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TITLE: THE PROBLEM OF WATER SHORTAGE IN KARAI
LOCATION OF KIAMBU DISTRICT: CAUSES AND
POSSIBLE SOLUTIONS.

BY:

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A THESIS SUBMITTED IN "PART" FULFILMENT FOR THE DEGREE OF
MASTER OF ARTS (PLANNING) IN THE UNIVERSITY OF NAIROBI.

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DESIGN AND DEVELOPMENT,
UNIVERSITY OF NAIROBI,
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DECLARATION:

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

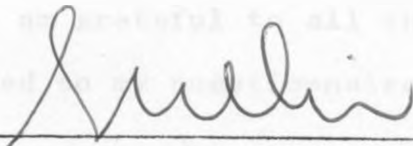
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June 1988

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ABSTRACT

Water is one of the five basic needs necessary for human life; others being food, shelter, health and education. However water is unique in that it is a chemical from which all life depends and it cannot be substituted in its use. It is necessary for life sustenance. There is enough water in the world to sustain life but it is unevenly distributed so that some settlements are found very far from natural water sources while others maybe next to such sources but the water is unsuitable for consumption either because it is salty or because it is contaminated.

To obtain clean potable water for everyone therefore calls for governments to invest heavily on piped water schemes that enable water to be equitably distributed amongst the people. Ideally all homesteads should be having piped clean water supplies but the heavy initial capital required for such an undertaking becomes a limitation. In Kenya only about 20 percent of the population lies in the urban areas where water supply is fairly adequate. The rest of the population is unevenly distributed in the rural areas usually on small farm plots. To supply each such homestead with water calls for the central Government and the people themselves to spend a very high portion of their income on funding water supply schemes.

Water schemes in Kenya are funded either by the Government or by the beneficiaries on "harambee" basis but highly subsidised by the Government. In the low potential areas especially arid and semi-arid lands (ASAL), the Government has been fully involved in supplying the water to the people because the people's incomes are low and the inhabitants cannot be expected to contribute any significant amounts of money towards the funding of such schemes.

The Government of Kenya on recognising the importance of water has set itself the goal of ensuring that the whole population has access to potable water at convenient distances by year 2000 A.D. In areas where perennial sources are absent or unsuitable, piped water schemes whose sources are normally outside such areas or the ground-water extraction have been used to provide the water. Such has been the case in this study area where no naturally occurring surface water bodies are found and water supply is from a source outside the location (Bathi River Water Supply Scheme) and from several borehole schemes.

Generally, a commodity is found to be scarce either because its physical or natural occurrence is inadequate or because human factors come to play and cause even a commodity that is plentiful to be scarce. In the case for water natural factors that can cause scarcity include low rainfall, lack of natural water sources such as rivers and lakes or very low water tables where groundwater is used. Human factors

such as mismanagement of existing schemes, activities that pollute water or inequitable income distribution may also result in unequal access to water while poverty is also a factor that adds to the inaccessibility of clean water.

In the study area, the Government has done its best to ensure that there is an adequate supply of water for domestic and livestock watering purposes. Several small schemes exist but unfortunately the schemes are found to be supplying less water than they were designed to; resulting in water being in short supply. The problem is made worse by the fact that rainfall is low so it cannot be depended on to supply enough water while the area lacks in alternative sources of water since there are no perennial sources.

Having identified the problem of water shortage in Karai and having studied literature on possible causes of water shortage, this study set out to investigate what problems obtain for Karai location and in the same respect the study also undertook to investigate possible solutions to these problems. Certain recommendations have then been made whose implementation could ensure that everyone in the study area gets enough water not only for human consumption and livestock watering but also to necessitate activities suitable for rural development of such a low potential area.

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C H A P T E R I

I N T R O D U C T I O N

1.0 PREAMBLE

Water is a basic human need, a chemical from which all life comes to common substance and without which life cannot be sustained. It is indispensable not only to human life but also for agricultural and industrial development. It is different from other natural resources in that there is no substitute for it.

Human civilization is founded on the development of two primary resources, namely land and water. Civilizations have perished due to mismanagement of their water resources while others have flourished as a result of their good management of water resources.

The earth has about 1.5 million cubic kilometers (396 billion gallons) of water (Dasman, R.F.) but the water is unevenly distributed so that 99.997 percent of it is not readily available for human use (Dixey, F.; 1946). This amount is either contaminated or salty especially if found in oceans, seas or lakes. The rest 0.003 percent is fresh water found in rivers, lakes, swamps and as underground resources. As a result, water of usable quality and quantity present in the right place at the right time is not inexhaustable. Water is a renewable resource but one for which, in many areas of the world, the demand is far greater than the supply (Gordon, G.C.; 1976).

The Most affected people by this water shortage are found mainly in the rural areas particularly in the least developed countries. In 1970, only 14 percent of the people in the rural areas in developing countries had access to safe supply of water which had risen to 29 percent by 1980 (Greifer, J.; Ed.). In response to the recognition of this deficit, the United Nations Organization (UNO) declared the 1980s to be the International Drinking Water Supply and Sanitation Decade (IDWSSD) with the aim of satisfying the world populations with clean water and sanitary disposal of human wastes (Holdgate, M., 1972). Such an enormous task calls for a concerted effort by all agencies responsible for planning for water resources at international, national, regional and local levels.

At the local level and as if in response to this declaration, the Kenyan Government (to be referred to as "the Government") had set itself in the 1966-1970 Development Plan a goal of providing water to the entire population by the year 2000 A.D. This 30-year plan was to be implemented through multiphased programmes starting with the areas that were worst hit first (Hoyle, B.S.; Ed. 1974). This study has studied how well this goal has been achieved for a localised area in Kenya, namely Karai Location in Kiambu district and suggested solutions for the short comings identified.

1.1 NATURE OF THE PROBLEM

Karai is one of the locations in Kikuyu Division of Kiambu District, Central Province, Kenya (Map No. 1). Because of its low rainfall, 200-800 millimeters (mm) per annum, Karai falls into what has been classified Arid and Semi-Arid Lands (ASAL). In the tropics, Arid Lands receive an annual rainfall between 25 and 250 mm while Semi-Arid Lands receive between 200 and 500 mm of rainfall (Hutchinson, J.; 1977). In Kenya ASAL zones are defined as those receiving less than 800 mm of rainfall annually (Migot-Adholla; 1980 p98). They occupy 80 percent of the land and support 20 percent of Kenya's population and half of its livestock (Sessional Paper No. 1 of 1986; p.84).

Besides the low rainfall, the location lacks surface water bodies apart from a small man-made dam in Nachu, one of the sublocations in the location, which is fed by rainwater whenever it rains. This factor has added to the seriousness of the marginality of Karai.

Settlement in Karai is found to be recent compared to the rest of Central Province. This is because as a frontier area between the highly populated and expanding agricultural area of Kikuyu land and the Maasai pastoral activities, Karai and the adjacent Ndeiya locations have been found an easier alternative for those seeking land due to the pressure on land elsewhere in the surrounding areas.

Besides its marginality, the Government has continued to settle the landless in this area the result of which is



KENYA: ADMINISTRATIVE BOUNDARIES

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AND REGIONAL PLANNING
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NORTH

PLAN / FIG
No. 1

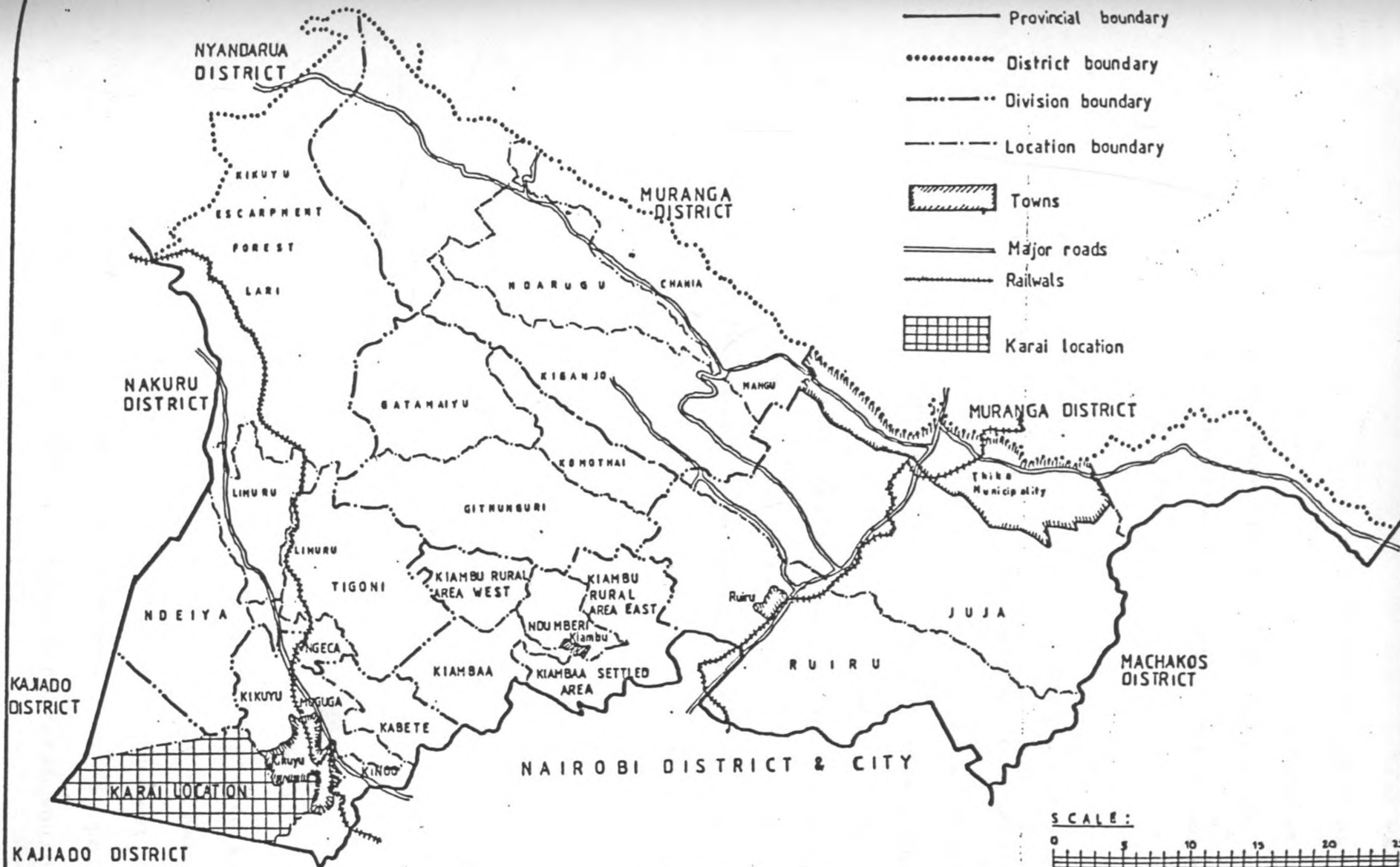
high population growth rate in the location being as high as 16 percent in Nachu sublocation which is the most recently settled area in the location, reasons for which are explained in Chapter IV Section 4.10.

Because water is a basic commodity, the Government has attempted through the Kiambu County Council (KCC) and the Ministry of Water Development (MoWD) to exploit the only naturally occurring water in this area, the groundwater, in order to supply the people with water for domestic and livestock watering purposes. Boreholes have been sunk by the two agencies and in a few cases by individuals or groups of individuals (Map No. 7) and distributed through standpipes and water kiosks. In some cases, individuals have made connections to their homesteads from the public water schemes.

