of water members of the community at varying times of the a ay are i n ustrated in table (5) below.

Table 5 . DISTANCES FROM HOMESTEAD TO SOURCES OF WATER

DISTANCE (KM)	NO. OF HOMESTEADS	% OF TOTAL
Upto 0.9	7	12.7.
1.0 - 1/9	8	14.6
2.0 - 2j 9	12	21.8
3.0 - 3.9	15	27.2
4.0 - 4;9	5	9.1
5.0 - 5J 9	4	7.3
6.0 +	4	7.3

Source: Field Survey 19 85/86.

From Table 5 it is clear that much of the people's (drawers of water) energy is spent in walking long distances, particul arly w h e n s e v e r a l trips are made per day to water sour ces that are far from homesteads. The information **presented** above show that 72,74 of the homesteads are staying over 2 kilometres from water sources as opposed to the expected 2 km. distance recommended in the development plan (1978/83) in high potential zones, of which the study area is one.

4.2.1.3;, SYSTEM OF TRANSPORTING WATER

It was also found that energy wastage could be attributed to the system of transporting water to the homesteads. Large amounts of water used in the households is transported using human labour (pottery) was reported by 87.3% of the respondents. The remaining percentage of household transported their water using donkey (7.3%),vehicle (3.6%), and by other means (1.8%). Table 6 below illustrates this.

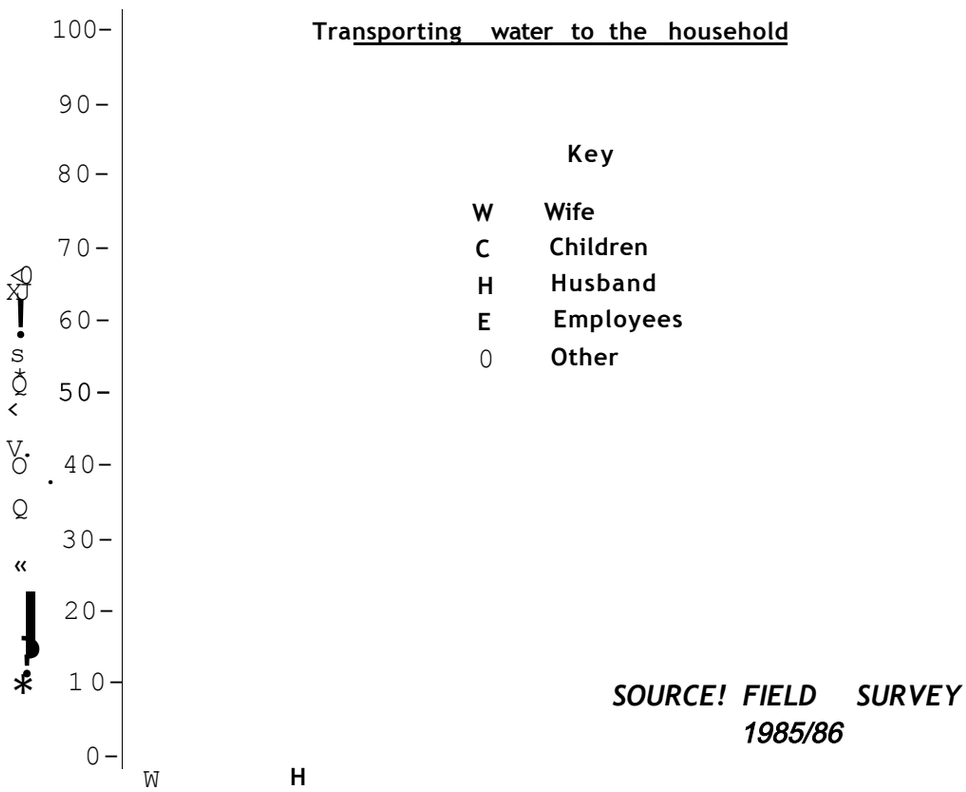
TABLE 6 ; SYSTEM OF TRANSPORTING WATER TO THE "HOMESTEAD

SYSTEM	HOUSEHOLD NO.	PERCENTAGE
Human Labour	48	87.3
Donkey	4	7.3
Vehicle	2	3.6
Other (oxen)	1	1.8

Source: Field Survey, 1985/86.

4.2.1.4 PERSONS TRANSPORTING MATER TO THE HOMESTEADS

This study found that persons whose energy is largely exhausted by transporting vfater . using human labour (pottery) or by donkey, are solely who the wives and children/comprise 94.5%* and 89.1%* respectively. The remaining percentage comprise employees (10.9%)* working in the households visited. There was no homestead where the husband participated in the drawing and transporting water to the homestead Chart II below illustrates this.



Persons transporting water to households

w .

<kL? rCentages do not add "P to 100% rnost families reported their
| «"ers of water to be both wife and children.

Drawing from the above analysis, it can be inferred that the wife, who apart from engaging in agricultural activities and daily domestic chores, is also burdened by the task of transporting water from distant sources, making her exhausted.

Children's participation in water transportation on the other hand not only exhaust their energies but affects their studies particularly when times for drawing and transporting water is considered.

4.2.1.5: NUMBER OF ROUND TRIPS TO WATER SOURCES PER DAY

The distance to source of water is lengthened by the number of round trips made by the drawers of water. Field surveys showed that as a result a lot of time is spent in search of v/ater. This survey indicated that the number of round trips made by the people range from one to ten with over 67.2% making over three trips a day and 32.8% upto two round trips as shown in Table 7. below.

TABLE 7 ; NUMBER OF ROUND TRIPS TO WATER SOURCES/DAY

NO ROUND TRIPS	FREQUENCY	PERCENTAGE
1	3	5.5
2	15	27.3
3	18	32.7
4	9	16.4
5	4	7.3
6	2	3.3
7	1	1.8
8	1	1.8
9	1	1.8
10	1	1.8
	55	100

Source: Field Survey 1985/86.

As a result of the large number of trips made to distant water sources, the repeated water fetching activities become exhaustive and may not allow for any significant participation in other activities in the day. This study found out that total distance covered by such repeated trips ranged from one to over twenty six kilometres a day with 76.4% of the drawers of water walking over 6 kilometres a day. This is illustrated in Table P below.

TABLE 8: TOTAL DISTANCE COVERED BASED ON TOTAL NUMBER OF ROUND TRIPS PER DAY

DISTANCE (KM)	NO. HOUSEHOLDS	PERCENTAGE
1 - 5	13	23.6
6 - 1 0	11	20.0
11 - 15	12	21.8
16 - 20	11	20.0
21 - 25	3	5.5
26	5	9.1
	5	100.0

The above calculations indicate that the residents of the area make an average of 3.6 trips per day with an average distance travelled per day of 12.4 km.

4.2.1.6: TIME TAKEN IN WATER FETCHING

Using information supplied on approximate distances travelled and the number of round trips made per day it was found that time spent in fetching water ranged from 1 hour to over 9 hours a day, with 70.9% of the residents spending over 3 hours. The average time spent per day in fetching water was found to be 6.3 hours . " Table 9 below illustrates this.

TABLE 9.: TIME SPENT IN WATER FETCHING

TIME SPENT (HOURS)	NO. Of HOUSEHOLD	PERCENTAGE
1 - 2.9	16	29.1
3 - 4.9	18	32.7
5 - 6.9	14	25.5
7 - 9.9	7	12.7

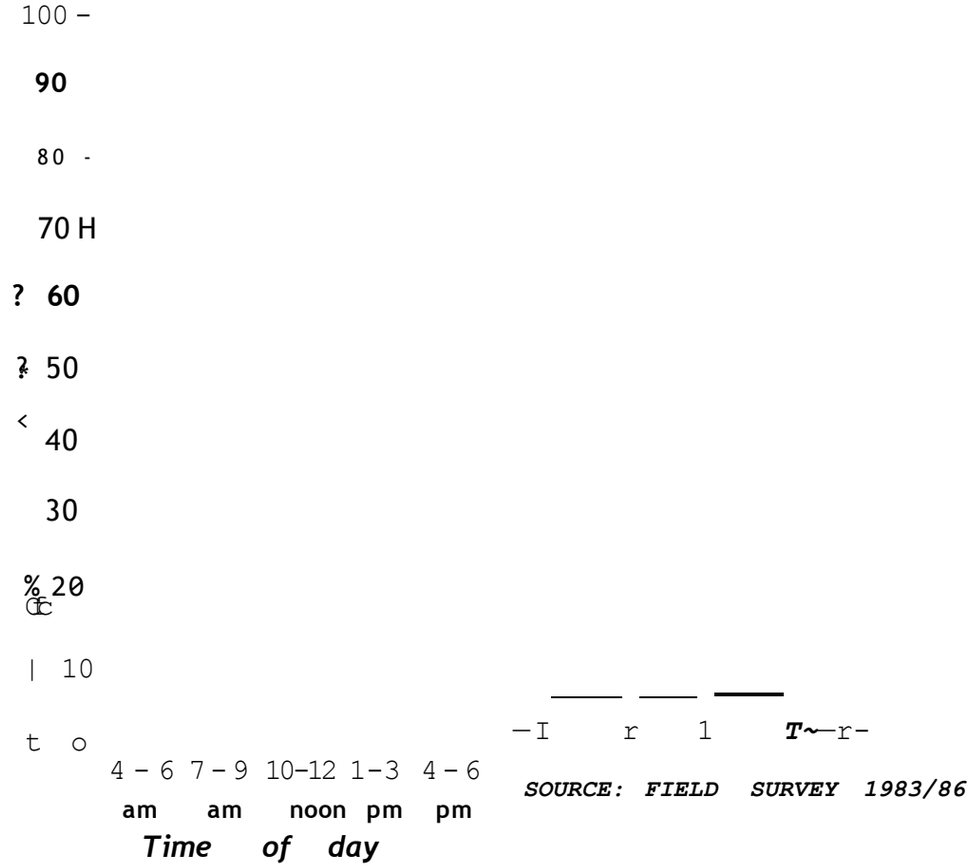
With regard to the time of day when trips to water sources were made, this study found that water fetching starts very early in the morning from 5 a.m. to late in the evening at 6 p.m. Trips to water sources were found to be highest between 7 a.m. and 9 a.m. when 44.9% of the trips were made. A second high period when water fetching trips were made was between 4 pj.m. and 6 p.m. when 41.3% of the people made trips to water sources. Water fetching frequency was lowest between 1 p.m. and 3 p.m., a time when people have retired for lunch and rest after an exhaustive morning. This is" illustrated in Table and Chart III.

TABLE }P TIME OF THE DAY WHEN WATER TRIPS WERE STARTED ;

TIME	FREQUENCY	PERCENTAG
4 a.m.-6 a.m.	6	6.5
7 a.m.-9 a.m.	62	44.9
10 a.m.-12 a.m.	7	5.1,
1 p.m. - 3 p.m.	3	2.2
4 p.m. - 6 p.m.	52	41.3

Source: Field Survey, 1985/86.'

Chart. 111 Percentage representation • of time of day when water trips are done



Drawing from the above foregoing analysis it can be seen that there are two peak periods when drawers of water make trips to water sources. These two peak periods are between 7 a.m. and 9 a.m. and between 4 p.m. and 6 p.m. Chart IV above), these .are also the times when productive activities such as agriculture could be undertaken. As such water fetching is likely to disrupt such activities.

Field data analysis showed that school children and women were the ones who fetch water. The two peak periods for water trips thus imply that school children have to walk long distances to a water source first thing in the morning and afterwards go to school when they are already exhausted, and they are not likely to be able to concentrate on their studies This situation is repeated in the evening 4-6 p.m. when the same school going children are required to fetch water after school and thus would have little-time for their private studies. Although no data was obtained to establish a relationship between water fetching and performance at school it is likely that water fetching could be affecting performance of school going children in school.