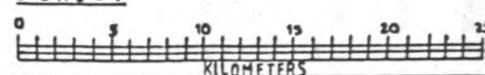
In a bid to increase amounts of water available in Karai, the Government in 1980 brought in water from a perennial source outside Karai Location, namely the Bathi River Water Scheme whose source is 40 kilometers outside Karai Location in Lari Division to the north of the study area (Maps No. 2 and 8). The scheme's first and second phases were designed to cope with water demand for an area including Karai Location by 1985. These two phases have been completed and a third phase (designed to cope with the increasing demand for water in the catchment area either due to increase in population of the scheme's catchment area or due to an increased number of people wishing to have individual connections) has not been started.

LEGEND

- Provincial boundary
- District boundary
- - - - - Division boundary
- · - · - Location boundary
- ▨ Towns
- == Major roads
- Railways
- ▣ Karai location



SCALE:



KARAI WATER SCHEMES

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MAP No.
 2

By the time the second phase of the Bathi Scheme was completed, at least half the households in Karai had made individual connections either to the scheme or to the borehole schemes while the rest obtained their water by buying it from communal water points (Ndeiya and Karai Water, Assessment Study; 1983).

It was while in Karai on another field project in 1986 that it was noted that most of the taps in the homesteads were dry for most of the days. This study found out that some of these taps have been dry since they were connected, especially those connected to the Bathi Water Scheme. Others connected to the borehole schemes get irregular supplies once or twice a week. It was further noted that there were long queues at the communal water points (CWPs) and alot of time was being lost just standing in the queue while waiting for one's turn to buy water.

The Government in a bid to acheive its goal of availing water at convinient distances to all households by year 2000 has instituted several water schemes in the country so that in the rural areas in Kenya no household is found to be more than 1.8 kilometers away from a water point in a dry season (Development Plan 1984; p. 36). While this is an average distance for the whole nation, observations in the field have revealed that some households in Karai travel a distance of over 6 kilometers to the nearest preferred water point. Even using the more specific policy that households in low potential areas like Karai would be

provided with water at distances not exceeding 2.5 kilometers away from any homestead, it is still evident that this goal has not been achieved in Karai.

The problem therefore identified for Karai and which this study set out to investigate is that besides the several small water schemes found in Karai, water is still in short supply contrary to what records would have us believe. The two parameters of the dry taps and long queues at communal water points, and the longer distances, than those stipulated in the Government records, that people have to travel to the nearest preferred water points have been used in this study as indicators of the said shortage.

1.2 JUSTIFICATION OF THE STUDY

Previous studies of Karai Location have left no doubt that lack of access to water is a major constraint to development (Robins, C.; 1985 p. 21). Robins noted that the main sources of water at household level are public standpipes, piped supplies, stored rainwater and supply from neighbours with more reliable sources. Due to these sources being unreliable most households have to rely on more than one source, the most highly relied on alternative being public standpipes. Robins study also found out that over half the households spend more than one hour to make a round trip to fetch water, ten percent of whom require more than three hours.

Robins further noted that the number of public boreholes is small and have limited water supply especially during

dry seasons, when the upper areas of Lari and Limuru from where the groundwater in Karai is recharged are also dry. Households in Karai have therefore at times to rely on water sold by vendors which they get at prices much higher than those they are used to from the public standpipes.

Robins hence concluded that there is shortage of water in Karai and recommended that further research should be carried out towards provision of adequate amounts of water for the location. This she found necessary as the shortage of water has humpered development in the location, the result of which is low standards of living.

Other studies by the University of Nairobi (Department of Urban and Regional Planning; 1983/84 and 1986/87) recommended that before any other rural development activity can be instituted in Karai, water has to be supplied in sufficient quantities as most such activities would require water as one of its inputs. The studies therefore recommend that the priority problem number one for Karai is that of water shortage and further research should be done to define ways and means of availing more water for Karai.

Observations have also shown that although physical water schemes are not lacking, adequate quantities of water are not reaching the people as was designed. There must therefore be some other factors that are affecting the schemes so that they are not delivering the water as

designed, and these factors need to be investigated in order to introduce measures that can remove such hinderances.

It is also important to note that Ndeiya and Karai are two locations in Kiambu district whose agricultural potential is lower than the rest of Kiambu, but those population density is as high as anywhere else in the district. As such the two locations are found to be lagging behind in development and this can be attributed to lack of water. According to the Government's strategy, the worst hit areas should be considered first when making any development plan (District Focus for Rural Development Strategy). Yet the current District Development Plan for Kiambu pays little or no attention to water supply in Ndeiya and Karai Locations, an anomaly found worth investigating.

In conclusion therefore this study is justified by the fact that previous studies in the area have recommended further studies into the area of water supply for Karai, and this study picks up from there. A gap has also been identified in that while existing schemes have assumed that there is enough water from the source to cope with the designed quantities, the reality is that adequate supplies are not reaching the people either because the supplies are limited from the source or because somewhere along the way, some people are consuming more water than

their designed share. There is therefore need to find other alternative sources of water that can be used to supply the whole of Karai adequately and those which are not affected by overconsumption of water in upper areas of the schemes before it reaches Karai.

1.3 OBJECTIVES OF THE STUDY

The following are the objectives of this study:-

- a) To assess the existing supply and demand of water in Karai as an indicator of the said shortage.
- b) To evaluate the factors that cause scarcity of water in the location.
- c) To bring out, in discussion form, the benefits that accrue from rural water supply schemes and hence justify the need for an adequate water supply in Karai.
- d) To recommend planning strategies which can be adopted to solve the problem of water shortage in Karai.

1.4 SCOPE OF STUDY

The study covers the whole of Karai Location and the major factors investigated included the human and physical factors that have caused scarcity of water in the location. From the objectives, the first one was achieved by use of secondary data obtained from the Ministry of Water Development which had done a feasibility study in this area when designing the Bathi Water Supply Scheme. Such technical

data was considered to be complementary to what this study collected in the field and the two have been used to explain the first objective.

To evaluate the factors that have caused water shortage in Karai, secondary data, as well as primary data were used in order to bring out the problems specific to the area of study and hence to direct the policy recommendations for this study.

Benefits that accrue from rural water supply schemes were reviewed as a way of highlighting the disadvantages that Karai has been put into by lack of this facility. This was found necessary as a way of adding more weight to be thrown behind the need for action towards availing an adequate water supply for Karai.

Finally, by suggesting short and long term strategies which can be adopted in order to solve the problem of water shortage in Karai, it was hoped that execution of such strategies could bring the desired benefits and hence raise the standards of life of the people of Karai.

1.5 STUDY ASSUMPTIONS

- a) That there is enough physical water supply in the country to meet the demand of all the households but its occurrence and suitability for consumption are the factors that result to some areas of the country having a shortage.

- b) That, scarcity of any commodity (water included) is caused by two factors; namely natural shortage and human factors or behaviour. The human factors include the efficiency with which a commodity is converted from raw to consumer good, and inequitable distribution due to the institutional arrangements, unequal income distribution and poverty.
- c) That, water is a basic necessity for any economic activity in ASAL areas.

1.6 METHODOLOGY

Both Primary and Secondary data were used in this study. Secondary data was mainly obtained from written and or published materials obtained from various libraries such as Ministry of Water Development library, Institute for Development Studies library and other University of Nairobi libraries. A lot of research has been done in Ndeiya and Karai Locations by Non-Governmental Organisations (NGOs), donor agencies and individuals and their reports were reviewed whenever found necessary.

Government publications especially the 5-year Development Plans, Population Census Data Books, Sessional Papers and others were also used. Text books were used not just to provide information applicable to Karai but to guide whenever possible in drawing conclusions and making decisions on various policy recommendations.

Primary data was collected in three different ways. The first format is whereby the author went to the study area

and noted any physical characteristics necessary as inputs into this study. These included the physical features of the study area, the conditions and distribution of water supply facilities in Karai and the general socio-economic characteristics of the study area.

Further to the physical observations more information was obtained through interviews and discussions with leaders both local and administrative. These included the District Water Engineer, the District Officer of Kikuyu Division, the Chief of Karai Location and all assistant chiefs of the five sublocations in Karai. Also interviewed informally were the councillor of Karai Location, village elders and women groups' leaders. The author also visited all the formal schools in the area which included eleven primary schools and three secondary schools. Here, the schools' headteachers were interviewed and where they were not available their deputies, any available teacher or the school bursar were interviewed. All these people were treated as the key informants whose information was used together with information gathered from secondary data to complement data collected in the third type of information gathered and the secondary data.

The third type of primary data was collected by use of household questionnaires. From literature review and from key informants it had been found out that approximately half the people in the whole location had made individual

water connections to their homesteads while the rest were expected to be getting their water from communal water points. Two types of questionnaires were hence formulated and administered to households in Karai. One questionnaire was for those people with individual connections as it was assumed that their water supply problems would be different from those of people who depended on communal water points. For the same reason another questionnaire was used for people with no piped supplies in their homesteads. The number of households visited in each sublocation was distributed according to the proportions of households in each sublocation with a few modifications found necessary because sublocations such as Nachu had nobody with individual connections while in Gikambura almost all the people had individual connections. Apart from these it was assumed that 50 percent of the households in the other sublocations had individual connections. The questionnaires were hence distributed in equal numbers for those with and those without individual connections in these sublocations. The final distribution of the questionnaires administered in each sublocation was as shown in Table I.

Table I : Distribution of Sample by Questionnaire Type

Sublocation	Number of households interviewed		
	Without Individual Connections	With Individual Connections	Total
Muslim Karai	2	2	4
Nachu	14	0 *	14
Renguti	15	15	30
Lusigetti	20	21	41
Gikambura **	16	29	45
Total	67	67	134

* Nobody in Nachu Sublocation had individual connections.

** In Gikambura the proportions of those interviewed is not fifty-fifty because more households had individual connections than those without.

Four assistants were engaged and together with the author they administered the questionnaires, selecting the households to visit at a random.

A third type of questionnaire was formulated and administered to those people who sell water either as employees of the Country Council or the Government. These were mainly found at the public standpipes such as communal water points or water kiosks. Individuals who have sunk boreholes and sell water from there were also interviewed

using this type of questionnaire. The aim of this questionnaire was to find out what problems the sellers experience when dispensing their duties and which might warrant policy recommendations as a way of improving water supply for Karai.

1.7 STUDY LIMITATIONS

While a lot of information and data is available for Karai, most of it is an average for both Ndeiya and Karai. Locations which are often studied together as an ASAL unit. As a result it was found difficult and in some cases impossible to obtain data for Karai which is segregated from that of Ndeiya making it necessary to discuss the two locations together in some cases rather than discussing Karai on its own.

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C H A P T E R I I

L I T E R A T U R E R E V I E W

2.0 I N T R O D U C T I O N

Water is one amongst the five human basic needs identified as Nutrition, Housing, Health, Education and Water (Ghai, D. et. al; 1979). At the same time, water is a natural resource that is essential for the survival of man and for his economic activities and whose availability greatly affects economic development because unlike other natural resources it cannot be replaced in its use (Cunha, L.U.et al). The World Bank Executive Agency in one of its reports stresses the importance of water thus;

"Water is perhaps the most important of all basic needs as it is essential for personal needs, healthy living, and for all productive activities in both rural and urban areas".

Inspite of its importance, millions of people go without a safe, clean and adequate supply of water; while to many, water is a very scarce commodity. Calculations show that over 70 percent of the globe is covered with water (Stein, J. 1977). Only one percent of this water is needed for everyone in the world to have enough for their daily use. However, much of the global water is unsuitable for human consumption so that about seventy percent of the world's population is without safe and dependable water supplies (Stein, J.).

The reasons for this scarcity have been given by certain scholars as starting with the suitability of water for certain purposes not being right in time and place (Dasman, R.F.; p. 141). Dasman explains that water in the oceans, atmosphere and falling upon land is more than adequate to meet all the human needs now and in times to come. However, water of usable quality and quantity present in the right time and place is not inexhaustible. He sees water as a renewable resource but one for which in many areas of the world the demand is far greater than supply.