4.2.2. SOURCES OF WATER FOR LIVESTOCK

This study found out that the main sources of water for livestock in the study area are rivers, dams, and wells. The rivers dominated by providing water

to 92.7% of the total livestock population, the dams provide 5.5% and wells 1.8%. Table 11 below illustrates this.

TABLE 11 SOURCE OF WATER FOR LIVESTOCK

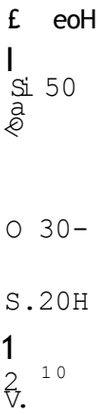
SOURCE OF WATER	PROPORTION OF LIVESTOCK
Drivers	92.7
Dams	5.5
Wells	1.8
Piped safe water	-
Boreholes	-

The above statistics indicate that livestock in the area rely mostly on river water which in most cases is contaminated and become infested with disease.

Distance to source of water for livestock

Unlike the sources of water for domestic purposes the distance to water sources for livestock are far, often to sources where water is adequate and reliable.The study found that over half of the inhabitants drive their livestock for over 4 kilometres to water sources. The percentage were as follows: Those who drive their animals between 1 and 2 kilometres were 10.9%; 2 to 3 km. 27.3%; 3-4 km. 54.1% and over 5 km. comprised 7.3%. These percentages are presented in Chart 12 below.

CHART IV **Percentage representation of distance to woter sources for livestock**



SOURCE: FIELD SURVEY 1983/86

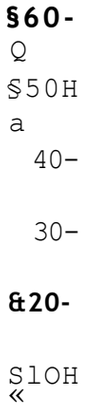
From the foregoing analysis, the long distances to water sources by livestock implies that livestock's energy are exhausted which may affect their health and thus indirectly, affect the quantity of their milk and quality of their meat.

4 2 2 2 Time taken for driving livestock to water sources:

The time taken to drive livestock to water sources is alot, particularly in areas such as Chepseon, Fort Ternan Barscnelleh where water sources are far. The situation is made worse during dry spells when seasonal water sources, which are replenished during rainy seasons dry up necessitating the inhabitants to travel far from homesteads in search

of water. This study revealed that alot of time is spent in search of water for livestock compared to the time spent in search of water for domestic purposes, Those who spent between 1 and 2 hours comprise 5.5%, 3 to 4 hours 12.7%, 5 to 6 hours 63.6% and 7 hours and over 18.2%. This is illustrated by Chart V below.

CHART V **Percentage representation of time token**
For driving livestock to water sources



SOURCE: FIELD SURVEY, 1983/86

Source: Field Survey 19 85/86.

ft

The above analysis on time taken in driving livestock to far water sources implies that much time for herdsmen is taken and as such they may not engage themselves in any other significant productive activities or necessary leisure, because by the time they arrive back to the homesteads their energies are already exhausted.

The above analysis on the implication of distance to sources of water, indicated that long distances to sources of water both for domestic and livestock wastes time, and exhaust energy, factors that are vital in productive activities of man.

4.3 WATER AND HEALTH

It has been demonstrated by various scholars (Biswas 1976, Feachem 1975 a, Bradley 1977, Bourne 1981) cited above that water has implications to man's health. If there is little water available to people either because the sources of water are too far from homesteads or because water sources are infested

with water related diseases or the sources are unreliable, it will be difficult for the people to maintain good health, either by good personal hygiene, or by regular washing of utensils.

Drawing from the analysis of sources of water in the study area (Table 4) it was found that all the inhabitants get their water from unsafe water source* Ural that included rivers with 83.6% of the inhabitants geK their water from them, dams with (3.6%), wells ng (7.3%) and roof catchment tanks (5.5%). The following implications can be drawn.

4.3.1: Unsafe water sources:

The reliance of water from river sources, dams and wells which due to their exposed nature are liab^ be infested with 'lany forms of pollution (faeces, dea<J animals and insects leaves and litter washed into them by rain water . This, ; implies that the peop]^ who drink water from such sources are exposed to watet$_s$ related diseases like intestinal worms (Guinea worms), diarrhoea, bilharzia, river blindness, skin infections typhoid, bacillary, amoebic dysentry, trachoma. Out of the daily 300 hundred cases of diseases reported in Kipkelion health centre in 19 85 it was confirmed by the District Medical Officer that 40% were water-related. The diseases diagnosed include bilharzia 10% river blindness 7%, diarrhoeal20% and infant mortality .

3%. The remaining percentage of 60% are non-water related diseases. Table 12 below illustrates this.

TABLE 12; PERCENTAGE OCCURENCE OF WATER-RELATED DISEASES

TYPE OF WATER-RELATED DISEASE	PERCENTAGE OCCURENCE
Bilharzia	10%
River Blindness	7%
Diarrhoeal	20%
Infant Mortality	3%
Non-water related	60%

Source: District Medical Office, Kericho, 1985.

The presence of such water related diseases implies that peoples' health may be affected and as such disrupting the productive ability of the people. It may also imply that people spent their money on medical treatment or spent their time attending to the sick or visiting them.

Though there was no concrete data to prove the extent to which unsafe water affect livestock it is not unlikely that some of the livestock diseases and mortality in the study area could be related to the water problem in the area.

The respondents cited cases of death among their livestock which they attributed to polluted water sources. The incidence of such deaths was reported to be discouraging farmers from investing in the otherwise profitable occupation. According to the field data, 83.6% of the inhabitants cited dirty and infested (polluted) water as the second pressing problem after far distances to sources of water.

The importance of improving unsafe water supplied in relation to the reduction of water related diseases like those mentioned above, has been described by Bradley (1977). Table 13 below summarizes Bradley's description and shows the percentage reduction of certain diseases that might be expected following the provision of safe and adequate water supplies. The estimates are based largely on experience in Africa south of the Sahara where progress in water development is still low.

TABLE 13; PERCENTAGE REDUCTION OF CERTAIN WATER-RELATED DISEASES BY WATER"SUPPLY IMPROVEMENT.

DISEASE	ESTIMATED % REDUCTION OF WATER RELATED DISEASE BY WATER SUPPLY IMPROVEMENTS
Guinea worm, typhoid, cholera, scabies, leptos-pirosis	80 - 100 %
Trachoma, Conjuctivitis, Yaws, schistosomiasis	60 - 70 %
Diarrhoeal, bacillary, Tularemia, amaebic dysentry, gastro-enteristis, louse borne disease, ascariasis, skin infections.	40 - 50 %

Source: Bradley, D.J. (1977).

4.3.2: Unreliable water sources:

It was found that some of the water sources (rivers, wells, dams) mentioned above are unreliable particularly in dry season This causes occassional water shortages th&t lead people to ration water for domestic use. This may mean that people have to reduce the number of times they bathe or use very limited amounts of water in washing utensils. This may lead to unhygienic conditions and thus diseases. The percentage of people affected by the Problem of unreliable water sources was 78.2%,

(iii) Tafete, smell and colour of water:

The reliance of water from rivers, wells, dams was found to have a problem of taste, smell and .colour, particularly in Fort Ternan, Kimoson, Nyando and parts of Chepseon. The problem of taste and smell was found to be prevalent in dry spells when water from water holes and "standing" pools of streams are not adequately replenished by rain water and the decaying organic and in-organic matter are left to stay in these water sources making the taste and smell of water bad. it was also found that in wet seasons litter and soil mixed with other particles are washed into these water sources making the water unsuitable for man's use. In areas like Sitian, Nyando, Lesirwa and Kipsegi, water was reported to contain Chemical pollutants (including fluorides) . Respondents reported that when water is left in containers, it formed scums or sediments which often stained clothes. 58% of the inhabitants reported to be affected by this problem, which in one way or another indirectly contribute to water-related diseases.

4.3.3.: Congestion in water sources:

This is a problem which was found to be affecting only 5.4 of the rural inhabitants, particularly in areas where water sources are limited relative to the population. It was not uncommon to find water drawers queing for their turn to fetch water. This has

implication in that where there are many people the possibilities of contamination are increased and in the case of an epidemic many people could b£ affected.

PART B:

4.4. BENEFITS ASSOCIATED WITH ACCESSIBLE WATER SUPPLIES:

Many studies (Warner 19-69, carruthers, 1969, ^9*73, Jakobsen et al., Development Plans 1966/70, 1970/74, 1974/78, 1979/83, 19-83/88) have found that the provision of water of good quality, abundant and quantity/within easy reach to rural communities results in many benefits that include economic, social, health and political.

The absence of rural water supply schemes that provide good quality piped -v/ater and the absence of precise measurement in the rural areas did not allow analysis of the benefits of water supply to rural households. However since Kipkelion urban centre which is located within the study area has piped water , Water provision benefits indicated by respondents from this uruan centre was used to analyse the benefits of water supplies in the study area.

4.4.1: Economic Benefits:

Economic benefits identified to be resulting from good quality and accessible water supplies were found to be in the following areas: Increased time

for productive activities, opportunities to engage in new productive activities and savings in the cost of medical treatment.

(a) The increased time for productive activities

The respondents close to the sources of water, either by virtue of having their private welis, or rivers crossing their farms, or even those served by Kipkelion water supply, indicated that they have adde^ time which they would have used for drawing water particularly for: improving upon existing productive activities. The relief from the drudgery of hauling water to homes of those people previously carrying water from distinct water sources becomes available for more attention to crop husbandry improved livestock caring ^ improved marketing agricultural products and finally improved livestock health and welfare, which indirectly contributes to good quality meat and milk. Savings in the cost of medical treatment, especially the urban population using Kipkelion's water supply scheme water, was also found to be an economic benefit. The percentage of the inhabitants who reported the improvement of existing economic activities is illustrated in table 14 below:

TABLE 14:

IMPROVED EXISTING ECONOMIC PRODUCTIVITIES

IMPROVED PRODUCTIVE ACTIVITY	% OF FARMERS
Improved livestock attention/ caring	60.00
Improved Crop husbandry production	67.30
Improved animal health and welfare	70.90
Improved marketing of agricultural Product	30.90
Improved other productive activities	21.80
Savings in the cost of medical treatment	40.00

SOURCE: FIELD SURVEY, 1985/86

The above benefits have also been cited by Illass Bose (1969), Carruthers, 1969, Alai (1975), Warner (1969) on their studies on expected benefits of water supplies.

(b) Opportunities to institute new productive activities

This study also found out that for those respondents living near the sources of water (Wells, dams, rivers and Kipkelion water supply) they have ample time to permit development of new productive activities, particularly if the water is of good quality as to allow for good health of the people. Among the new productive activities are: the adoption and expansion of crop activities and livestock, especially for those farmers who previously felt water to be a constraint thus preventing them from either adopting the water related farming (horticultual crops, grade cows, etc); adoption of commercial activities like retail trading, commercial sewing and embroidery, poultry keeping, employment elsewhere. This is illustrated in table 15 below:

TABLE 15:

ADOPTION OF NEW ECONOMIC ACTIVITIES WITH ACCESS TO WATER SUPPLIES

ADOPTION OF NEW ECONOMIC ACTIVITIES	PERCENTAGE
Adoption of irrigated crop agriculture	92.7
Adoption of Grade cattle	94.5
Adoption of poultry keeping	61.8
Adoption of commercial weaving, sewing, tailoring and embroidery with released time	87.3
Adopting of businesses (e.g. retail trading) with released time	76.4
Adoption of Employment elsewhere with released time	25.5

4.4.2 Social Benefits

This study also found out that there are social benefits availed to those near the sources of water, particularly as the convenient access to these sources have the effect of tremendously reducing the effort and energy expended in bringing home the daily water needs of household, a task that often falls on women. Thus those within easy access to water sources have more time available for social activities like tending to the needs of their children and for other possible social activities like "Maendeleo ya Wanawake" Social meetings. Other social oriented benefits is the convenience benefits i.e. the time saving associated with convenience together with the elimination of the back bending labour associated with the carriage of water over long

distances, has enhanced the quality of life for those within the water sources points as opposed to those where sources of water are at a long distance from the point of use. This is illustrated in table 16 below:

TABLE 16:

SOCIAL BENEFITS RESULTING FROM WATER PROVISION

PARTICIPATION IN SOCIAL ACTIVITIES	PERCENTAGE
Intensive child care	89.1
Domestic Chores improvement (cooking, washing utensils, laundry, house clearing; fetching firewood, fencing and clearing compounds;	96.4
More time for children's studies and plays	92.7
Main for Adult Literary classes for the illiterate adults	69.1
Participation in communal meetings (self-help activities, local organisations, religions etc.)	78.2
Visiting relatives, neigbours friends etc.	30.9
Necessary leisure and recreation	41.8
Attending personal matters	52.7
Other social activities	10.9

Source: Field Survey, 1985/86

* Percentages do not add upto 100 as the inhabitants reported more than one benefits.