Other scholars see water as a scarce and hard-won commodity because inland waters occur in strictly limited volumes (Water Supply Management; Vol. 2; p. 147). The publication adds that less than 0.01 percent of global waters flow in rivers and their associated lakes and swamps, undergo both seasonal and yearly fluctuation and are subject to man-made changes in their physical and biological quantities.

World Bank figures show that rural areas are worst hit by this scarcity of water. The figures show that seventy five percent of over two billion people in developing countries do not have access to adequate supply of water and that more than 1,500 million who lack this basic service include 1,200 million in rural areas (World Bank Executive Agency; p. 1). There is a very distinct disparity between rural and urban areas where World Health Organisation (WHO) statistics show that only 20 percent of the rural population

in developing countries have reasonable access to clean water, while 75 percent of those in urban areas have access to water supply either through piped facilities or public stand pipes (Stein, J.; p. 2). Martin Holdgate et al. also tends to agree with this view, that rural areas are more affected by this scarcity.

The current theories of regional development advocate for an economic growth that is well balanced between rural and urban areas. This is because previously the theories tended to stress overall national economic growth with little concern for what was happening within the nation. As a result rural areas were becoming more and more underdeveloped because whatever they produced was exported either to the urban areas or to the imperial markets but the benefits would be shared by the whole nation overshadowing the individual producer. Multiplier effects would benefit the nation as a whole rather than the individual producers. United Nations Organisatio (UNO) did infact recognise this ambiguity and recommends strategies that raise the standards of living in the rural areas which have previously been lagging behind in development. UNO then declared the 1980s as the International Water Supply and Sanitation decade whereby even rural areas should be provided with these two facilities (Development Plan; 1979/1983; p. 107).

For rural areas, which are of interest to this study, rural water supply schemes have been recommended and in some cases

implemented in line with the strategy mentioned above. But because such supplies are an expensive undertaking and because the benefits are not directly tangible, there have been arguments for and against governments investing their resources in such schemes. An evaluation of some of the existing water schemes by some scholars has concluded that selection of areas for water development should always be based on maximisation of socio-economic effects regardless of whether they contribute substantially to the national income or not (Jacobsen and Ascaroft; 1971). These two writers argue that as long as a water scheme satisfies the needs of its recipients in terms of adequacy of water for domestic and livestock consumption, such water schemes would appear justified. They however pointed out that such schemes should be geared towards generating surplus in agricultural production so as to be able to provide resources for their maintenance costs in the long run.

Others see rural water projects as economic investments and hence suggest that different primary effects should be expected from different ecological zones. Zones with high agricultural potential are expected to produce more than low potential ones. This group of people therefore sees a water scheme to be of economic value if it results in larger increase to national income and unless a scheme causes surplus production one should not invest in it (Carruthers, I.D.; 1969). Carruthers therefore maintains that an area of very low subsistence level, no matter how deserving in terms of welfare needs should not be selected

for supply because it will not produce large additions to the country's income.

These last two views are found to be very important and relevant to this study because the area of study is a low potential area and recommending that the Government invests in water supply schemes for such areas would spark of a debate on whether or not the recommendations should be implemented. Such arguments as the ones above would be used and depending on the stronger arguments the schemes may or may not be implemented. The benefits of such rural supply schemes have been summarised in Section 2.1 below.

2.1 BENEFITS OF RURAL WATER SUPPLY SCHEMES

The arguments by Jacobsen and Carruthers have been synthesised so that rural water supply schemes have been seen to bring both social and economic benefits. Klasse Bos summarises these benefits as follows:-

- i) Direct Economic Benefits; where rural water supply is likely to encourage the farmers to increase or improve their livestock and hence get more milk and meat.
- ii) Indirect Economic Benefits; for example, time released from water carrying by farmer and family. These benefits depend on size of farm, type of crops grown and availability of labour to carry out essential tasks

especially at the peak of labour requirements periods.

- iii) Health Benefits; reliable supplies reduce health hazards and lead to better health which results in increased capacity for work and therefore increased production and income.
- iv) Social Benefits; such as personal relief from the heavy job of fetching water.
- v) Collective Benefits; out of decreased rural-urban migration, political stability, more balanced development in rural and urban areas.

However, Klasse Bos does not specify whether different benefits are likely to be expected from all rural water projects under different geographical, climatic and social conditions. These benefits have been elaborated further as follows in the next subsections.

2.1.1 TIME SAVED AND AGRICULTURE

A lot of useful time is spent in search of water. A water supply scheme would therefore greatly reduce the time spent and the time so saved would be used in more productive work like agriculture which in the developing countries is heavily dependent on human labour (WHO, 1974).
Sunders in a study on water supply in Kpomkpo in Ghana asked women how they would allocate their time if a new

water supply saved them about 12 hours per week. The responses given are shown in Table 2 below.

Table 2 : Utilisation of time released from fetching water.

Activity	Hours	Percent
Directly productive work e.g. agriculture)	6.8	57
Household jobs	4.2	35
Leisure	0.9	8
Total	11.9	100

Source: White, G.F. et al 1972.

Since in developing countries the most important economic activity is agriculture, and since most farms are left under the care of women as men go outside in search of wage-earning employment, the amount of time "lost" in search for water becomes an important policy issue. In Kenya, for example, more than 500,000 farms are under the care of women and during the peak demands for farm labour women are found to be spending considerable amounts of their time drawing water. With availability of close water supplies, the women are able to devote more time to their children, housework and leisure, but most of all in farming. The children who constitute the second most important drawers of water can also concentrate more on their studies and have more time for leisure and games.

Still on agriculture, farmers are usually reluctant to keep grade cattle unless their farms are connected to a water supply with individual connections so that the cattle can be grazed and watered on the farm. High quality milk production is only possible if sufficient water is available, (WHO Report, 1972 : p. 21). A good example is the summary given by Fenwick where he noted that after four years of completion of a potable water supply scheme in Nyeri, Kenya, there was an increase in number of cattle, pigs, sheep and poultry in the same areas where there was access to watering points all the year round (Fenwick, K.W.H.; 1969).

2.1.2 WATER AND HEALTH

A water supply scheme is a basic requirement in the improvement of public health with the accompanying effects on the general well being and increased productivity. A healthy population is able to work longer hours at agricultural labour peak demand periods and this increased labour availability may have a high economic value (WHO; 1972 ; p. 21). Another way in which water brings about economic benefits is that with improved health, there is a saving on health expenditure since medicaments do not have to be bought and all other related services do not have to be provided. Improved water supply may also have the effect of reducing the necessary expenditure on famine relief and hence make it unnecessary to create famine relief funds. It also helps to reduce water-borne diseases. For example, in Japan installation of

water supplies to 30 rural areas resulted in the number of intestinal diseases being reduced by 72 percent in those areas as well as a decrease in water related diseases (Stein; 1977; p.2).

Improved quality from a protected water supply will help to eliminate the water-borne diseases whereas greater quality of water used will help eliminate water-washed diseases. People served from communal water points will only benefit with respect to water-borne diseases while increased consumption due to individual connections will benefit with respect to both water-washed and water-borne diseases. Here it is important to note that untreated water supply will greatly increase the incidence of infections if it increases water consumption. In conclusion, improved water supply improves health, decreases mortality and increases working life.

2.1.3 WATER AND INDUSTRY

Availability of water has been known to influence the location of industries. For example, in processing of agricultural produce like coffee availability of water in abundant quantities is necessary.

2.1.4 SOCIAL IMPORTANCE OF WATER

Besides the time lost, the immeasurable inconveniences and the burden of long journeys in search of water, it has been estimated that drawing water takes more than 12 percent of the day's calories' needs of most carriers

in non-dry areas while in dry areas and in mountainous regions this figure maybe as high as 25 percent (Assit K. Biswas; p. 261).

Good water supplies, together with other improved facilities in the rural areas would help to prevent or reduce migration to rural areas where little opportunities for productive work exists (Stein, J.; 1977).

Once water is available, the costs incurred to transform it to clean potable water are so high that it calls for conservation and preservation so it can last longer. It therefore does not make much sense to plan for water conservation alone because land and water are two interacting and inter-related planning units. Any planning should therefore encompass the two, land and water; into a general scheme of environmental conservation (Milos Holy, 1971; p.39).

To begin with, such plans must pay attention to proper land conservation in the watershed areas. The conservation of forests particularly in the watershed areas have significant hydrological implications. Forests transform surface run-off into groundwater and therefore regulate the requirements of streams by restricting the fluctuations of discharges and limiting flood situations. The quality of water is also protected by trees and hence relatively purer water is produced by afforested rather than deforested drainage basins (Milos, H.; 1971).

In Karai, the groundwater is recharged by rainfall in the north, Lari-Limuru area, so the forests there should be conserved if constant and regular flows of water from boreholes is to be expected. Milos has recommended that in order to conserve forests, felling of trees should be done choosing a logging system which will reflect the dual need of preventing soil erosion and providing wood for other purposes. Secondly, clear cutting of trees should be avoided in favour of selective cutting. Failure to this will result in rainfall exceeding infiltration capacity of soil which can generate storm-runoff. Tilling the land in conjunction with transpiration losses after the removal of tree cover and the reduced interception of forest vegetation will tend to increase overland flow thus accelerating soil erosion. Under undisturbed conditions, hardly any overland flows occur in the forested watersheds (Yusuf, J.A.; 1982). Soil movement due to erosion is therefore kept at a minimum.

Water preservation becomes necessary when water is polluted or contaminated. Such water contains micro-organisms, chemicals, industrial or other wastes or sewage so that it is unfit for intended use. Pure or unpolluted water for drinking purposes must have two qualities:

- i) it should not have substances with diverse physiological effects, and
- ii) it should have no taste, odour or colour. (Ongweny, G.; 1973).

Potable water on the other hand is water which is safe to drink, pleasant to taste and usable for domestic purposes.

Present day agricultural practises require intensive use of farming pesticides, chemicals and fertilizers. Because the plants do not consume all these additives, some of them find their way to water sources and hence pollute the water. Certain chemicals may be leached or infiltrated and may therefore pollute underground waters while others are washed down through erosion to enter the stream waters (Holdgate, M.W.; 1972; p. 278).

2.2 ISSUES TO CONSIDER WHEN PLANNING FOR A WATER SUPPLY SYSTEM.

The following issues should be considered when planning for a water supply system as they may affect the system after its completion so that it fails to deliver the designed amounts of water:

- i) Management
- ii) Operation and Maintenance
- iii) Institutional arrangements
- iv) Public participation
- v) Attitudes and education

Below is a short discussion on what to consider under each issue.

2.2.1 MANAGEMENT

The history of water management is the episode of socio-

economic and cultural development of human race (Dasman, R.F.). A number of civilization have flourished or perished depending on how good or how bad their management of water resources was. Dasman stresses that if our ability to manage water falls short, the entire framework of civilized life is threatened. A lot of money is spent in the implementation of water projects but unfortunately in a number of cases the expected returns are not realised while in others the projects are commissioned but are only partly implemented. Writers like Kulp see the problem as being caused by irrational management practises when he states that:

"...the major problem in the area of water resources development is not one of Malthusian spectre of impending scarcity, but one of instituting rational management practises, and that what is needed urgently is the formulation of long-term policies that reflect changing water demand patterns, consistent with efficient use".

(Kulp, E.M.)

2.2.2 OPERATION AND MAINTENANCE

Other writers are of the opinion that the major problem that can create scarcity of water even if schemes are implemented is inefficient operation and maintenance of the scheme therefore. The success of a water project is hanged on how it is operated and maintained which depends in turn on the existence of a systematic and comprehensive working principles built on a part history experience (IDRC; 1980). Other schools of thought see failure of

water supply system as being caused by lack of proper supervision of maintenance, and lack of cost conscious technically disciplined personnel capable of professional commitment to public service (Water Supply and Management Report; Vol. 5, No. 3). This report concludes that:

"...indeed it is the inability of the operation and maintenance staff, due to lack of proper training, to carry out their responsibilities effectively that really is the cause of the problem".

This quotation is very important in this study as will be seen later, because one of the noted causes of shortage of water in Karai is lack of proper maintenance of the schemes which has resulted in temporary or permanent breakdowns of equipments such as pumps installed in boreholes.

To solve the problem of operation and maintenance, the World Bank recommends that a training programme for operation of the systems should be instituted at the same time as the schemes are being installed. This is because many water systems do not work properly for virtually no-one locally knows how they operate. A cadre of barefoot technologists could keep supply systems functioning well over a large rural area (World Bank Sector Policy Paper on Rural Development; p. 40). KEFINCO working for rural water supply in Western Kenya seems to have adopted this strategy.

2.2.3 INSTITUTIONAL ARRANGEMENTS

It has been noted that even a well planned water supply system can fail due to subversion from within the society it is supposed to serve. In many cases, avoiding opposition from powerful and influential sections of the rural community is essential if the programme is not to be subverted from within (IDRC; 1980; p.10). This is because in any such undertakings, it is the powerful and/or the influential who are usually also the elites who are most outspoken and have the power to subvert such systems. For these people any project should give them some benefits (financial, political or social) otherwise they may subvert the system.

Other institutional arrangements that are of interest to this study are those whereby a section of the clientelle is antagonised and the staff are deprived of unofficial income (World Bank Staff Working Paper No. 453; 1981; p. 8-4). The paper summarises some of the practises in the field as follows:

".....increasing the effectiveness of water distribution staff frequently means antagonising an influential section of their clientelle as well as depriving themselves of a source of unofficial income".

(Antony, F.B.; 1981 : pp. 8-4).

Illegal dealings, as suggested above, may result to head-reach farmers taking more than their share of water leaving tail-reach farmers with insufficient and

unpredictable supplies. This was perceived to be the cause of the Bathi Water Scheme not delivering water to Karai as designed. The situation is not different when planning for a water scheme whose intended uses include irrigation, as inequitable water allocation on an irrigation, scheme can often be attributed to dishonest water masters, overly zealous upstream irrigators or both (Bomley, D.W.; 1981). Instances of water masters depriving the people of water in Karai until they are given something in form of cash or other gifts were reported during the time of this study; an issue discussed later on in Chapter V Section 5.9.

2.2.4 PUBLIC PARTICIPATION

The success of rural water supply programmes depends on the extent to which society is considered during planning stages. Genuine and unfailling involvement of intended beneficiaries right from the initial stages ensures the systems' success (Haille, T.; p. 381). The community should be involved from the initial stages of data collection and identification of users' preferences, through the design and construction stages right up to the permanent operation and maintenance of facilities (Warford, J.L.; 1976). IDRC also recognised that community involvement in the selection, design, construction and implementation of rural water development programmes has often been the first step in the acceptance of change and adoption of new technology (IDRC; 1980; p.10).

The role of women cannot be overemphasised as it is they who remain the drawers of water and the ones who actually experience the burden and drudgery of fetching water. It has been found out that at least 1/6 of all energy expended by rural women is used for carrying water (IDRC; 1980:p. 86). It has also been found out that after the idea of a project has been conceived and accepted by the community it is the women's groups that are often the driving force that keeps the momentum (Water Supply and Management; p. 157).

2.2.5 ATTITUDES AND EDUCATION

Once a water supply system has been implemented, it is important to educate the users so that they do not continue to see water as a free good that can be used according to one's wishes. They should be guided to see it as a paid-for good that needs to be conserved and preserved. They must be taught to use the water sparingly knowing that misuse will result to added costs and that days are gone when water used to be treated as a free resource, a gift from God, that can be used as desired or squandered on whims (Water Supply and Management; Vol. 2 : p. 215).

The user attitude towards water and its use must be looked into in relation to matters of hygiene and sanitation.

This brings the entire issue of education of the user in matters of water rationing, water storage, reduction of wastage, proper disposal of waste water and in general towards a sense of responsibility. Education

of the villagers must go further to include simple operation and maintenance techniques as discussed earlier in section 2.2.2.

The people must also be informed of the uses to be accommodated within the supply system, so that systems for domestic use are not used for irrigation purposes. Where water supply system is to include irrigation, people must be taught to adopt methods which involve application of smaller amounts of water such as drip irrigation.

In conclusion, while a lot of literature exists on water and water supply development, the few issues discussed here are the ones selected on the basis that they seem to affect very strongly the situation of water supply in the study area.

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C H A P T E R III

REVIEW OF GOVERNMENT POLICY

3.0 INTRODUCTION

This paper comprises mainly a review of what the Government's policies on certain issues related to this study have been since independence in 1963. The term policy has hereby been defined as "the course(s) of action" that the Government intends to follow on certain issues. Three main areas were investigated and these are the Government's policy on Rural Development, water in general and finally the policy on Arid and Semi-Arid Lands (ASAL). In each case, the key issues related to water supply have been highlighted as well as the extent to which public participation has been involved.

3.1 GOVERNMENT POLICY ON RURAL DEVELOPMENT.

The term rural development has been defined to mean different things depending on the area and context concern. But generally the term assumes that the standards of living in rural areas are lower than in urban areas and recognises the need to raise and improve ways of life there. In the context of this study the most appropriate definition of rural development is the one by Chambers in which he defines rural development as:

"....a strategy to enable a specific group of people, poor women and men, to gain for themselves and their children more of what they

want and need. It involves helping the poorest amongst those who seek a livelihood in the rural areas to demand and control more of the benefits of development. The group includes small scale farmers, tenants and the landless".

Chambers, R.; 1983; p.147.

Chambers adds that the initiatives start with outsiders but the aim is to transfer more and more power and control to the poor.

While Chambers' definition looks at rural development as transfer of power, to make decision, from the powerful to the rural poor, the committee on Human Environment in Kenya sees rural development as a holistic concept whereby a series of quantitative and qualitative changes occurring among a given rural population and whose converging effects indicate in time a rise in the standard of living and favourable changes in the way of life (Ominde, S.H.; 1971; p. 6).

In Kenya the idea of rural development was borne of the Kericho Conference in 1966 where social scientists, government planners, administrators and other leaders met to discuss related issues in education, employment and rural development. One of the points made was that the Government should develop a comprehensive approach to rural transformation which would include short term measure to promote agricultural productivity. A special programme, the Special Rural Development Programme, was launched in which a series of small pilot projects were established to

test the concept of integrated rural development.

A review of Government Policy shows that little direct attention was paid to rural development in the first Development Plan for 1966-1970 and also in the Sessional Paper No. 1 of 1965 on which most parts of the Development Plans are based. Development trends continued in the same direction as in colonial times whereby interests of the rural areas were relegated to the progress of urban areas and the export economy.

The rate at which the urban population was growing, due to natural growth and to rural urban migration attracted by higher wages and better facilities in the urban areas, was much faster than the Government could cope with in terms of providing the necessary facilities and infrastructure. The Government therefore saw the need to improve conditions in the rural areas as a way of checking migration to urban areas. It is for this reason that the second Development Plan for 1970-1974 incorporated the policy for regional development under the strategy of directing an increasing share of total resources available to the nation in the rural areas. The same strategy was adopted and strengthened in the third Development Plan for 1974-1978 by reinforcing the process of decentralisation of development planning and implementation to the district level.

The objective of the rural development strategy was to improve the overall standards of rural life at least at a

rate faster than the rate of increase in average incomes in the country. This did not just imply raising incomes but also other services such as education and health towards those levels that existed in the urban areas. One of the programmes adopted, and which other than education, had the most significant impact on rural areas was seen to be the Rural Water Programme whose target was to bring a safe and reliable water supply to an additional two million people in 1978; bringing the total of those served with piped water in the rural areas to three million.

The fourth Development Plan for 1979-1983 also recognised the need to continue with rural development strategy but gave special reference to the development of ASAL regions. This was because of the realisation that the problems of such marginal lands, be they social, economic or environmental, here complicated enough to warrant integrated approach and a high degree of co-ordination among various Government ministries. The Ministry of Agriculture was to play a major role of developing programmes and establishing co-ordinated procedures for ASAL. Planning was on regional basis (on the basis of major watersheds and agro-climatic areas) but implementation was on district basis, relying on established administrative systems and ensuring local level participation in assessing the needs and priorities.

The components of rural development policies were summarised in the fourth Development Plan as:-

- i) Increased rural production and income.
- ii) Increased equity in the distribution of this income.
- iii) Increased access to services.
- iv) Increased participation and decision making.

The policy regarded providing the low-income groups with access to opportunities and basic needs (water included) as central to the success of this strategy. The Government therefore undertook to increase disperse facilities for education, health and other social facilities more widely. In this respect, the nomadic people in ASAL areas were given the highest priority. Secondly, the Government was to allocate more resources for the identification of appropriate technology for those with limited resources in rural areas while accelerating the development of water and power resources. All these efforts were aimed at increasing productivity and hence incomes of the rural population and also at enhancing attractiveness of rural living and consequently checking rural-urban migration.

Although it does not say so in so many words, the strategies and policies of rural development in the current Development Plan for 1984-1988, the plan tends to continue with the same trends as in the previous plan as far as rural development is concerned. The Plan however stresses the need for the recognition that rural and urban areas are highly inter-dependent. The latter provides markets for rural production

and is the source of inputs for rural activities and consumer goods for rural households. On the other hand the dependence of urban areas on rural areas is even greater because the urban areas do not have the opinion of providing their own subsistence needs. To a large extent therefore, the rural areas provide urban areas with the necessary raw materials for manufacturing and service industries which influence the economic base of any urban centre.

3.2 GOVERNMENT POLICY ON WATER SUPPLY

A study done in 1977 reviewed that in Kenya, the geographical deficiency of water is worst in Coast Province as far as general access to water is concerned, with 71 percent of its rural households being within 2 km of a source (Ghai, D.; 1979; p. 39). But in terms of access to piped water the province, due to its being highly urbanised, is leading with 42 percent of its population having access to water in any dry season. Western Province, however, has negligible piped water supply but universal access to water of some kind. Central Province was near the top whatever indicators were used, while Eastern Province was near the bottom in all cases. These figures do not of course consider the nomadic areas especially in North Eastern Province.

The same study also revealed that 85 percent of rural households in Kenya (outside nomadic areas) were within 2 km of a source of drinking water of some kind but only 15 percent had access to piped water. Further disaggregation

showed that the following groups suffer particularly from deficiencies in water supply:

- i) the poorer small holders
- ii) small holders in low potential areas especially Eastern Province (this study area would also fit in this category).
- iii) rural wage earners and landless in high potential areas.
- iv) pastoralists.

It also follows that these same groups are the ones whose productivity and incomes are lowest in the country.

It was also found out that in the rural areas only the prosperous farmers were able to afford individual connections (which in terms of number of users, the amounts of water consumed, time saved, energy conserved, possibilities for off-farm use, hygiene potential and avoidance of contamination risk and reliability of supply are superior to communal points). Also, only the more prosperous communities are able to finance the construction of self-help communal water points. Where rural production and incomes are low, the Government has provided subsidised communal water points giving priority to the most deprived areas.

One of the Government's programmes for supplying water to rural areas is the Rural Water Supply Programme which has several characteristics of a basic need activity. For

instance by providing water to the rural people, it achieves one of a core-basic needs, it also raises indirect productivity and works best if self-help groups are involved. The aim of the programme is geared towards the Government's official target of providing safe water from whatever source to the whole population by year 2000 A.D.