4.4.3 Health Benefits

It has been found (Warner, Klassbasse, Carruthers, Alai) that the installation of **water** supply and sanitation facilities has the greatest potential

for yielding health benefits in the communities where sources of water are dirty and infested, and often causing iii$_{nes}$ses and deaths. In the study area, it was found that diarrhoeal and child mortality were common in the rural areas where there are no safe water supplies. However, Kipkelion water supply scheme has contributed to health benefits to its consumers, and the above diseases as revealed by the divisional health records are low in areas served by the scheme. Among the health benefits that were reported included improvement of hygiene through regular bathing and laundry, and clean utensils, improvement of sanitation and prevention of water related diseases . This is illustrated in table 17 below.

TABLE 17:

HEALTH BENEFITS RESULTING FROM WATER PROVISION

HEALTH BENEFITS	PERCENTAGE
Improvement of hygiene through regular bathing, laundry, etc.	70.9
Improvement of sanitation	58.2
Prevention and reduction of water related diseases (diarrhoea)	85.5

Source: Field Survey, 1985/86

4.4.4.: Political Benefits

The political benefits were analysed from the on-going self-help water projects in the study area and it was found that the water projects have encouraged public participation in decision making among the members, greater sense of identity with community aspirations through contributions and use of communal water supplies after project completion, and finally, the people have been capable to organise themselves and choose their leaders. Political benefits are illustrated in table 18 below:

TABLE 18:

POLITICAL BENEFITS RESULTING FROM WATER PROVISION

POLITICAL BENEFITS	PERCENTAGE
Democratic participation in Decision making	63.6
Greater sense of co-operation (socialism), through shaking and contribution	89.1
Community organisation	75.5

Source: Field Survey 1985/86

4.4.5 Expected Benefits with the Provision of Piped Water:

Expected benefits that can accrue with future provision of safe and accessible water were also analysed while in the field. Field data showed that most of the benefits are social, health and political, as illustrated in table 19 below:

TABLE 19:

CATEGORISED EXPECTED BENEFITS FROM PROVISION OF FUTURE PIPED WATER

TYPE OF BENEFITS	PERCENTAGE
Economic	90 .9
Social	81 .8
Health	72 .7
Political	49 .1

Source: Field Survey, 1985/86

However, the expected benefits will not solely accrue from the provision of safe piped water for there are other factors that are necessary for the derivation of benefits from water provision. For instance, in agriculutre, particularly in areas where water has been a constraint, provision of water alone will not be enough, for the people will also need to have technical know-how, adequate and fertile agricultural land, as well as farm equipment.

On health benefits, rural communities would also need sufficient education on the importance of hygiene. Provision of good quality water supplies in adequate quantity, and within easy reach should be accompanied by a package of complementary inputs in order to realise water-related benefits. These

complementary inputs should include good advice and education on agricultural extension services that include both animal and crop husbandry, need for cooperatives for marketing, need for credit facilities. On health, education on hygiene and environmental cleanliness is necessary. On social and political benefits, people need to be educated on the need for community participation and support of Water programmes. Thus, water supply programme is but one of the many components that bring benefits to the people.

4.4.6 Negative Effects of Water Supplies Provision

Water supplies provision is not without its negative effects. Already in Kipkelion water supply scheme the consumers, particularly the low income group (62%) are complaining of high bills paid for the use of water supplied. This situation is worse for those who buy their water from kiosks and for those who have private water connections who have to pay charges for water evei when no water is consumed.

Studies on negative effects of reticulated water supplies have been done by Jakobsen et.al. (1971) in Zaina Scheme in Tetu Division, Nyeri District.

In their study, they found that those people previously employed in drawing water for others are kicked out of work by the introduction of water schemes and this may also be the case for the 10.9% of the employees who were engaged in water drawing in the study area as illustrated in chart (ii) above. Jacobsen et al. also found that due to social strata of the population comprising the upper socio-economic, the middle socio-economic and the lower socio-economic groups„ there will be disparities in the use of water, with the upper group using more water and thus deriving more benefits due to its economic status at the expense of the lower groups whose use of water is limited though they may be paying 'flat' economic rent similar to those paid by the upper group and thus realize very limited benefits. Though no data was collected on this, the same effect may be expected in Fort Ternan,Chepsir, Kimologit and Kapseger water supply projects when they become operational.

PART C

PROBLEMS EXPERIENCED BY EXISTING WATER SUPPLY SCHEMES

This section focuses on objective of examining the functioning capacity and management of the existing Kipkelion water supply scheme currently serving 300 households. It also focuses its attention to the objective of reviewing the ongoing self-help water projects (Fort Ternan, Chepsir, Kimologit and Kapseger) in the study area with -a view to .determining ho

self-help water projects experience can be made more effective basing on the identified problems encountering them.

4.5.1 URBAN WATER SUPPLIES

KIPKELION WATER SUPPLY SCHEME AND PROBLEMS FACED

Kipkelion water supply scheme, currently serving 300 households out of 889 households with 85.2% of the consumers having individual connection systems, 11.1% communal watering point connection and 3.7% kiosk water sales, was found to be encountering a variety of problems among v/hich are:

(a) Lack of storage facilities which result in water being pumped directly to the consumers. This has repercussions in that whenever there is any technical problems with the booster engine there is no stored water that can last through the time of repairing the technical problems. Wherever such technical problems occur people have to walk to far sources of water which may be infested. Field survey found that 70.9% of the consumers do not have emergency storage facilities.

(b) **The small size and old booster engine- The water supply scheme having started in colonial period has a small and old booster engine using diesel for pumping water. This has implications in that due to its old age there are almost regular engine breakdowns causing water shortages every now and then. Since the booster engine uses diesel for pumping** water to the consumers, when!' the diesel is used up and is not available in the local market, the consumers have to draw water from distant river sources that may be infested with water related diseases. Further, the small size of the old engine is not able to pump water for the ever increasing population associated with the increasing awareness of hygienic conditions, and as such, some parts of the town particularly those at elevated areas such as the soil conservation station and **T. Towett High school do not get sufficient** water supplies.

(c) **Insufficient funds, which have indirectly contributed to a variety of probleits that range from inadequate maintenance due to lack of maintenance materials; inadequate personnel, particularly those who can monitor vater reticulation systems and report failures and**

finally inadequate diesel for pump^ng **water** to consumers.

(d) Inadequate staff, particularly the te(whnicai staff has contributed to no prompt r0sponse to technical problems. As such w^ere there are technical problems like pipe bi)rsts, such problems are left unattended $Qr several weeks causing water shortages in the a ;ffected areas. Inadequate staff has also Affe/Cted the laying down of water pipes in new of the town.

(e) Poor management of the day to day a^ti%/ities of the water supply scheme was also fQl^ind to be a problem, especially as directives Qn **what** projects to attend to come from the ai^trict's headquarters in Kericho town. Such ext^ernal directives do not allow the scheme[1]^ -^cal management to make decisions on mat^er^ concerning the administration of the scheme. administrative matters which can be solved locallyar0f often referred to the headquarters where t^ey ^ke along, period of the time before fee^]3ac k is received.

Lack of transport facilities was also found to be one of the problems facing the water supply scheme. The already limited number of w^ter supply ooficials walk long distances with maintenance materials, thereby reducing the work which can be done per day because much time is spent walking. This problem limits them on regular routine checks on the water reticulation system.

Lack of knowledge on how best to use the water supply system especially on aspects such conservation and storage. As such water is oft/en wasted at consumer points, either by uneconomic^ use or by leaving the taps running due to negligence or due to the fact that such water supply is a new innovation to some people and this requires a clarification on its utilisation*

Lack of the community involvement in the affair^ of the water supply scheme. This is because the water authorities have not involved the people. This has rendered the people to consid the project as "Government's" projects with the result that local people felt that they have nothing to do with such projects at times of ,breakdown. Thus, there is no co-operation with water supply officials on how to solve recurring problems.

(i) Lack of proper planning especially in relation to the growing population. The planning of the water supply scheme was done in colonial period and did not take into consideration the expanding population, commercial and industrial activities. As a result, the current demand for water by exceeds current water supplies. In the case of human population, 300 out of the total 889 households living in the town are supplied with water. Lack of proper planning has also contributed to the absence of large storage facilities which can store water for emergency cases.

However, looking into the possibilities of expanding this water supply scheme to serve the immediate rural areas, it was found that its water source, namely river Kipchorian (Nyando) has adequate water of an average of $180m^3$ in wet season and $150m^3$ in dry season of which it can be obstructed to serve the rural areas.

4.5.2 RURAL WATER SUPPLIES:

Kipkelion Self-help Water Supply Projects

Though self-help water supply projects (Kapseger, Kimologit, Fort Ternan and Chepsir) are expected to solve

some of the problems associated with water, there are problems and setbacks facing them. This study found out that the four water supply projects have similar problems among which are:

(a) All projects are not properly planned, particularly on areas related to population, commercial and other productive activities expansion. Due to this,water supply may be exceeded by the demand for water immediately after the projects are completed.

(b) The funds for construction, paying labour and buying necessary equipment are insufficient. The funds used to establish water projects were contributed during a fund raising meeting. Although the funds are not adequate local people are not able contribute further due to other pressing needs like school fees. However without additional funds it will be difficult for such projects to be completed and made operational. This problem had greatly affected Kimologit self-help water supply project which had to be abandoned for sometime , although the local community is now engaged in an attempt to revive the scheme.

(c) Lack of technical personnel, which has resulted in the laying of pipes in inappropriate areas and the construction of water reticulation in a haphazard manner which has resulted in the wastage of expensive water supply material.

(d) Local groupings of the people has also affected the self-help water projects, often delaying the completion of the water supply projects, particularly when the projects are identified with politicians be it councillors or Members of Parliament. This problem has had adverse effects on Kimologit and Chepsir water supply projects.

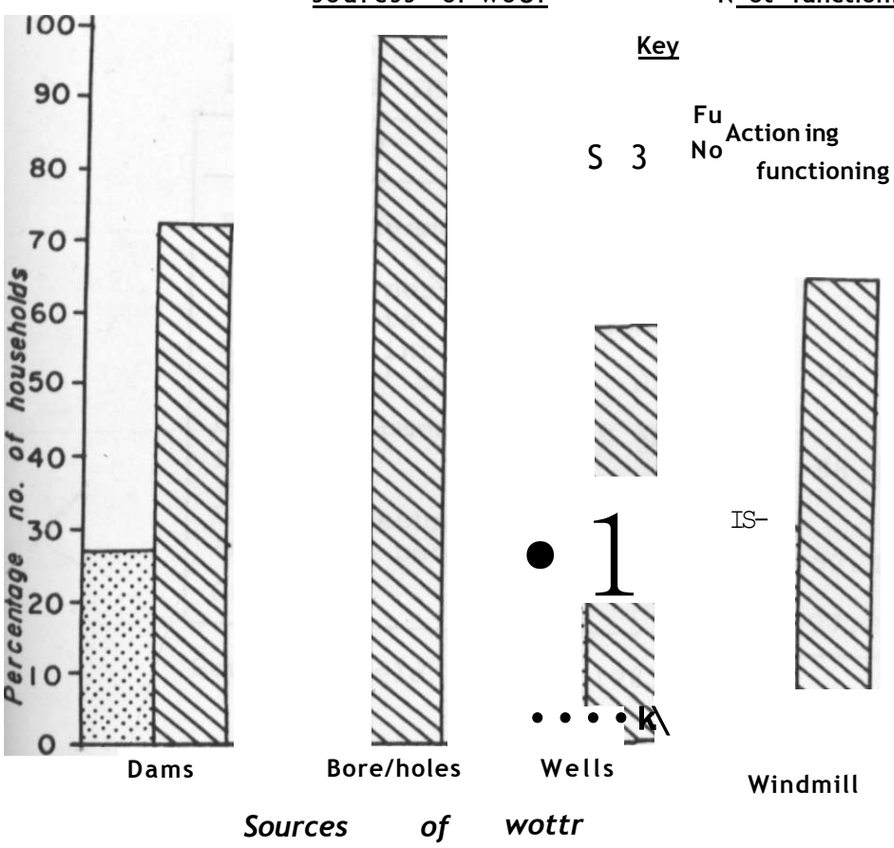
4.6 ASSESSMENT OF DISUSED WATER SOURCES

One other objective of this study was to study the formerly existing water sources in the area with an aim of examining the possibility of rehabilitating and re-use of the silted wells, dams and boreholes. This study revealed that there are a variety of water sources the study area had but have fallen into disrepair due to mismanagement and negligence. Such sources include dams of which 72.7% are not functioning boreholes with 98.2% not functioning; wells with 58.7% not functioning; and lastly, the wind mill pumps with 67.3% not functioning.

Chart VI: below illustrates this.

CHART VI : FUNCTIONING AND NON-FUN< ^TIONINGSOURCES OF WATER

CHART)VI P«rc«ntog» of functioning ond sourcss of woUr N^ot functioning



source: F I E SURVEY m 5 / 8 6

With such a large percentage former sources of water not functioning, it is easy tQ understand why</ many people do not get adequate watej. fQr consumption.; Part of the blame for this problem could be laid on the people themselves and on the authorities entrusted/ with the management of the water resQurces in fche area/ especially on the failure of replac^ the Qld equipit/ which currently do not have spare pa*ts^ and by draini/ these water sources (dams) for farm .•

Reasons for such disrepair and disuse of these sources as were given by the respondents are indicated in the table below, in order of magnitude.

TABLE 20:

REASONS THAT HAVE LED TO DISREPAIR AND DISUSE OF THE WATER SOURCES

REASON	PERCENTAGE
Poor Management	78.1
Unwillingness among the inhabitants to participate in the maintenance of sources of water, e.g. dams	69.5
Old equipment without spare parts	58.3
Lack of technical knowhow among the people	52.4
Others	27.2

Source: Field Survey, 1985/86

The above water sources (dams, wells, boreholes) were constructed by the white settler farmers and unfortunately no similar sources have been constructed and completed for use in the farms after African re-settlement, despite the increase in population due to immigration to the former settler (white) farms. Thus one of the causes of water problems in the study area has been mismanagement of existing water sources.

PART D

4.7 ASSESSMENT OF WATER SUPPLY SYSTEMS BY VARIOUS SPONSORING AGENCIES AND ORGANIZATIONS

One other objective of this study was to examine water supply projects (systems) being funded and operated by a variety of water development sponsoring agencies like the Religious missions, the community self-help organizations, the County Councils and the Government Water programmes. This was with a view to indicating which agencies among them are more appropriate to supplying water to the rural communities and the approaches which such agencies have adopted to fulfil the Government's objectives of providing safe, adequate and accessible water to the target community.

In what follows, an attempt is made to indicate the weaknesses and problems of the above mentioned projects with an attempt to indicate which one of them is more appropriate to solving the water problems in the study area.

(a) Kipchimchim Mission Water Supply Scheme:

This water scheme is fully sponsored by the Catholic Mission of Kipchimchim Parish, it supplies water to big institutions that include Kipchimchim boarding secondary school with over 800 students; a primary school with over 1,000 students;

the school for the physically handicapped and hostels, a nursery school, a hospital and maternity centre, the convent, the church, the staff households and the community within.

Its management is efficient, its financial resources is limited but is used productively. Employees work with dedication and members of the community are willing to support it in terms of labour (laying of pipe in new areas) or materially. They have identified themselves with the project as of their own benefit.

Its only great problem is lack of technical personnel but the church officials still hire technical personnel to ensure that the provision of water is constant. The success of this water supply scheme is due to good planning objectives with good supervision -and administration of the church's resources.

(b) Kipchimchim Community Self Help Water Scheme:

This water supply scheme was started by the people after they felt the need for water supply. It serves a community of about two thousand people.

The water supply scheme is handicapped by a variety of problems with the result that at one stage it was abandoned. Among the severe problems are the grouping of the people according to local politics which have contributed to emergence of competing groups certain withgroups supporting the water supply project and some against it. Those against the

project were reported to have «. broken the water pipes and even refused contributing (finance, labour) towards its operation and maintenance.

Secondly, the scheme is very poorly planned as no proper feasibility study was carried out before its installation. As a result, there are areas where water is not supplied though the people contributed towards the establishement of the scheme. Further there is lack of technical personnel and as such technical problems remain unsolved for long periods of time.

The above problem as was reported is reinforced by the fact that some of the members of the water supply scheme lack commitment to the scheme and are always in a state of apathy whenever their labour decision or material contributions are required. This affects the running of the scheme especially with the fact that the scheme has poor and inexperienced administrators who come from the local villages without any administration training.

These problems have plagued the operations of the water supply scheme thus making it unreliable and unsuitable for solving water problems for rural families which were expected to be served by the project.

(c) Sosiot County Council Water Supply Scheme

This water supply scheme is run by the county council of Kipsigis and has a few problems like lack of electricity, funds voted for it are utilized carefully with less mismanagement. It has proper procedures of collecting water bills. Local groupings by the people do not affect it as is the case with that run on self-help basis. Its planning as reflected by the installed capacity has considered future expansion of the population, commerce and light industry together with livestock. Technical problems are attended to promptly by the county council technical personnel. Its administration is relatively effective with the local councillors being there to report any laxity.

(d) The Government water programme (Kipkelion)

Though the water supply scheme (Kipkelion) has the advantage of securing adequate technical personnel, finance and modern water equipment, it was found that there are still problems that Plague it. One problem is that the people are not Required to participate in planning of the water

supply scheme or make any major decision. Affairs that deal with the source of water, the design of stora^e tanks and the distribution system are wholy handled by the Ministry of Water Development personnel without consultation with the villagers who are expected to be beneficiaries of the supplied water. The exclus.t_on people in decision making, design and participating in construction has made the people dissatisfied with the scheme. As a result the people felt that the project was the Government's and that the Government has an obligation of constructing and maintaining the project for the people. It was also found that the technical personnel who are supposed to attend to the water supply scheme do not do their work adequately and as such technical problems are left to hamper the provision of water. The administration is also weak in supervision and as a result when spare parts for repair and maintenance are required, the administration takes along time to send for therti in the headquarters. Thus the problems in the water programmes belonging to the Government seem to be that of laxity among its employees, bureaucratic delays and monopoly in the affairs of the water projects.

4.7 ASSESSMENT OF TYPES OF AGENCIES PREFERRED BY THE INHABITANTS TO CONSTRUCT, OPERATE AND MAINTAIN WATER SUPPLY SCHEMES AND REASONS FOR PREFERENCE

This study was also interested in establishing (using the above various water development sponsoring

agencies) ' the type of water sponsoring agency preferred by the respondents. Field data showed that the people based their preference on that agency which has good administration in terms of personnel, was quick to solve water problems and ability to provide adequate and safe v/ater supplies within reasonable reach. The type of projects that were preferred most by the people are those constructed and maintained wholly by the church, because as the respondents put it, church administration is efficient and has lowest levels of corruption.

second preference is water projects run by the County cotf110!-1-3, followed by community self-help water programmes. This is illustrated in Table 21 below:

TABLE 21:

AGENCIES/ORGANISATIONS PREFERRED BY THE INHABITANTS TO CONSTRUCT, OPERATE AND MAINTAIN THEIR WATER SUPPLY SCHEMES AND REASON FOR PREFERENCE

AGENCY/ORGANISATION PREFERRED	%	REASONS
Those constructed by church organisations and maintained entirely by them	60	Minimal corru^tion Effective adm^nistj/3tive management Fast repair or construction Its scarce res0urcei are utilised and maximumly. Minimized groupings and l1ttle partiality in provision of w^er households. Workers are more commited.
Those constructed by the County Council and entirely maintained by it	27.3	Adequate equipm5nt facilities Availability of technical person^^ Effective metho<is of collecting economic rates for maintenance Proper care and maintenance Good planning ancj serves a small loCa^.. / as compared to the ^ Central Government

Those constructed by the community self-help organisation	9.1	Community participation and sense of belonging Choice of development projects leadership
Those constructed under the Government programmes and maintained by it	3.6	Though with adequate technical personnel takes very many years to complete Delays in repairs Rampant corruption Laxity among water officials High rates of abandonment Poor system of charging water bills resulting in demand notices even areas where there are frequent failures in water provision

Source: Field Survey : 1985/86

Drawing from the foregoing analysis on various water sponsoring agencies in the area, it can be inferred that Religious organisations are more appropriate in solving water problems, because as was indicated above such organisations ensure minimized or absence of corruption, partiality and laxity among the individual water supply officers. The preference of this agency was indicated by a large proportion of the population 60%, as opposed to those constructed by the Government through the Ministry of

Water Development of which only 3.6% of the population indicated their preference. The 3.6% preference of the agency Government as a water sponsoring/implies though it may be having advantages of technical Personnel and finance, it is still a weak agency due to considerable laxity of its water officials and bureaucratic delays in providing water supply equipment. The Ministry (Government water Development Ministry) needs complete streamlining.

4.8 SUMMARY OF THE CHAPTER

The foregoing chapter dealt with the analysis of water problem in the study area with particular reference to sources of water and their implications. The analysis showed that the long distances to sources of water result in much of the respondents time being wasted in water fetching. It was also clear that a lot of human energy was wasted in transporting water to homesteads.

The chapter also demonstrated the presence of water-related diseases (diarrhoeal, bilharzia' river blindness) and child mortality in the study area which was associated with water from unsafe water sources like rivers, dams and unprotected •

The chapter also dealt with the expected benefits of accessibility to water supplies, discussing the benefits under the headings of economic (improvement

of productive activities), social (realised time for necessary leisure and recreation), health (reduction of water-related diseases), and finally, political (greater sense of cooperation and democratic participation).

From an analysis of the existing and disused water sources, it was found that the major problem facing them is the mismanagement and lack of funds for operation and maintenance.

With regard to involvement of the various water development sponsoring agencies based in the study area, it was found that according to the respondents religious organisations could manage water problems in the study area effectively.