Due to inadequacy of Government's funds to meet all the water supply requirements, the 1977 study recommended that Government's role is restricted to installation of the primary system while secondary and tertiary distribution systems are installed by local communities on self-help basis. The number of individual connections should be limited and more emphasis be given to communal water points also constructed on self-help basis. The operation and maintenance costs to finance this kind of water supply programme was estimated to be between K£16.5 million and K£18.5 million by year 2000 at 1977 prices (Ghai, D., 1979; p. 39).

Financing these recurrent water expenditures is a problem and as a result planners tend to prefer individual connections for they are easy to collect revenue from, while it is almost impossible to do the same with communal water points. Secondly, organisers of self-help schemes assume rightly that the Government should meet these costs and hence there is wide resistance by consumers to the idea of paying for water. On the other hand, if Governments cut off supplies or cease to maintain the schemes, the whole purpose of the schemes would be defeated.

One solution to this problem has been found in construction of water kiosks at communal water points from where water is sold to individuals. The kiosks are found to be advantageous in that they:-

- i) solve the revenue problem
- ii) prevent damage to water points by vandalism.
- iii) limit waste of water, and
- iv) encourage individual connections.

This move has however been found to be inconsistent with the strategy of meeting basic needs unless certain designated poor areas are given free communal water. This would also mean extra costs because monitoring personnel would have to be employed.

Secondly, even after revenue collection the amounts collected would only meet one tenth of the expected operation and maintenance costs of the programme as a whole (Ghai, D.; 1979).

One of the major problems experienced in Rural Water Supply Programme was lack of skilled staff and the study therefore recommended intensive training. In order to meet the needs of the expanded programme, the study recommended that the training should raise the number of trained employees as shown in table 3.

Table 3: Recommended Staff Training.

CADRE	1977	1985	1999
A: For Operation and Maintenance:-			
i) Inspectors and assistant inspectors	120	421	1878
ii) Operators of all grades	350	1890	4550
iii) Pumps and treatment works attendants	400	1660	5460
iv) Site and Headquarters artisans	?	2740	5690
B. For Development:-			
v) Professionals (planners, designers, engineers etc)	258	480	2000
vi) Technical staff, formen and artisans	131	277	1040
vii) There would also be need for increasing the number of administration staff.			

? means the number was "unknown".

Source: Ghai, D.; 1979.

The first Development Plan (for 1966-1970) recognised that water should be treated as an important natural resource which should be carefully planned with a view of enhancing its contribution to economic and social welfare. The plan was concerned with the provision of water for human and animal consumption, for irrigation, for manufacturing and power development, among others. It also recognised the need to provide adequate and clean water

to rural areas which had been previously ignored by the colonial government. However, one obstacle to this desire was seen as the heavy investment in such undertakings especially in areas of low productivity. The water development scheme therefore divided supplies into:-

a) Township supplies;

Because of high growth rates in urban centres there was need to maintain and expand the existing supplies. Local authorities with strong economic base would be expected to finance their schemes with loans from the Central Government through Local Government Loans Authority (LGLA). Smaller towns unable to finance or operate water supplies were to continue to be served by using Central Government's resources until they were able to take over.

b) Rural Water Schemes;

Since inhabitants in rural areas were not able to raise the necessary capital to finance water supply projects, it was recommended that the Government makes funds available by loan or grant according to financial capabilities of particular areas. Once loans have been repaid and the costs of maintenance met, the balance of the revenue collected from the sale of water was to be put back into further development. Therefore such schemes were to be established on commercial

basis as:-

i) Sub-economic rural projects - whereby the effort to provide water to low productivity areas especially arid areas was the concern. These were seen as being essential for improved livestock management upon which economic development of these areas largely depends and for development of ranching lands of Kenya. The Government had of course realised that the economic returns of these projects was not great enough to enable loans to be repaid on commercial terms and that some subsidy from the Government in the form of low interest loans or capital grants was required.

ii) Economic rural projects:-

These were for the more fertile areas of the country and were expected to result in substantial economic benefits. They were also expected to improve the productivity by small farmers and hence increase their farm income, improve their health and be convenient to all users.

c) Water Resources Surveys and Ancillaries:-

These were to ensure the continuing development of Kenya's water resources by for example carrying out hydro-meteorological surveys for the catchments of certain areas especially the five water catchment regions in the country.

The second Development Plan for 1970/1974 revealed the achievement of water supply to be that 15 percent of the rural population had access to piped water, but still most people had to spend 3-4 hours carrying water especially from distant streams, ponds or wells. The Government realised that this diverted tremendous time for other possible activities e.g. cultivation, animal husbandry, more intensive child care and necessary leisure. The Government objective therefore became to provide water so that it releases from $\frac{1}{2}$ - $\frac{3}{4}$ of the time spent on water collection in rural areas. Government also recognised provision of water as a fundamental condition for rural development and hence mounted the Rural Water Supply Programme whose objective was to bring acceptable water supplies to all the rural households by year 2000 A.D. On health, the status was that poor health was eminent in rural areas due to lack of clean water but was also picking up in urban areas especially in slum and squatter settlements without standard water systems and sanitation.

The major elements of the water policy in this Plan were therefore:-

- i) To undertake vigorous expansion of water installations in the rural areas, both for human needs and animal husbandry.
- ii) To ensure that growth of urban systems was sufficient to meet demand, and
- iii) To improve the state of knowledge of the

country's water resources and hydrology and to develop adequate long-term Master Plans for urban and rural water development.

The rural areas were found to be unable to meet their water requirements due to the local authorities not having enough technical and financial resources for it, funds were also insufficient while shortage of skilled manpower and an inadequate central organisation for water development made the position even worse.

The Government therefore saw the solution to these problems in providing water communally at spacings appropriate to the areas in which they were placed. Also the major piping system was to be made large enough in order to cope with larger volumes if and when individual connections were found to be possible at a later date. Water was also to be connected from all available sources from simple rock catchments, wells, boreholes and piped supplies both gravity and pumped types.

During this Plan, the Government also planned for a long-term national programme which guided rural water development also in subsequent plans. The National Master Plan for water development had the functions of:-

- i) assessing potential demand,
- ii) determining criteria for scheme selection,
- iii) designing standards
- iv) indentifying projects

- v) establishing firm programmes, and
- vi) forecasting requirements for finance and manpower.

The water Development Division of the Ministry of Agriculture was incharge of collecting fees for water at a flat rate for individual connections. Unless otherwise metered, amounts depended on income levels. Where the number of consumers was large enough to justify necessary operating costs, as in larger rural centres, water was sold in water kiosks.

Where possible, self-help activities were employed to contribute substantially towards improvement of water supplies in rural areas. The Water Development Division's technical staff were to work with the community development officers in promoting and assisting such projects.

In the third Development Plan for 1974-1978 the position was still bad with only one million people in the rural areas having access to safe water (Ghai, D.; 1977 p. 39). The Government therefore made the target at 3 million people by the end of that development plan period. Besides the supply of water, other benefits to be accrued by the people included higher cash incomes, more secure subsistence, improved health and increased leisure time. This called for a strategy that integrated water development with programmes and projects in other sectors. Basing agricultural potentiality on amounts of rainfall received per year, the country was subdivided into the following potentialities:

Table 4: Kenya's Agricultural Potentiality.

Area	Percent of Country	Rainfall received p.a.
i) High potential	12	7850 mm
ii) Medium potential	5.5	600-800
iii) Low potential	74	600

The rest of the country (8.5 percent) was classified as being of range potential

Source: Development Plan 1974/1978.

Since previous Plans had already highlighted the difficulties and disappropriate costs of attempting to collect user charges at communal water points, standards were set for maximisation of Government subsidy so that communal water points were to serve only domestic and livestock needs were provided at:

- a) 2 km radius in high potential areas,
- b) 5 km radius in medium potential areas,
- c) within an appropriate larger radius in areas of low potential and sparse population.

Fees were also charged for individual connections and were to comprise of an installation charge and a monthly user charge to meet costs of maintaining and operating rural

water supply projects. There were five programmes involved in the construction, maintenance and operation of water supply development in rural areas:-

- 1) New rural supplies were undertaken by the Water Department of Ministry of Agriculture.
- 2) Water Supply for settlement schemes was funded by Department of Settlements in the Ministry of Lands and Settlements.
- 3) Livestock Development programme by the Ministry of Agriculture.
- 4) County Councils Water Supplies
- 5) Self-help Water Supplies.

In 1974 a Ministry of Water Development (MoWD) was created as a principal agency for management, development, operation and maintenance of water supplies, sewerage disposal and pollution control. This was in recognition of the great importance of water in promoting health, sanitation and economic growth. The Ministry then took over rehabilitation of County Council water supplies programme and some 800 rural water schemes of which 600 were not functioning (Development Plan 1979-1983; p. 195).

By the time the fourth Development Plan was drawn up, only 1.5 million people were being served by an improved water supply (as opposed to the targeted 3 million by the end of the third Development Plan period). The problem was

recognised as not being due to total quantity of water available but due to storage and distribution facilities. It was also realised that the costs of inputs to the water development programme had outstripped the rate of increase in resources available for the same. Water development activities had to compete in scarce resources at a time when other very pressing needs were emerging and making their claims.

The Government policy was therefore limited to rehabilitation of existing schemes found either functioning inadequately or not at all, or those schemes whose design features were poorly suited to the location of the scheme. The Government was also to be involved in a water conservation programme which was concentrating its activities on marginal areas where settlements were taking place (Karai was one such area), and in areas with population densities of less than 40 persons per square kilometer.

The Government was to ensure that the maximum walking distance to fetch water was 5 km in these areas. This water conservation programme was also to be integrated with soil conservation, afforestation and reafforestation.

The current Development Plan for 1984-1988 shows that the coverage of water supply is between 4 percent in Eastern Province and 20 percent in Central Province. In 1975 rural women used to spend up to 1/5 of their time collecting water and covered average distances of 3.4 km. The same Plan

states that by 1984 water had moved closer towards rural households so that for most regions, average distances to sources of water have been halved so that no region is more than 1.8 km away from a water point in the dry season.

Just like in the previous three Plans, the current one still maintains the broad goal of providing water of good quality, in sufficient quantities and close proximity to the whole Kenyan population. The objectives of the Plan are similar to those of the fourth Plan which are:-

- i) Provision of potable water to all, balancing supplies between human needs, requirements for livestock and the needs of the industrial sector.
- ii) Management and development of water resources to achieve multi-purpose development goals e.g. flood mitigation, hydro-electric power generation, irrigation and drainage, recreation and wildlife conservation, and minimising deleterious environmental effects.
- iii) Development and control of waste water to reduce pollution in the rivers and lakes as well as in water catchments.
- iv) Adoption of water distributive practises and pricing which will ensure that social objectives are not ignored.

- v) Provision of incentives to efficient water use and penalising wasteful or environmentally harmful water-use practises, and
- vi) The recognition of principle of "cost-sharing" where the beneficiaries also contribute to provision and maintenance of water services.

c) The strategy for urban areas is towards provision of metered individual connections to all properties and to develop adequate water-borne sewerage disposal facilities. In rural areas, the strategies aim at:-

- i) Providing water facilities at intervals of 1 km in the high and medium potential areas and at 5 km in low potential areas. Those requiring individual connections would do so at their own expense. Priority is also given to those self-help water programmes approved by District Development Committees (DDCs) in accordance with the "District Focus" approach to rural development.
- ii) The provision, operation and maintenance of water supply facilities is also to be undertaken on "cost-sharing" basis where Government and beneficiaries contribute. Those farmers able to employ cost-effective technologies such as roof catchments, wells and the construction of small rural dams and ponds are encouraged to do so.