CHAPTER FIVE

5.0 CONCLUSION

This study has focused on the extent and magnitude of the water problem in the study area and from its data analysis it has been shown that although water is a very valuable component in man's life, its availability and quantity in the study area has been a problem. Its sources are far from homesteads, necessitating the inhabitants to spend a lot of man-hours per day for fetching it, hours could be diverted to performing productive activities that promote human well-being. Its sources are unprotected from contamination and are often infested with water-related diseases, thus affecting peoples health and causing infant mortality. On the other hand the data analysis showed that the provision of water, of good quality, adequate quantity and within reach accessible/results in economic, social, health and political benefits.

The above conclusions are discussed in detail under the heading of findings so as to provide a base for proposals and recommendations on how the water problems in the study area could be reduced.

5.1: FINDINGS:

The findings of this study are summarized under the headings: long distances to water sources, infested water sources, expected benefits of accessible water supplies, problems affecting existing water supply projects and assessment of water sponsoring agencies.

5.1. Long distances to water sources:

Walking long distances to water sources was found to be the greatest problem associated with water supply in the study area. This was found to have many implications including the following:

(i) a lot of time (upto 6.3 hours) is wasted in water fetching per day per household. These hours could be diverted to productive activities if piped water could be supplied at the homesteads

(ii) since it was found that the system of transporting water is by human labour no matter how far the sources of water are from the homesteads, a lot of time is wasted in water fetching, especially for housewives who despite performing other daily domestic chores (cleaning the household, caring for the children and husband) are expected in other agricultural activities in the remaining part of the day. The result is that at the end of the day, such persons would have exhausted their energy.

(iii) Since it was found that the times of ~~after~~ fetching trips are started in the morning (7-9 a.m.) and in the evenina (4.6 p.m.), the school going children who constitute the majority of those who fetch water in the household, it has been argued that such children have their studies affected as they fetch water first thing in the morning and in the evening after they arrive home, leaving them with very little time for school work and necessary leissure.

tiv) though no data was collected to verify the effect of long distance to water sources on livestock, it is argued that long distances exhaust

and quantity of their milk and meat.

5.1.2 : Infested Water Sources:

The study found that the majority of rural population fetch their water from traditional water sources (river 83.6%, dams 3.6%, unprotected wells, and roof catchment 5.5%). Due to the exposure of such water sources to all forms of pollution includi faeces, dead animals and insects and litter, such water was infested, with water-related diseases. This had the following implications:

(i) the consumption of this water had infected people with water-related diseases like bilharzia 10%, diarrhoea 20%, river-blindness 7% and was considered a contributory factor to the high infant mortality in the study area.

(ii) the reliance on some of these water sources such as seasonal rivers, streams, waterholes, dams meant that families which depend on such sources experience shortages of water during dry seasons.

5,1,3.: Benefits of accessible water supplies:

This study found that accessibility to water supplies of good quality, in abundant quality, results in economic, social, health, and political benefits.

The economic benefits associated with the accessibility of such water supplies include improved crop and animal husbandry .» In terms of social benefits, there is increased time for domestic chores, children's studies and intensive child care. Health benefits include reduction of water-related diseases and improved hygiene through regular bathing and laundry,

while political benefits include a greater sense co-operation, community involvement with th^ choice of leaders.

5.1.4. Problems of urban water supplies;

This study revealed that Kipkelion water supply scheme, falling under urban water programme 3nc* currej^tly serving only the urban population, has many p^r°kl^ems among which are: poor planning, small and ol^ b°oster engine, lack of storage tanks, inadequate staff, lack of participation by the benefici^ir^ community and lack of education on the use ofi water supplied.*

As a result, the following specific pr are encountered

(i) some areas such as Taita Towett hicrh sc^°01' soil conservation station and their sur^°Unding areas are not served with water due to fi^oor planning;

(ii) shortage of water due to small booster ^-ngine and lack of storage facilities to serve °c reservoirs in emergency periods (engine i^reak down or diesel shortage).

while political benefits include a greater sense of co-operation, community involvement with the choice of leaders.

5.1.4. Problems of urban water supplies:

This study revealed that Kipkelion water supply scheme, falling under urban water programme and currently serving only the urban population, has many problems among which are: poor planning, small and old booster engine, lack of storage tanks, inadequate technical staff, lack of participation by the beneficiary community and lack of education on the use of water supplied.'

As a result, the following specific problems are encountered

(i) some areas such as Taita Towett high school, soil conservation station and their surrounding areas are not served with water due to poor planning;

(±i) shortage of water due to small booster engine and lack of storage facilities to serve as reservoirs in emergency periods (engine break down or diesel shortage).

(iii) lack of committment by the beneficiaries leading to no contribution in ways to run and maintain the scheme due to non-involvement in the affairs of the scheme; and

(iv) misuse due to lack of education on water management by the beneficiaries.

5,1,5 i Problems facing Rural self-help water supplies:

This study found out that there are many problems affecting rural water supplies which have been started. The pressing problems identified are: improper planning procedures, insufficient finance, inadequate technical personnel, poor management and administration, local political groupings and apathy among some community members.

The above problems have the following consequences

(i) haphazard planning without due consideration of the expanding population and business because of lack of planning personnel ;

(ii) the delays in completion of these water projects due to insufficient finance.;

(iii) haphazard laying of pipelines and waste of materials due to inadequate technical personnel,

(iv) misappropriation of the little funds contributed by the community due to poor management and administration and

(v) abandonment of Kimologit water supply project due to local political groupings and apathy of some community members.

5.1.6; Assessment of various water development sponsoring agencies:

In examining various water supplies development agencies with a view to establishing which one among them has appropriate approaches to solving rural water problems, it was found that projects sponsored and maintained by the religious organisations are more effective, with 60% of the inhabitants preferring them as opposed to those sponsored by the County Council (27.3%), the community self-help (9.1%) and by the government (3,6%), The reasons given by respondents to explain the efficiency and effectiveness of the water supply projects by religious organisations included:

(i) effective administrative management;
(ii) minimized local political groups;
(iii) proper maintenance and fast repair in case of breakdown;
(iv) minimized corruption;
(v) the scarce resources are utilized carefully and put to maximum use for the benefit of all

water beneficiaries;

(vi) staff employed by these organizations are more committed to their work.

5.2 RECOMMENDATIONS;

The field data analysis above revealed many water-related problems which have been discussed above. The following recommendations are based on the views expressed by the inhabitants of the study area and experts of various water sponsoring agencies. It is hoped that the recommendations will serve as guidelines to future planning of rural water supplies in the study area and hopefully in other rural areas in the district.

5.2.1 SPECIFIC RECOMMENDATIONS;

5.2-1.1 REDUCTION OF DISTANCE AND WATER-RELATED DISEASES:

To solve the problem of long distance to water sources which costs much in terms of time and energy devoted to it, and to reduce water-related disease cases, the use of ground water sources (well, boreholes, springs) are recommended. Ground water sources have been known to offer good quality water to communities which do not have sufficient finance for piped and treated water supply systems.

(a) Construction of wells and boreholes:

This study recommends the development of new wells and boreholes in various areas of the study area because they not only reduce distance to water sources, but compared to other water supply systems based on surface water (dams, rivers, lakes, waterholes, pools) have water which is safer. They contain no sediment loads, requires no treatment and is less liable to evaporation (Moerman, 1982:2). As the result of the above advantage, the ensuing costs of investments and chemicals for treatment do not occur. Except for boreholes, the construction of these water sources require simple tools and unskilled labour. Furthermore wells can be equiped with handpumps, wind mills or solar pumps, an appropriate technology that greatly reduces running costs.

(b) Spring water:

Spring water on the other hand, if properly maintained and protected is pure, reliable and can be used without chemical treatment. Since spring water in the study area is naturally discharged from the ground where its flow is impedded by a less permeable strata, it is recommended that careful control and protection of land near the location of the spring should be done to avoid contamination of the water.

In situations where springs are far from homesteads, the water from the spring should be made to flow directly into the pipe and let to flow to water points down the homesteads. This will reduce long distance to their sources.

If such precautions are taken, springs are cheap, safer, and quicker way of supplying water to the rural communities of the study area whose income is meagre, especially because springs in the study area are on the hills sides requiring only gravity to pull down water to the homesteads in the low areas.

(c) River water:

Where river water is used, simple pot filtering system can be used to filter water. This system involves the lining of stones of various sizes in a locally made pot fitted with a water tap beneath it. This system reduces the costs for chemical treatment of water. Boiling of water before use (drinking) is also recommended.

(<3) ' Roof catchment tanks;

It is also recommended that the people of the study [ar]ea be encouraged to harvest rain water through [r°]of catchment tanks. This will not only reduce the long distance to water sources, but its water is

relatively pure for consumption. Building regulation codes which require each house to be equiped with rain water collection facilities can be passed. This undertaking will prove expensive to the rural peasants, but through self-help activities, money could be raised collectively for individual households at a time for buying impervious roofing materials and storage facilities. Roofing materials cost can be kept down by the increased use of local materials such as tiles which can be produced locally on self-help basis. Such roofs (tile made) are very durable and make less noise during rains than corrugated iron sheets. Storage tanks can be made using locally produced building stone . This material requires simple technology in construction/allowing the inhabitants to participate in their construction. In cases where individuals can buy corrucrated in iron sheets they can be encouraged to do So, The amounts of water which can be harvested from roof catchment are given in appendix A2.

5.2.1.2. Recommendation on problems facing Kipkelion water supply scheme;

(a) To solve the problem of water shortage c^ue to poor planning, it is recommended that there should be a complete new design of the scheme which will take into consideration the expanding population and commercial

businesses. It is also recommended that this new design should take into consideration the expansion of the scheme to serve the rural areas. This can be done in phases, with phase I aimed at serving T. Towett, soil conservation,station, veterinary camps which currently do not have piped water. Phase II should cover such areas as Blue Hills, Mononiat, Kimoson, Kimugul, Tuiyobei, and Nyando, while phase III would serve wandore, sitian, and siret areas.

(b) It is also recommended that the small and old booster engine should be replaced with a big new booster engine. To avoid shortages of water due to the direct pumping of water to the communities and which stops when there is booster engine pump break-down, it is recommended that the Ministry of Water Development build water storage tanks for emergency purposes .

(c) To reduce technical problems that face the water supply scheme, it is recommended that the water development ministry should increase the number of technical personnel to run and monitor the scheme. Such personnel will also design the laying of future pipe lines and sites for storage facilities. Maintenance materials should also be increased together with improving transport systems which can facilitate immediate repairs and maintenance.

(d) In order to minimize wastage, it is recommended that water use meters be installed in both private and communal systems so that every drop of water released be paid for. The other method which could be used for rationing water is the use of water rationing values. Among these are the "Fordilla value" which is automatic self-closing tap and the "control value" which discharges only a controlled amount of water into a balancing tank.

5.2.1.3: Recommendations on problems facing self-help water projects!

(a) To solve the problem of improper planning, the water project management should consider employing a competent planner to work with the technicians to assess the viability of the water projects proposed by the community. Such a planner should take into account the needs of the population to be served, adequacy of water sources, to meet future demands.

(b) To solve the problem of lack of technical personnel, it is recommended that the technologies used in the water projects should be simple so that the people should, with some little training, be able to operate, maintain or do any other work i.e. the technologies used should not demand a high level of technical skill.

(c) To solve the problem of poor management and administration which has resulted in misapprop.ri.a-tion of funds, it is recommended that the management committee should be given training on finance and project management together with public relations.

(d) To solve the problem of political groupings and interference, it is recommended that Once the project has been registered and started the management should be left to the elected leaders who have no allegiance to any potical grouping.

5.2.2- GENERAL RECOMMENDATIONS;

The following general recommendations apply to both Kipkelion urban water supply scheme ^.nd the on-going rural water supply projects.

5.,2.2.-l-Community participation in water supply provision^

In order to legitimize the water sup^piy projects and also educate the people on the importance and use of water supply projects, it is important that people participate in all stages of projec**^t development/** The study therefore recommends participate__on in the following stages:

(a) Project Initiation Stage:

At this stage the local people shoul**^_d** be **involved** in the discussion on where a water supply project in 4£he t area .is needed &nd how such wate^r project can

be established. The local community should also be involved when establishing water supply project goals, objectives, expected benefits and liabilities. This can be done by taking community leaders to visit successful water supply projects in other parts of the country to be able to see benefits that accrue from such water supply projects. Such tours can be accompanied by local sessions that discuss the water supply projects' expected benefits. Feedback from the people must be analysed and taken into account when planning water projects. People should also be involved in decision regarding the choice of the water-related activities to be undertaken. The involvement of the people will make the water supply projects to be identified with the local community thereby making it possible for the local leaders to take upon themselves the responsibility of developing, operating and maintaining the water supply projects.

(b) Implementation stage:

During implementation stage, the people should be involved actively in the installation and establishment of the water supply projects. This is necessary in order for the beneficiaries to understand how their water supply projects work.

be established. The local community should also be involved when establishing water supply project goals, objectives, expected benefits and liabilities. This can be done by taking community leaders to visit successful water supply projects in other parts of the country to be able to see benefits that accrue from such water supply projects. Such tours can be accompanied by local sessions that discuss the water supply projects' expected benefits. Feedback from the people must be analysed and taken into account when planning water projects. People should also be involved in decision regarding the choice of the water-related activities to be undertaken. The involvement of the people will make the water supply projects to be identified with the local community thereby making it possible for the local leaders to take upon themselves the responsibility of developing, operating and maintaining the water supply projects.

(b) Implementation stage:

During implementation stage, the people should be involved actively in the installation and establishment of the water supply projects. This is necessary in order for the beneficiaries to understand how their water supply projects work.

(c) Evaluation stage:

In evaluation stage, the beneficiaries should be allowed to evaluate the performance in terras of failures and successes of their water supply projects, for if external agencies do evaluate, people might think that any mismanagement is due to their misuse and neglect;

(d) Maintenance stage:

In maintenance stage, the beneficiaries should be involved in maintaining water supply facilities. This can be done by establishing water management seminars where simple maintenance skills would be taught.

From the foregoing, it can be inferred that by involving the community at all stages of the project, committment, necessary responsibility and accountability in the projects will be achieved. Community participation further has advantages of:

(i) exploiting underutilized local resources' that include local materials, labour, cash, and local consultancy;

(ii) creating and developing leadership which maybe important to any rural self help development programmes; and

(iii) creating a feeling of togetherness in which individual members of a community may find self-satisfaction.

5.2.2.2. Water supplies management and leadership/

To assure that the beneficiaries fully participate in water supplies' projects and not be merely passengers in the process, it is recommended that local water supplies leadership in the form of water supplied development committee be established. Membership should be drawn from the people's local leadership, ministries of water, agriculture, health, culture and social services, provincial administration and other non-governmental agencies. This will enable the leadership to share ideas and experiences.

Such a committee should be set up prior establishing a water supply project to ensure full participation of the community right from the start of the water project.

The following are suggested functions of local water supplies committee:

(i) involve the people in site selection;

(ii) mobilize the people in the installation of the water system;

(iii) to organize peoples participation in cash labour, and material contributions;

(iv) to respond to suggestions made by water supply project beneficiaries pertaining to training of project maintenance personnel and educational tours

(v) to control finances and administer the water supply projects.

(vi) to monitor, review and write reports on water-related problems that have arisen and suggest solutions.

5.2.2.3. Community education and training on the use of water supplied.

On the misuse of water at consumer points and the possible contamination of such water, it is recommended that the community be trained and educated before the project is opened up for use. The purpose is to prepare the beneficiaries psychologically for the project and its sound use. The trainers of the beneficiaries should be drawn from as many ministries and organisations as possible to ensure that all necessary subjects are taught especially in the areas of health care and sanitation and in income generating activities. Government ministries should be consulted

to provide trainers for technical aspects of water, especially with regard to regular projet maintenance in order to ensure longer life of the equipment and to avoid major breakdowns. It is also recommended that emphasis should be on training women because they are the ones who are involved in the drawing of water and because of the existing women group organisations which make it possible for many people to be reached.

Various methods can be used in training and educating the beneficiaries among which are lectures on regular forums, audio visual materials, and study tours. A major aspect of training should be the creation of an awareness of the need for clean water for good health. Once these have been accepted by the people, greater interest in safeguarding of the water source will be near guaranteed from the community itself.

5.2.2.4. Funds for implementation, operation and maintenance of water supply projects:

In order to generate sufficient funds for implementation, operation and maintenance of water projects it is recommended that the elected local water supplies development committee should be given mandate to raise funds through the following suggested areas:

(i) establishment of income generating activities, especially those that relate to water projects such as horticulture, animal husbandry, tree fruit nurseries which could be a source of revenue.

(ii) the contribution of funds voluntarily by each household based on the ability of each household

(iii) the water development committee should explore the possibility of benefiting from subsidy through government intervention in providing spare parts for maintenance, and money for other necessities,

(iv) the committee should also appeal for well-wishers for funds; and

(v) the committee should consider effective ways of charging a fee for the use of water supplied.

5.2.2.5. ~~Eva J-u^"tion of water supply projects~~:

In order for the water supply projects in the study area to realize its set targets the monitoring of the projects performance should be part and parcel of the projects implementation and operation. Regular evaluation meetings should be held, involving largely the beneficiaries themselves, and technical

personnel who can discuss the performance of the project in terms of successes and failures. The results are documented for further analysis and plans of action drawn. This will enable the people to address themselves to any problem in good time.

The purpose of such evaluation is to learn from experience and find out what went wrong so that successful procedures may be emulated in the planning and implementation of future projects. Thus such an evaluation will be a fact finding process whose output becomes input to on-going and planned development activities.

5.3 AREAS TFOR FURTHER INVESTIGATION:

Since this study has not been conclusive, given the limitations and constraints within which the research study was undertaken, the following are suggested areas for further investigation.

5.3.1. The study of the water sources in the area with a view to giving inventory of both underground and surface water potentialities. This will give data for future planning of water supplies;

5.3.2. Detailed studies on community participation with a special reference to women's participation in water development.

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APPENDIX A1

SIGNIFICANCE OF WATER PROBLEM IN THE DIVISION (KIPKELION)

DISTRIBUTION OF WATER SUPPLY FACILITIES BY ADMINISTRATIVE DIVISIONS - RELATIVE TO KIPKELION DIVISION - KERICHO DISTRICT

	A	B	C	D	E
ADMINISTRATIVE DIVISION	MWD WATER SUPPLIES	UNICEF/MOH SUPPLIES REHABILITED BY MWD	CCK/UNICEF/MOH ALDEV SUPPLIES MAINTAINED BY COUNTY COUNCIL OF KIPSIGIS	LOCAL COMMUNITY (RDF/CARE-ASSISTED) SUPPLIES MAINTAINED BY COUNTY COUNCIL	LOCAL COMMUNITY (RDF/CARE-ASSISTED) SUPPLIES, MAINTAINED BY THE SAME COMMUNITY
1. KIPKELION	(1) Kipkelion Township	-	-	-	-
2. BELGUT	-	(1) Kapsoit	(i) Kabokyek (ii)' Poiywek (iii) Kenegut (iv) Sosiot (v) Kebeneti		(i) Kanaso (ii) Kipchimchim (iii) Kiptere (iv) Kabungut
3. BURET	(i) Kapkatet Township (ii) Sotik Township	-	(i) Roret (ii) Tumoi	-	-
4. SOT (BOMET)	(i) Chepalungu Township (ii) Bcmet Township	(i) Longisa	(i) Ndanai (ii) Olbutyo (iii) Sigor (iv) Gorgor	-	-

Source: District Development Plan, Kericho : 1978/83

WATER WHICH CAN BE COLLECTED FROM ROOFS OF DIFFERENT SIZES UNDER DIFFERENT RAINFALL CONDITIONS (IN LITRES)

RAINFALL IN m.	ROOF CHATCHMENT AREA IN SQUARE METRES														
	1	2	3	4	5	6	7	8	9	10	15	20	24	25	30
1	1	2	3	4	5	6	7	8	9	10	15	20	24	25	30
10	10	20	30	40	50	60	70	80	90	100	150	200	240	250	300
50	50	100	150	200	250	300	350	400	450	500	750	1000	1200	1250	1500
100	100	200	300	400	500	600	700	800	900	1000	1500	2000	2400	2500	3000
500	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	7500	10000	12000	12500	15000
1000	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	15000	20000	24000	25000	30000
2000	2000	4000	6000	8000	10000	12000	14000	16000	18000	20000	30000	40000	48000	50000	60000
3000	3000	6000	9000	12000	15000	18000	21000	24000	27000	30000	45000	60000	72000	75000	90000

NB: Calculations are based on the fact that 1 litre of water can be collected from 1 mm of rainfall on lsg.m. of roof.

Source: Mujwahuzi, M.R. (1976): "Self Help in the Development of Improved rural Water supplies •

APPENDIX

Plate 1: Kipkelion Town: Divisional Headquarters.

Plate 2: Dried up water source (Dam).

APPENDIX B-,

Plate 3: Dam Drained to allow for agricultural land Arrow shows the cut trench.

Plate 4: Water-hole used for both domestic and livestock consumption. Its exposure to pollutants cause water-related diseases.

APPENDIX B-,

Plate 5: Roof catchment storage tank made of stone blocks, installed by Kipchimch Mission water supply scheme.

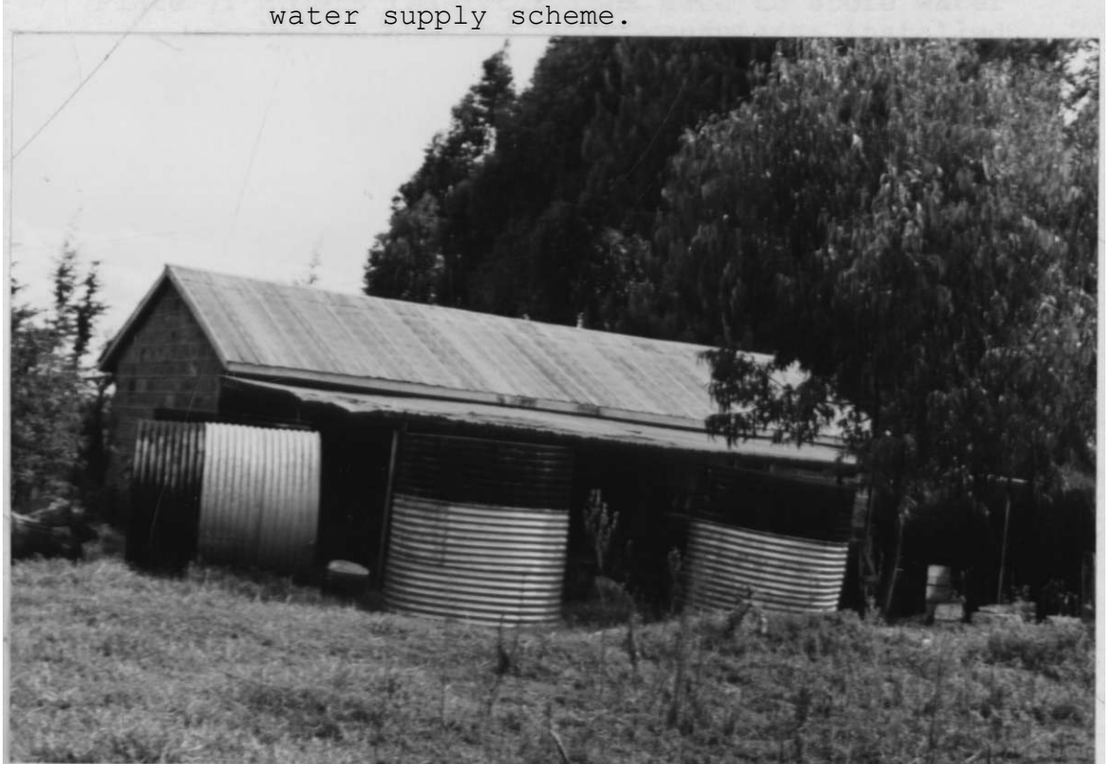

Plate 6: Roof catchment storage tanks made of corrugated iron sheets.