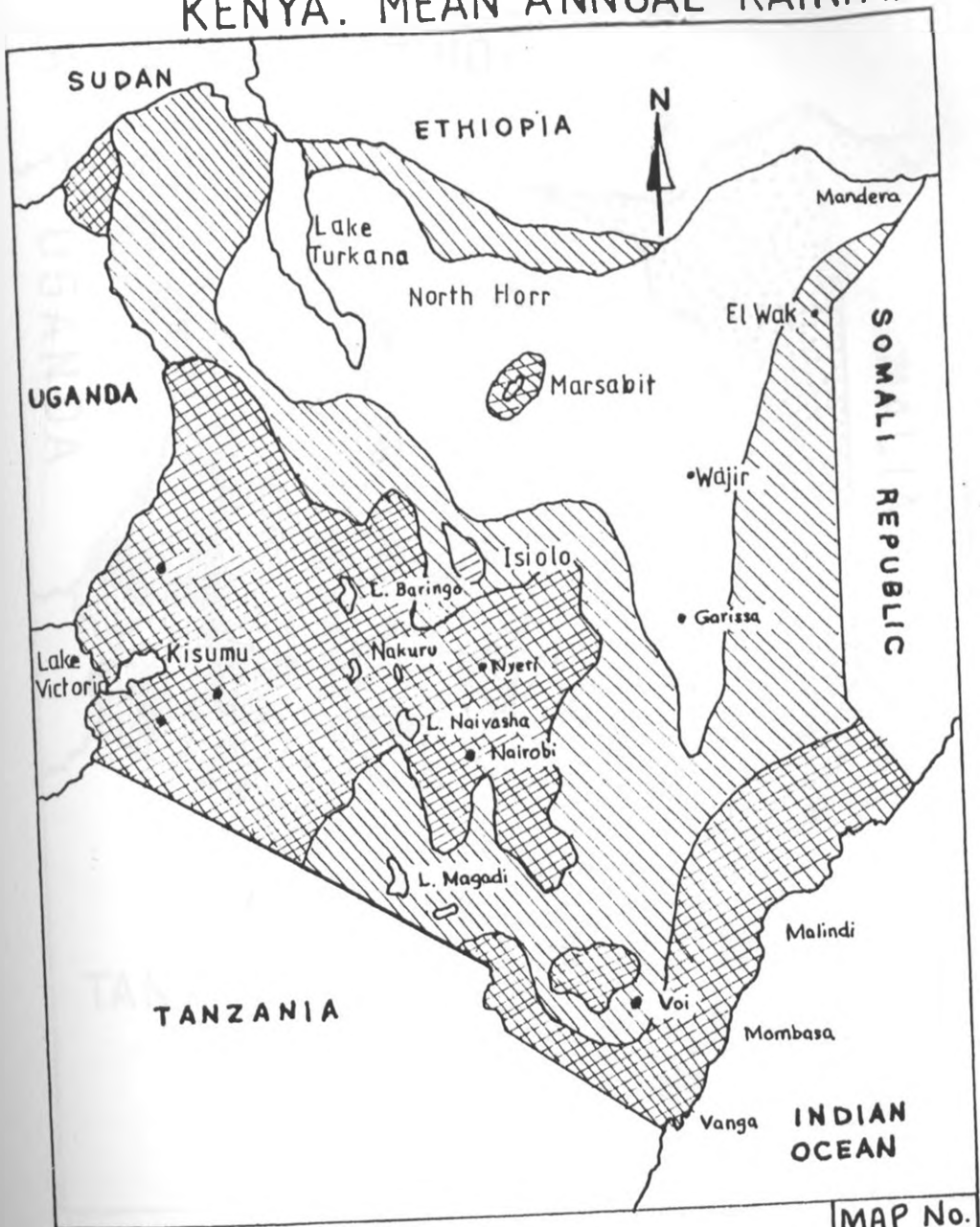
- iii) A review of today's standards, which seem to be too high in relation to needs and costs, aiming at new standards that are cost-effective and have large coverage with the available resources is also being undertaken.
- iv) A review of pricing policy so that rural water rates cover at least the direct operation and maintenance costs of rural supplies.

The Government also intended to undertake two programmes. The first one is the livestock water supply programme as an integral part of comprehensive programme for livestock development in the range herding and ranching areas of the country (relevant for Karai Location). The second programme is the Integrated ASAL Development Programme (Ndeiya and Karai Integrated ASAL Development Programme - NKIDP - is one of them), paying particular attention to the completion of already started projects in Machakos, Baringo, Turkana, Laikipia and Samburu, and new Programmes in Embu/Meru/Isiolo and Kwale/Kilifi projects.




3.3 GOVERNMENT POLICY ON ARID AND SEMI-ARID LANDS.

Arid and semi-arid lands (ASAL) have been defined as those parts of the world where the rain is insufficient or barely sufficient for satisfactory crop growth in most years. Arid lands between the Tropics correspond with those receiving between about 25 and 200 millimeters (mm) annual rainfall while semi-arid lands approximate to those areas with mean annual rainfall totals of 200-500 mm (Hutchinson, J.; 1977); (Map No. 3).

KENYA: MEAN ANNUAL RAINFALL



LEGEND

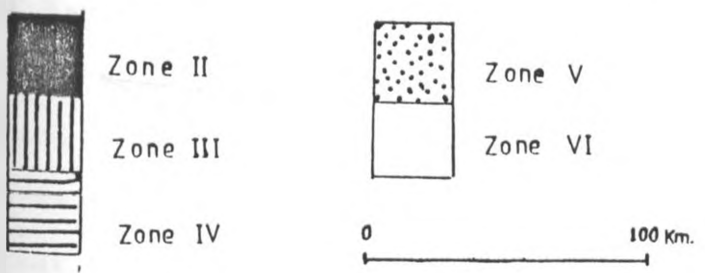
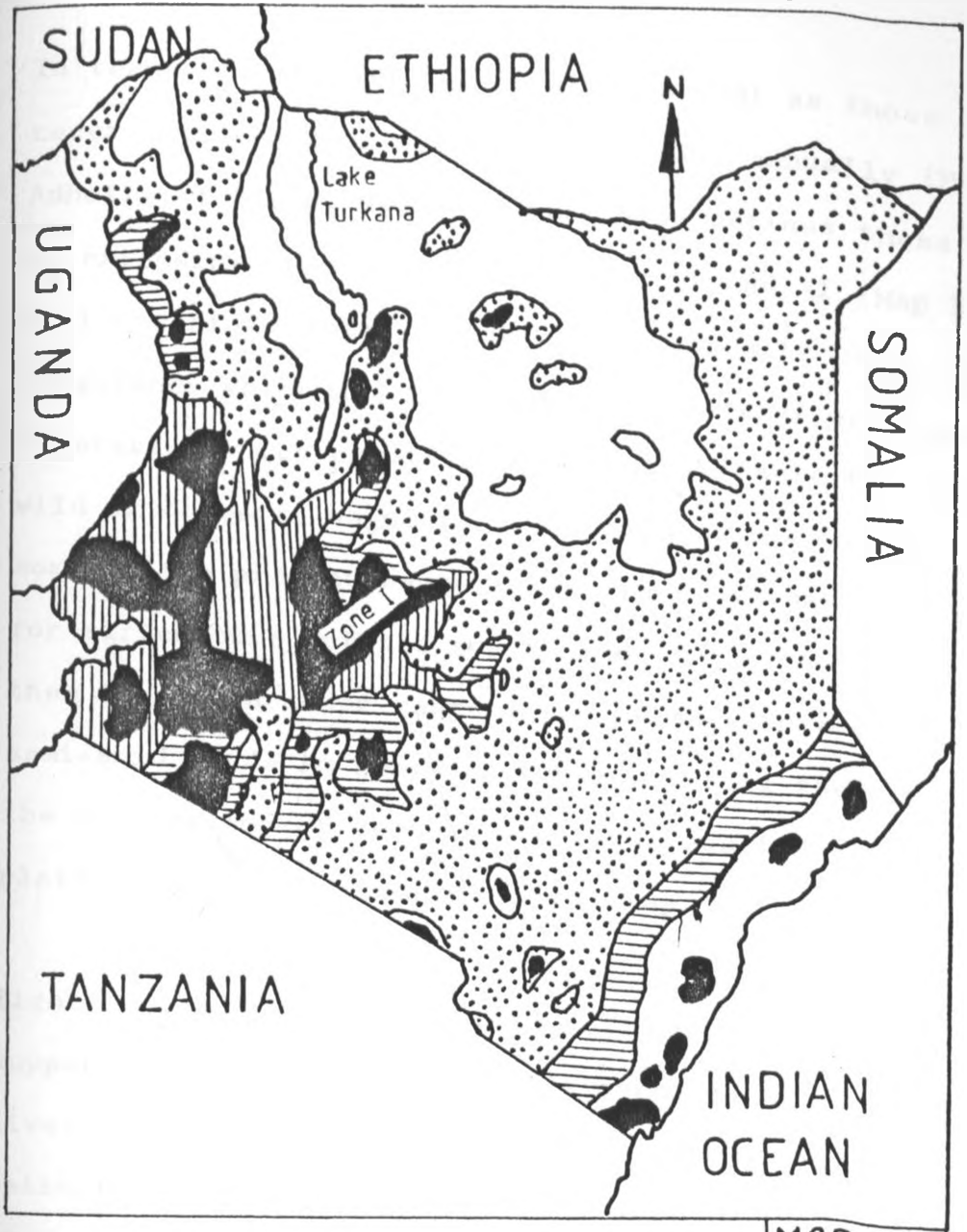
-  Over 500mm.
-  250-500mm.
-  Under 250mm.

0 100 Km.