f

APPENDIX B-,

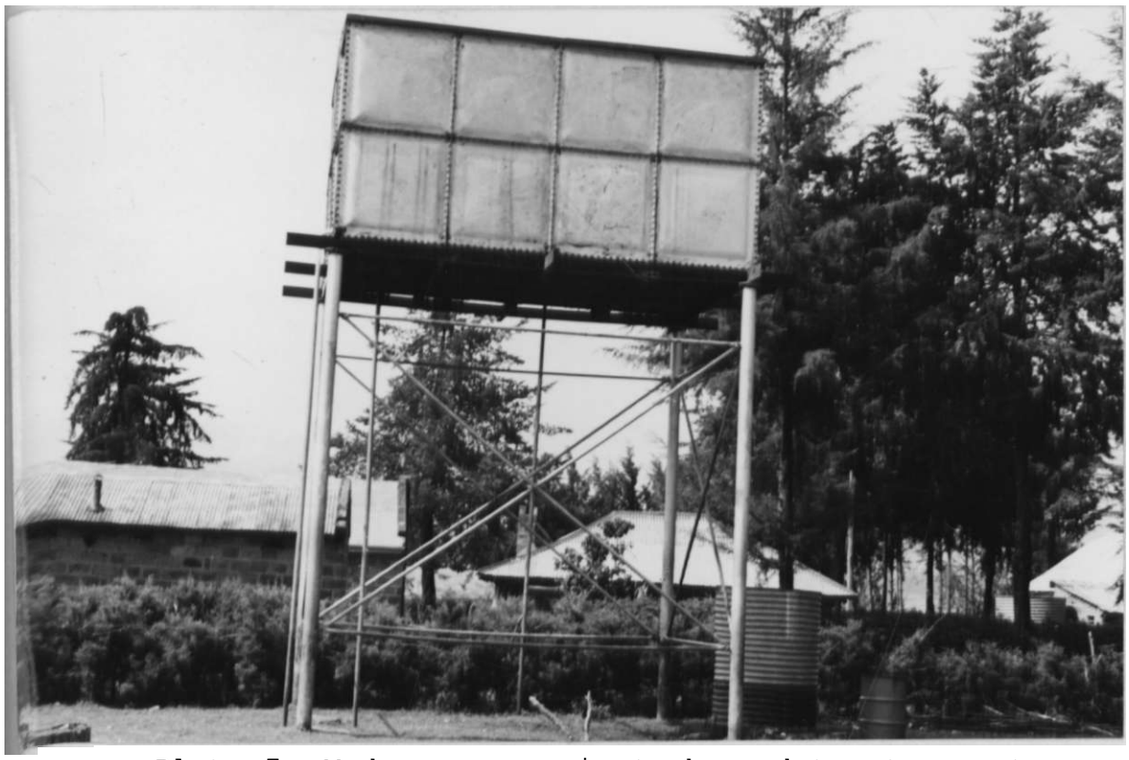

Plate 7: Modern reservoir tank used to store water before pumping it to consumers; installed by Kipchimchim Mission Water Supply.

Plate 8: A wind mill used to pump water from wells dams to homesteads. It reduces the cost of pumping water.

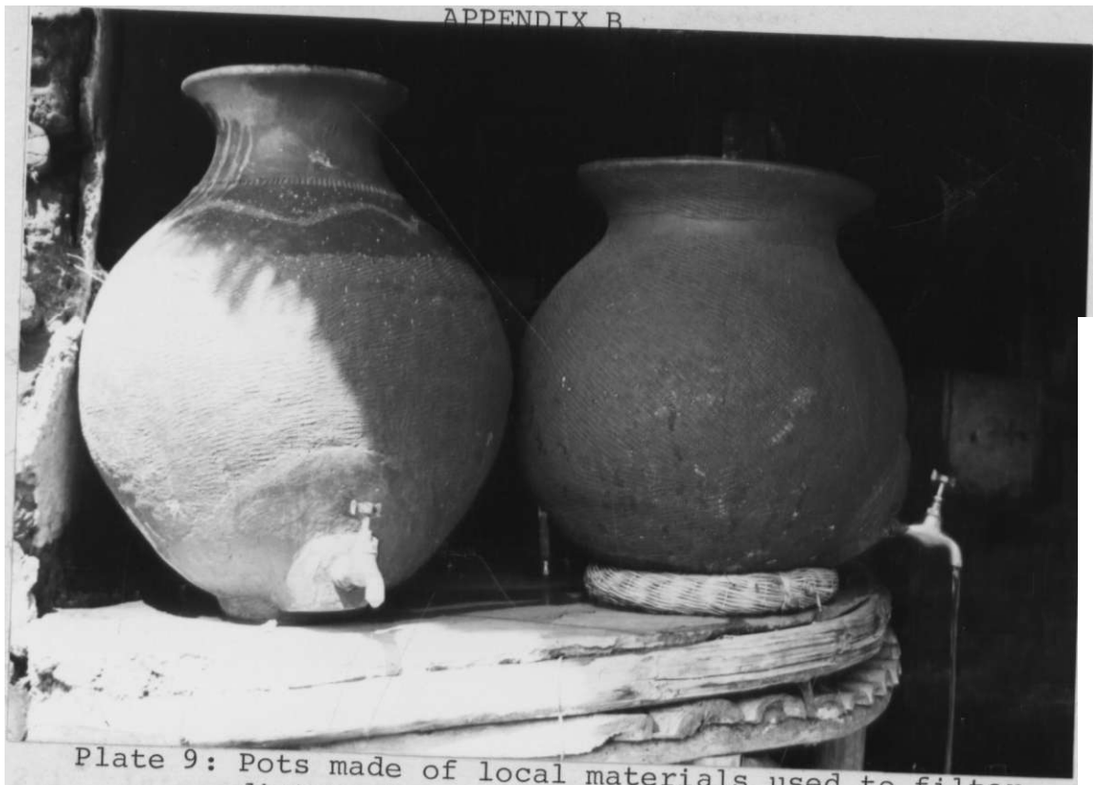

Plate 9: Pots made of local materials used to filter dirty water for human consumption.

Pate lo: n^r"* aueto TM _

QUESTIONNAIRE FOR THE RURAL POPULATION

PART I : GENERAL INFORMATION

1.0 ADMINISTRATION:

1.1 Administrative Division (Name)

1.2 Administrative Location

1.3 Administrative Sub-location

1.4 Farm (Name)

PART II

2.0 Date of Interview

2.1 Interviewer's Name

2.2 Interviewee's Name (optional) Sex

2.3 Total number of household members

3.0 HOUSEHOLD EDUCATIONAL CHARACTERISTICS

House hold mentoer (name) :	•Jursery	Primary	Seco-ndary	Poly-technic	College	Univ.	Adult-literacy	Adult %
Husband								
Wife								
Sons								
1.								
2.								
3.								
4.								
Daughters								
1.								
2.								
3.								

Other (Specify)										
1.										
2.										
3.										

3.1 Head of Household's occupation

3.2 Estimated income (Kshs.) per month for above occupation:

(i) Below 250 (iv) 3000

(ii) 250 - 750 (v) 3,001 - 6,000

(iii) 757 - 1,500 (vi) 6,001+

3.3 Estimated amount spent on water Kshs.

PART III : HOUSEHOLD WATER SOURCE QUESTIONNAIRE

4.0 DOMESTIC/HOME WATER CONSUMPTION:

4.10	SOURCE	PRIVATE	COMMUNAL	DISTANCE (Km.)
4.11	Piped water (tap)			
4.12	Well			
4.13	Dam/Reservoir			
4.14	Borehole			
4.15	River/stream			
4.16	Other (specify)			

5.0 System of transporting water:

(a) Human labour (pottery)

(b) Donkey cart

(c) Vehicle

(d) Other (specify)

6.0 Person(s) bringing water to the homestead:

(a)' Wife

(b) Children

(c) Husband

(d) Other (specify)

7.0 Time of day water trips started:

Time	No. of Trips	Time	No. of T ^ ^
5 a.m.			
6 a.m.			
7 a.m.			
8 a.m.			
9 a.m.			
10 a.m.			
11 a.m.			
12 noon			

8.0 Total number of round trips per day:

	Trips	Amounts (Litresjr-
(a)	1 trip	
(b)	2 trips	
(c)	3 trips	
(d)	4 trips	
(e)	Over 4 trips	

9.0 Time per round trip:

(a)	Under	1 hour	
(b)		1 hour	
(c)		2 hours	
(d)		3 hours	
(e)		4 hours	
(f)		5 hours	
(g)	Over	5 hours	

9.0 APPROXIMATE PROPORTION OF HOUSEHOLD'S WATER BY PURPOSE PER pf PAY:

(1)	PURPOSE	AMOUNT/LITRES	PERCENTAGE (%)
(1)	Cooking		
(2)	Drinking		
(3)	Laundry		
(4)	Bathing		
(5)	Washing utensils		
(6)	Irrigating horticultural crops		
(7)	Other (specify)		

10.0 Problems encountered in order of magnitude:

(a) Long distance to source area

(b) Unreliability/seasonality of water

(c) Dirty and often infected water

(d) Shortages and inadequacy of water

(e) Taste and smell of water

(f) Expensive water tariffs (if any)

(g) Other (specify)

11.0 Problem(s)that need to be solved first:

(a)

(b)

(c)

(d)

11.1 Reason(s)

12.0 Comment on distance to water source:

(a) Near enough for effective use

(b) Not near enough for effective use

12.1 Reason(s) for the answer

13.0 Preference to a change of the present source of water to:

(a) Piped water (private)

(b) Piped water (communal)

(c) Kiosk water sales

(d) Roof catchment tanks

(e) Boreholes

(f) Other (specify)

13,1 Reason(s)

14„0 Membership of any water supply project within th^ community

(a) Yes

(b) No

14.1 Name of that water supply project:

15. Contributions made or to be made for the project:

(a) Cash

(b) Labour

(c) Material

(d) Other (specify)

16.0 Benefits (social, economic, political etc.) likel/ to be realized after the completion of the water supply Project

(a)

(b)

(c)

(d)

17.0 Readiness/willingness to spent more money *to* achieve/ obtain closer source of water:

(a) Yes

(b) No

18.0 Alternative jobs or engagements that can be done with time saved by close water source:

(a)

(b)

(c)

(d)

(e)

19.0 Use of time that would have been spent in fetching water in long distance (i.e.) for those within the source ot water:-

(a)

(b)

(c)

(d)

(e)

20.0 Ways in which water supply problems can be solved in the community:

(a)

(b)

(c)

(d)

(e)

21.0 Engagements in Discussions and talks with other people in the present source of water:

(a) Yes

(b) No

21.1 Reason(s)

22.0 Difficulties (if any) in storing water fetched:

(a) Yes

(b) No

22.1 Name the difficulties (if any)

(a)

(b)

(c)

(d)

(e)

23.0 Type of water facilities required in future:

(a) Those entirely constructed by the Ministry of Water and maintained by it

(b) Those constructed by the community entirely and m maintained by it

(c) Those constructed by the community and taken over by the County Council for maintainance

(d) Those constructed by the County Council and maintained by it

(e) Those constructed by the agencies like U.N.I.C.E.F.; CARE-KENYA etc. and later rehabilitated by the Ministry of Water Development:

23.1 Reason(s) for the answer:

PART IV: LIVESTOCK WATER CONSUMPTION

24.0 Sources of water for livestock:

24.1

SOURCE	PRIVATE	COMMUNAL	PI STANCf
(a) Pipe water (top)			
(b) Well			
(c) Dam/Reservoir			
(d) Borehole			
(e) River/stream			
(f) Other (specify)			

25. LIVESTOCK CHARACTERISTICS

TYPE	NUMBER	**LITRES**/HE AD/DAY
Dairy cattle		
Zebu cattle		
Goats		
Sheep		
Pigs		
Poultry		
Other(specify)		

26.0 Total number of trips per day (if not piped water):

TRIPS TIME VpAKEN

(a) 1. .