MAP No. 3

Source: Mwangitu and Njue

-63-
KENYA: ECOLOGICAL ZONES



MAP No.
4

NB. Zone I is found on the mountain tops

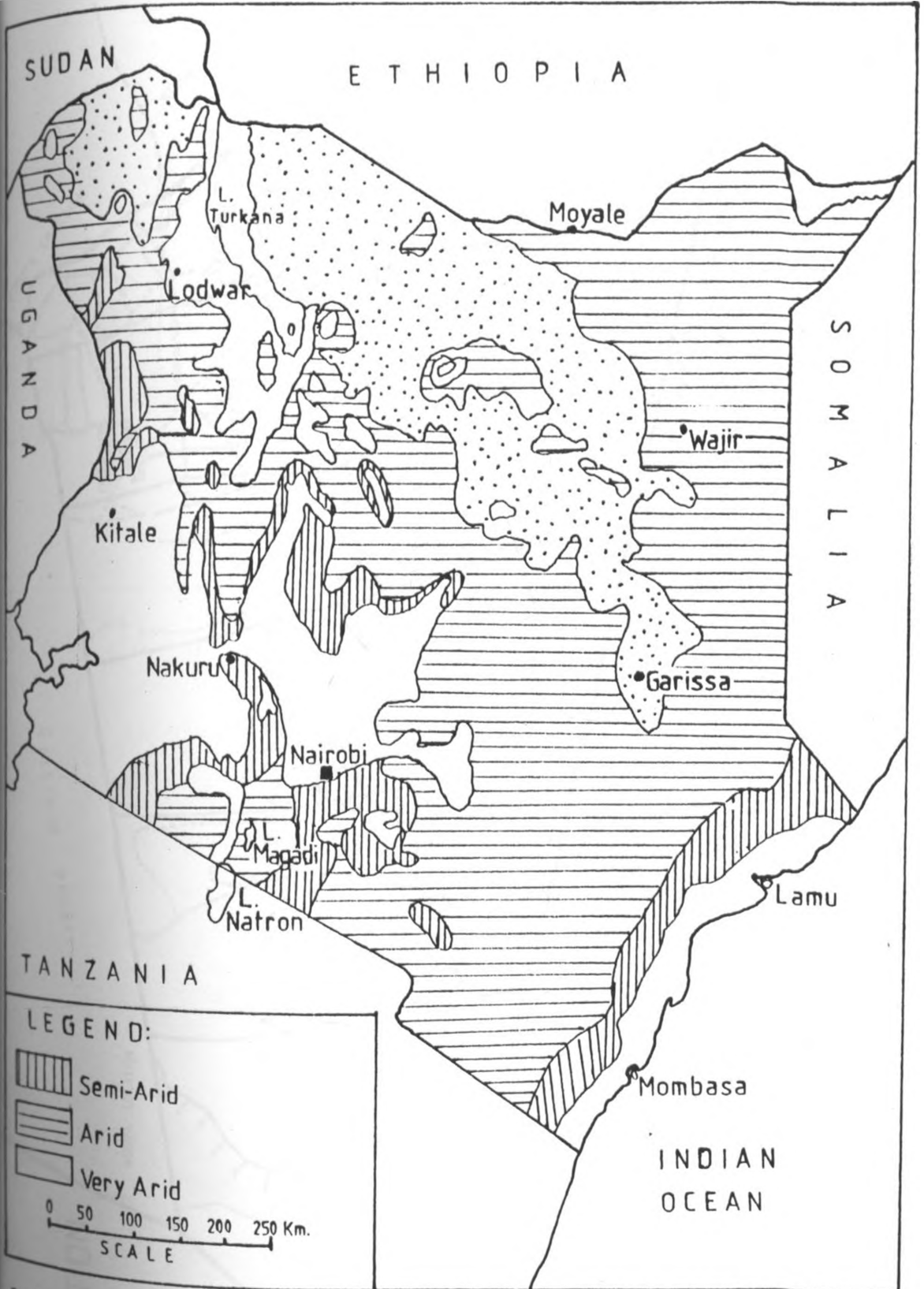
Source: Mwangi and Njue

In terms of rainfall, Kenya defines ASAL as those lands receiving less than 800 mm of rainfall annually (Migot-Adholla; 1980; p. 98). Adholla also defines these areas as extending from ecological zones IV and VI (Map No. 4). In terms of land-use, these areas generally comprise the rangelands which are lands carrying natural or semi-natural vegetation which provides a habitat suitable for herds of wild or domestic ungulates. Adholla also cautions that some of the present range areas in Kenya have a potential for agriculture but the scanty and erratic rainfall forces them to remain under range use. He therefore delineates semi-arid lands in Kenya as those covering the area around the core region of central highlands and the western sloping plateau bordering Lake Victoria (Map No. 5).

Eighty percent of Kenya's land falls under ASAL category supporting 20 percent of Kenya's population and half of its livestock (Sessional Paper No. 1 of 1986). Migot-Adholla estimated this at three million people in 1980 and 75 percent of Kenya's land area. ASAL regions have a fragile environment; easily degradable as more and more people move into them, from over-crowded lands of medium and high potential, in search of land. These areas are also characterised by great heterogeneity in vegetational, soil and climatic variations (Map No. 6).

Where rainfall is as scarce as described above and there are no surface water bodies (like in Karai Location), underground sources of water, some of them artesian or sub-artesian, have

KENYA: ARID AND SEMI-ARID LANDS



Source: Obara, E. O. (1980)

MAP No.
5

RAINFALL DISTRIBUTION

LIMURU DIVISION

NDEIYA LOCATION

LOCATION

RENGUTI

KIKUYU TOWNSHIP

NACHU GRAZING ZONE

MUSLIM KARAI

NACHU

Nyakumu Swamp

Nachu Dam

Nachu police post

BM 2717

GIKAMBURA

BM 3273

GIKAMBURA

BM 4063

BM 3257

LUSIGETI

Chief's camp
Health Centre

Riu Swamp














KINDO LOCATION

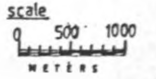
KAJIADO DISTRICT

KAJIADO DISTRICT

KAJIADO DISTRICT

LEGEND

-  BOREHOLE
-  DEPRESSION
-  MAJOR ROAD
-  MAIN TRUCK MOTORABLE
-  SUB-LOCATION BOUNDARY
-  LOCATION BOUNDARY
-  DIVISION BOUNDARY
-  PROVINCIAL BOUNDARY
-  ESCARPMENT
-  RIVER
-  TRACK AND FOOTPATH
-  SWAMP
-  ISOHYETAL LINE (RAINFALL IN MM)



KARAI WATER SCHEMES

NGARI, PN. (MRS) MA. (PLANNING) II 1987/88
UNIVERSITY OF NAIROBI
DEPT. OF URBAN AND REGIONAL PLANNING

MAP 6

-99-

been heavily exploited for watering stock, for irrigation and for industrial and domestic use. Where irrigation is practised using sub-surface water, the large volumes required for irrigation can lower water tables, necessitating the deepening of wells and boreholes and the installation of more powerful and expensive pumps.

Because of such impacts, as mentioned above, it is found that in semi-arid areas, away from perennial water bodies water can only be provided for non-luxury domestic use, livestock watering and possibly for limited extension irrigation of some crops grown primarily as dry farm crops relying on more secure short rains.

Such supplies can meet the needs of pastoralists and villagers whose essential needs per person or livestock unit are only about 25 litres per day and a single well yielding 5,000 litres an hour can supply the needs of a village or the cattle likely to be within walking distance of it. But such a well could only irrigate a hectare or two in the dry season.

In spite of such obstacles in development of semi-arid lands as the costs resulting from water scarcity and the hazards of drought, they have continued to attract people from more highly populated areas.

The vegetation cover is readily cleared for agriculture and with the low amounts of water from the rains, a wide

range of crops are grown. These crops include both annuals like cereals and pulses, and perennials such as citrus fruits, vines, olives figs and dates in the more winterly lands - having winter rain and then sunshine. With water from underground sources or rivers from more humid neighbouring regions, such crops yield more readily than anywhere else in the world (Hutchinson, J. 1974).

As per findings of this study, cereals especially maize and pulses (beans and peas) have very high yields in the study area when occasionally the rainfall is sufficient or when compared with yields obtained by those few farmers who have sufficient water to irrigate their dry-farm crops which they plant anticipating the short rains but the rains fail. Some farmers have also tried to grow oranges and they get good yields if they are well watered.

However, as the population of Kenyas marginal areas has increased both through natural population growth and immigration from the higher potential areas, so has the conflict over land-use and viability of productive systems a vital issue in development planning. The complexity of these issues makes it difficult to come up with solutions the result of which is rapid deterioration in the human conditions in these areas.

One reason why attempts at the development of the marginal areas have failed is because there is a basic bias in policies which favour high potential agricultural areas.

Measures recommended for the development of marginal areas have often been uncritically borrowed from those that have succeeded in water areas. Secondly, their implementation has often been half-hearted, resulting to a number of semi-arid areas becoming increasingly "welfare" recipients, "abandoned in effect to the largess of government relief agencies, charitable organisations and crash programmes designed to remove the symptoms rather than the essential causes of the recurrent food shortage and economic stagnation" (Adholla 1980; p. 98). Adholla suggest that solutions to these problems require clear commitment and long range planning which must take a rational account of the economic needs and ecological constraints of marginal areas.

Although drought-coping is carried out within the Ministry of Agriculture (formerly Ministry of Agriculture and Livestock Development) in Kenya, it appears that except for a lot of academic literature on drought affected areas there are no definite policies directed at ASAL. None of the literature is directly concerned with formulation of Government policy and of planning and implementation (Odingo, P.S.; 1985; p. 24). Odingo views droughts in ASAL from two angles:-

- i) Climate and climatic variability and
- ii) The human impact and its direct links with drought causation.

Odingo further contends that in Kenya it has been possible to realise real agricultural growth in high and medium potential areas using an array of well tuned technological packages and it should be possible to do the same for ASAL provided sufficient care is taken to provide for more climatic variability. What these writers are saying is that the orientation of Government's agricultural development strategies and policies for ASAL is crucial.

In this respect, the Government, in the Sessional Paper No. 1 of 1986, recognises that ASAL regions present a potentially important resource which if managed carefully can help serve the income, employment and food self-sufficiency goals of the nation. The paper hence spells out the elements for continued development of ASAL as follows:-

1. Livestock is the basis of ASAL economy. Central to this are measures to improve breeding of sheep and goats, to develop stock routes and water supplies and to control livestock diseases. ASAL regions should also be linked to other higher potential areas by intensifying a programme under which ASAL herders produce immature animals for fattening in high potential areas.
2. Crop research and development will focus on drought-resistant crops and suitable grasses to prevent erosion.

3. Small-scale irrigation, if suitable and inexpensive technologies can be found, could help provide food security. Exploitation of subsurface water, dams to conserve run-off water, and roof catchments will all be explored as ways of tapping water resources.
4. Environmental protection will be essential to maintain a viable economy in ASAL regions. Reafforestation will serve the three purposes of protecting watersheds, preventing soil erosion and providing fuelwood.

Kenya started a formal ASAL development programme in 1979 funded largely by donors. The Government has since then occasionally been required to assist financially, usually outside its budget. For budget rationalisation, these programmes require to be brought within the system and given scrutiny similar to all other development projects. Because these programmes are district specific they should be managed within the system of District Focus for Rural Development Strategy. The programmes should also be integrated into policies for rural-urban balance as their resources, if well developed, can make an important contribution to furthering the goal of rural urban balance in Kenya. The Ndeiya and Karai Integrated Development Programme is one of the ASAL programmes and deals with the provision of water to Ndeiya and Karai Locations sponsored by Netherlands Government in collaboration with the Kenya Government.

In general, one of the most critical issues in the development of ASAL is the integration of water development and other aspects of development planning. Each stage of project design needs to incorporate water planning perspectives and each stage of implementation needs to incorporate land, water and other resource use.

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C H A P T E R IV

STUDY AREA

4.0 LOCATION AND SIZE

Karai Location is situated in the South Eastern corner of Kikuyu Division which is to be found on the south-eastern boarder of Kiambu District (Map No. 2). To the north and north western side, Karai is bordered by Ndeiya Location in Limuru Division while to the north-eastern side is Kikuyu Location and Kikuyu Township. To the south and south-eastern side is Kajiado District.

The location lies between longitudes $36^{\circ} 30'$ East and $36^{\circ} 45'$ East and between latitudes 120° South and 115° South. It is one of the locations in Kikuyu Division the others being Kinoo, Muguga, Dagoretti and Kikuyu. Karai Location is subdivided into Karai Muslim, Nachu, Renguti, Lusigetti and Gikambura sublocations (Map 6). The total area that is settled is 32 square kilometers (1979 Population Census Data Book) but the whole location covers 100 square kilometers (Karai Location Rural Development; 1983/84; p. 5).

4.1 POPULATION

The total population in Karai Location was reported to be 18,794 by the 1979 National Census report. Table 5 summarises the distribution of that population by sublocations:

Table 5 : Karai Location Population Distribution.

Sublocation	Population		Total	No. of Households	Area (km ²)	Density/ km ²
	Male	Female				
Karai Muslim	231	248	479	88	3	154
Nachu 786	770	1556	449	339	3	449
Lusigetti	2567	2779	5346	962	10	521
Renguti	1671	1889	3560	673	5	620
Gikambura	3826	4027	7853	1419	11	710
TOTAL	9081	9713	18794	3481	32	Average 587

Source: 1979 Kenya Population Census Vol. 1

The total number of households is 3,481 with an average of 5.3 persons per household although other studies have shown that most households (37 percent) have household sizes of over 7 (Robins, C.; 1985; p. 13). Projected population using the national growth rate figure is expected to be 25,716 by 1988. Further disaggregation using more specific data shows the distribution of projected population per sublocation to be as shown in table 6.