(b) 2

(c) 3

27.0 Problems encountered:

(a) —

(b) —

(C) —

(d) —

28.0 Ways these problems can be solved:

(a)

(b)

(c) —

(d)

29.0 Agencies or individuals to solve these problems:

(a)

(b)

(c)

(d) ,

30.0 Plans that have been made to expand water sQurces for Livestock:

(a)

(b)

(c)

(d)

31.0 Associated problems with these plans:

(a)

(b)

(c)

(d)

QUESTIONNAIRE FOR THE POPULATION SERVED BY THE GOVERNMENT (KIPKELION) COUNTY COUNCIL (SOSIOT), COMMUNITY (KIPCHIM*/[11]^ AND CHURCH (KIPCHIMCHIM) WATER SUPPLIES SCHEMES

PART I : GENERAL INFORMATION

1.0 ADMINISTRATION:

1.1 Administrative Division (Name)

1.2 Administrative Location

1.3 Administrative Sub-Location

1.4 Farm (Name)

PART II

2.0 Date of Interview

2.1 Interviewer's Name

2.2 Interviewee's Name (optional)

2.3 Total number of household members

3.0 HOUSEHOLD EDUCATIONAL CHARACTERISTICS

Household member (name)	Nursery	Primary	Secondary	Poly-technic	Iblege	Univ.	Adult lite*[80]*	Adult [70]
Husband								
Wife								
Sons								
Daughters								
Other (specify)								

3.1 Head of Household's occupation

PART III : HOUSEHOLD'S/COMMERCIAL WITHIN KIPKELION WAT#r SUPPLY;

4.0 State whether served by Kipkelion water supply:

(a) Yes

(b) No

4.1 Reason(s) for the answer if it is (b)

5.0 System of water supply:

(a) Private metered individual connection

(b) Communal water point

(c) Kiosk sales

(d) Other (specify)

7.0 Water supply system preferred most:

(a) Private metered individual connection

(b) Communal watering points

(c) Kiosks water sales

7.1 Reason(s) for the answer

8.0 Problems encountered with the provision of water si>PP1Y:

(a)

(b)

(c)

(d)

(e)

9.0 Ways and means that these problems can be reduced:

10.0 Agencies or individuals who can solve these problems

(a)

(b)

(c)

(d)

11.0 Problems to be solved first:

(ft)

(b)

(c)

(d)

11.1 Ways such problems could be solved:

(a)

(b)

(c)

(d)

12.0 Individuals/organisations/agencies that can solve the above problems:

(a)

(b)

(c)

(d)

13.0 Type of education on the use and proper management of supplied water:

(a)

(b)

(c)

14.0 Type of participation in Kipkelion water supply affairs •

(a) Decision to undertake water project

(b) Further construction of the water supply facility--

(c) Maintainance

(d) Other (specify)

14.1 Level of participation:

(a) Chairman

(b) Secretary

(c) Treasurer

(d) Committee

(e) Other (specify)

(f) None of the above

15.0 Improvements which can be made in this water supply:

(a)

(b)

(c)

(d)

15.1 Activities which have been initiated/started/intensified since Kipkelion water supply was started:

(a)

(b)

(c)

(d)

QUESTIONNAIRE FOR FARM MANAGEMENT ON [illegible] nN mSIJSED WATER SOURCES

1.0 ADMINISTRATION

1.1 Administrative division (Name)

1.2 Administrative Location

1.3 Administrative sub-location

2.0 Farm Name

3.0 Number (total) of colonial water sources before African re-settlement:

source (water)	Number
(a) Dams	
(b) Boreholes	
(c) Wells	
(d) Private water pumps (pipes)	
(e) Other (specify)	

4.0 Number of colonial water sources still functioning:

Water Sources	Number functioning
(a) Dams	
(b) Boreholes	
(c) Wells	
(d) Private water pumps (pipes)	
(e) Other (specify)	

5.0 Reasons/processes which have led to the disuse of some of the water sources (colonial):

6.0 Problems that have resulted due to the disuse of such water sources:

(a)

(b)

(c)

(d)

7.0 Ways and means of rectifying the disused colonial water sources:

(a)

(b)

(c)

(d)

8.0 People or agencies responsible for such rectifications

(a)

(b)

(c)

(d)

9.0 Number of new water sources in the farm (i.e. after settlement):

Source of water	Number
(a) Dams	
(b) Boreholes	
(c) Wells	
(d) Private water pipes	
(e) Other (specify)	

QUESTIONNAIRE FOR KIPKELION WATER SUPPLY MANAGEMENT

PART I:

1.0 Sources of water

2.0 Actual amount of water in these sources:

SOURCE	WET SEASON AMOUNT/M	DRY SEASON AMOUNT/M
1. 2. 3.		

3.0 Areas served by each major consumer category:

Consumer category	Demands/m^3
(a) Residential	
(b) Commercial	
(c) Livestock	
(d) Industrial	
(e) Other (specify)	

4.0 Maximum water supply operating capacity at present:

5.0 Plans for possible new sources of surface or ground water

(a) Yes

(b) No

5.1 Name sources of water to be tapped (if answer is (a)

(a)

5.2 Areas planned to be served by these sources:

(a)

(b)

(c)

(d)

6„0 Constraints being met in planning and maintaining the water supply:

(a) at its source

i)

ii)

iii)

(b) In storage:

i)

ii)

iii)

(c) In treatment:

i)

ii)

iii)

(d) Delivery:

i)

ii)

iii)

6.1 Current proposed programmes aimed at at resolving these constraint:

(a)

(b)

(c)

(d)

7.0 Prospects for extending the Township's water supply to serve the immediate rural population:

	Name of area	Area (Km)
(a) Yes		
(b) None		

7.1 When (if (a)

8.0 Maximum Kipkelion's water supply operating capacity in relation to industrial, commercial, and housing expansion:

(a) Adequate

(b) Inadequate

8.1 If answer is (b) by what amount? (M^3)

9.0 Problems facing the water supply:

(a) Problem of design

(b) Problem of maintainance/pipe breakages

(c) Problem of water unreliability

(d) Other (Specify)

(e) Wastage at consumption points:

10.0 Ways of solving the above problems

(a)

(b)

(c)

QUESTIONNAIRE FOR THE MANAGEMENT OF RURAL SELF-HELP ffATER PROJECTS

1.0 Administrative Division

1.1 Administrative Location

1.2 Administrative Sub-Location

1.3 Farm/Zone

2.0 Name of the water supply project

3.0 Source(s) of water for the project

3.1 Potentiality of water source(s):

(a) Wet season (amount m^3 amount tf ^{3}

(b) Dry season (amount , m^3)

4.0 Area the water project is expected to serve

Consumer category	Amount of wat^.r - Litrog
(a) Households	
(b) Livestock	
(c) Industries	
(d) Commerce	
(e) Other (specify)	

5.0 Sponsoring agency or groups:

(a)

(b)

(c)

(d)

6.0 Factors which led to the start of the project:

(a)

(b)

(c)

(d)

C)¥

7.0 Problems which are or likely to affect the project:

(a) Poor management

(b) Finance

(c) Disunity of the members

(d) Technical assistance

(e) Other (specify)

8.0 Ways and means in which these problems can be solved:

(a)

(b)

(c)

(d)

9.0 Likely benefits after the completion of the project:

(a)

(b)

(c)

(d)

10.0 System of water supply the project will consider:

System	Number
(a) Private metered individual connection	
(b) Communal water points	
(c) Water kiosk sales	
(d) Other (specify)	

11.0 Ways in which the project can be carried out in order to meet the water demand by all categories of consumers (livestock, household, commerce, etc.)

(a)

(b)

(c)

(d)

(e)

QUESTIONNAIRE FOR DISTRICT WATER OFFICER/ENGINEER

1.0 Distribution of water facilities per Administrative Divisions of Kericho District:

Administrative Divisions	Total No. Water Facili^
(a) Kipkelion	
(b) Belgut	
(c) Buret	-
(d) Sot (Bomet)	
(e) Londiani	

2.0 Problems facing the Department of Water supply/developme^[1]- in relation to efforts aimed at furthering rural water supplies:

(a) _____

(b) _____ -/—

(c) _____ ' —

(d) _____ —

(e) —

3.0 Water supply Department's objectives and strategies to overcome the above problems:

(a) ___

(b)

(c) _____

(d) ___

(e)

4.0 Constraints likely to affect the above objectives:

(a) ___

(b) _

(c) —

(d)

H

5.0 Existing water projects in Kipkelion Division:-

Name Zone

(a)

(b)

(d)

6.0 Criteria used for selecting water project areas:

(a)

(b)

(c)

(d)

7.0 Sponsoring agency (Non-governmental organization (e.g. UNICEF, CARE KENYA etc,), Community which can develop and run water supplies in rural areas effectively:

(a)

(b)

(c)

(d)

7.1 Reason(s)

8.0 Water projects associated with leadership in Kipkelion Division:

Number

(1) Politicians (Member of Parliament) ;

(2) Religious leaders

(3) Councillors --

(4) Chiefs

(5) Others (specify) -

9.0 Reasons for any existing inequality in the distributions of water supply facilities in the administrative divisions of the district.

(a)

(b)

5.0 Existing water projects in Kipkelion Division:-

Name Zone

(a)

(b)

(c)

(d)

6.0 Criteria used for selecting water project areas:

(a)

(b)

(c)

(d)

7.0 Sponsoring agency (Non-governmental organization (e.g. UNICEF, CARE KENYA etc,), Community which can develop and run water supplies in rural areas effectively:

(a)

(b)

(c)

(d)

7.1 Reason(s)

8.0 Water projects associated with leadership in Kipkelion Division:

Number

(1) Politicians (Member of Parliament)

(2) Religious leaders

(3) Councillors

(4) Chiefs

(5) Others (specify)

9.0 Reasons for any existing inequality in the distributions of water supply facilities in the administrative divisions of the district.

(a)

(b)

(c)

(d)

10. Maximum Kipkelion's water supply operating capacity in relation to industrial, commercial and housing expansion:

(a) Adequate

(b) Inadequate

11.0 If answer is (b) by what amount (M^3)

12.0 Problems facing the water supply:

(a) Problem of design

(b) Problem of Maintainance/pipe breakages

(c) Problem of water unreliability

(d) Other (specify)

(e) Wastage at consumption points

13.0 Ways of solving the above problems:

(a)

(b)

(c)

(d)