Table 6 : Projected Population per sublocation.

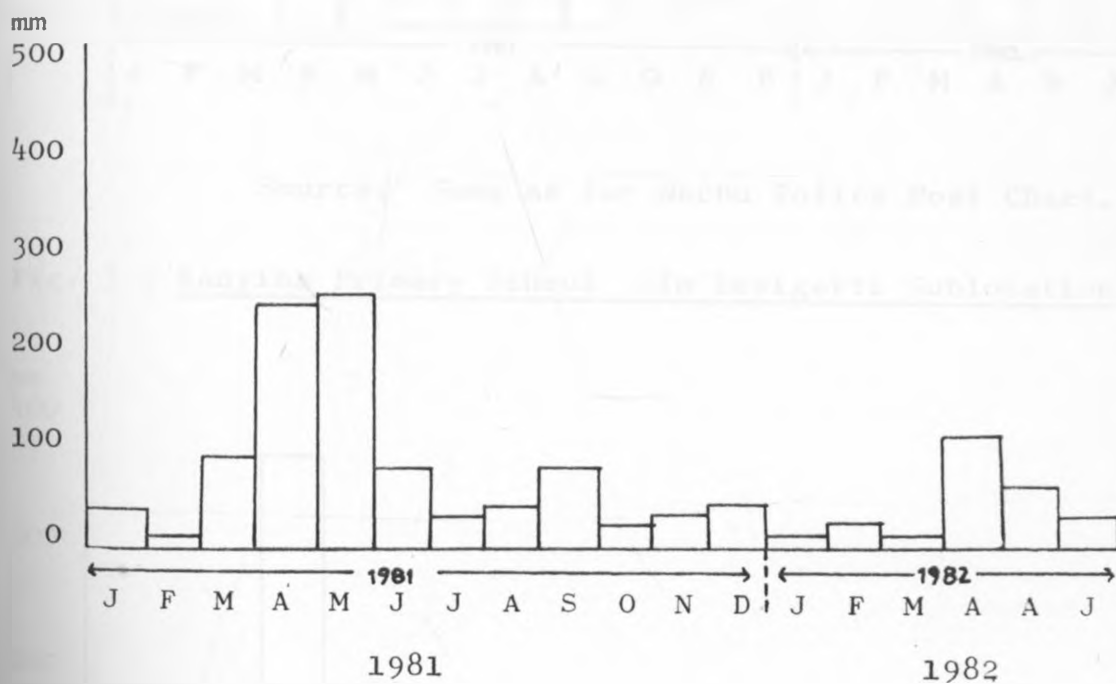
Sublocation	Population in 1979	Growth rate (%)	Projected Population 1987
Karai Location	18794	3.5	24,867
Karai Muslim	479	2	562
Nachu	1556	16	5596
Lusigetti	5346	1	5191
Renguti	3560	1.7	4079
Gikambura	7853	2.5	9592

Source: Robins C., 1985 (for the ° growth rate only).

4.2 CLIMATE

Most of Karai is hot and dry except for some parts of Gikambura and Renguti which are fairly wet and cooler. Rainfall varies between 200 and 850 millimeters per year decreasing gradually from the eastern side towards the west (Map 6). The rainfall charts below give more specific information on the rainfall distribution pattern at certain points within the location.

Fig. 1 : Rainfall chart - Nachu Police Post, 1981-1982.

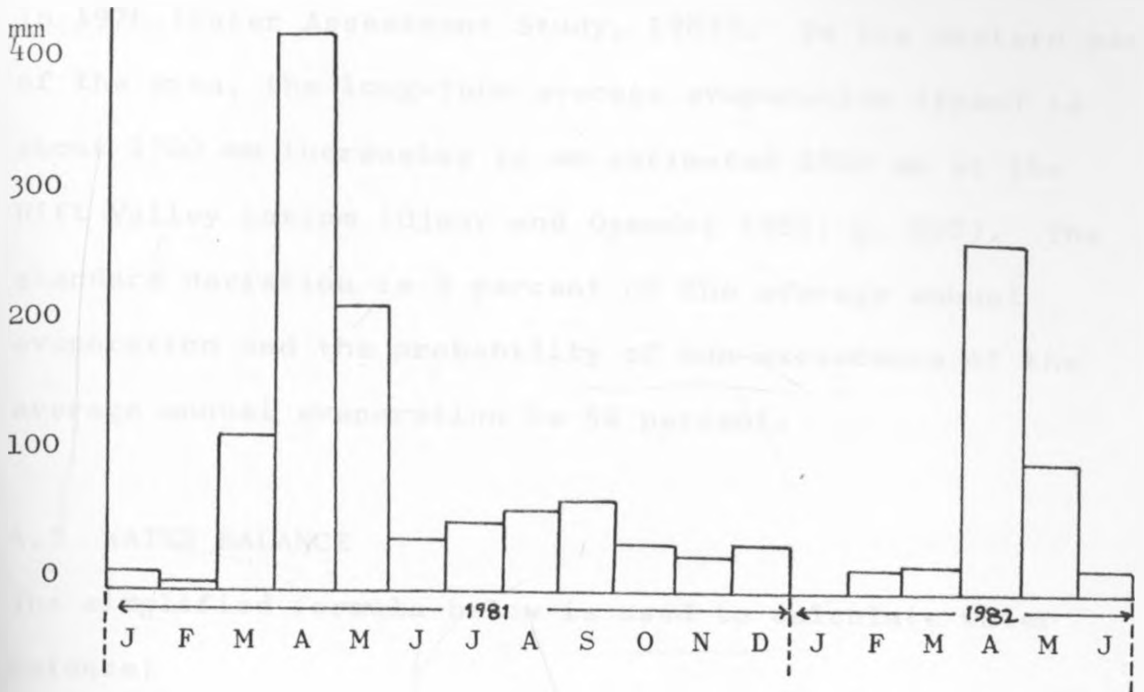


Source: Water Assessment Study for Ndeiya and Karai Locations (1983).

The long rains are between March and May while the short rains fall between November and December. The driest period is during the coldest months (July to August) and the hottest months are January and February.

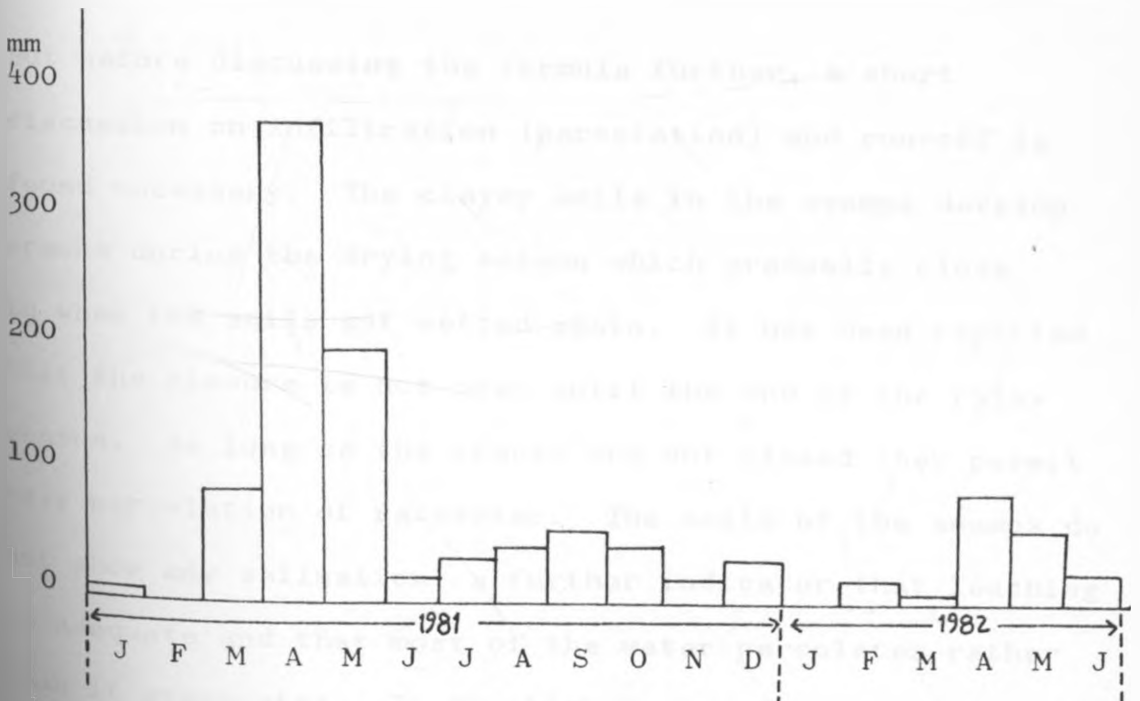
The maximum temperatures are between 23° and 28°C and the minimum temperatures are between 13° and 18°C.

Fig. 2 : Rainfall Chart - Wambaa Primary School - - 1981-82
(In Karai Sublocation).



Source: Same as for Nachu Police Post Chart.

Fig. 3 : Kanyiha Primary School (In Lusigetti Sublocation)



Source: Same as above.

Observed evaporation varies between 2050 and 1460 millimeters in 1976 (Water Assessment Study, 1983). In the western part of the area, the long-term average evaporation (Epan) is about 1700 mm increasing to an estimated 1800 mm at the Rift Valley bottom (Ojany and Ogendo; 1981; p. 228). The standard deviation is 9 percent of the average annual evaporation and the probability of non-exceedence of the average annual evaporation is 52 percent.

4.3 WATER BALANCE

The simplified formula below is used to calculate water balance:

$$\text{Precipitation} = \text{Evaporation} + \text{Runoff} + \text{Percolation} + \text{Change in soil moisture content} + \text{Change surface water retention.}$$

But before discussing the formula further, a short discussion on infiltration (percolation) and run-off is found necessary. The clayey soils in the swamps develop cracks during the drying season which gradually close in when the soils get wetted again. It has been reported that the closure is not over until the end of the rainy season. As long as the cracks are not closed they permit easy percolation of rainwater. The soils of the swamps do not show any salination, a further indicator that leaching is adequate and that most of the water percolates rather than it evaporates. In the higher grounds most of the rainwater infiltrates to become soil moisture which quickly evaporates as soon as the rains are over and the sun shines again.

Drainage is mainly internal whereby numerous isolated local catchment areas can be identified. Most water flows to the said depressions which have no natural outlets. Good examples are Nyakumu and Riu depressions. There is very little evidence of surface run-off and the assumption is that most rainfall evaporates, evapotranspires or infiltrates. The swamps remain dry most of the time even during the rainy season. The only swamp containing surface water throughout the year is in Nyakumu and even then it is only on a very small portion in the north western corner of it, the so called Lake Nachu.

In the study area, surface water retention is negligible (since there are no natural water bodies), therefore this term equals zero in the water balance formula given. Soil moisture content is assumed to be equal throughout the year and hence this term equals zero. Because drainage is internal, surface run-off is also assumed to be zero. This leaves the terms evaporation and percolation to balance against precipitation. Calculations by the Ministry of Water Development (Water Resources Assessment study for Ndeiya and Karai Locations, 1983) show that at least 10 percent of the annual rainfall percolates to the ground in most areas in the location. The rest 90 percent is lost through evaporation or evapotranspiration.

This description is a very simplified form of water balance but it serves the purpose of showing roughly how much of the annual rainfall percolates to the ground and hence contribute to the ground water quantities.

4.4 VEGETATION

Due to the decreasing amounts of rainfall from east to west, the eastern zone at the boarder is covered by luxuriant vegetation of trees and shrubs, crops and grasses, while the western zone has only xerophylic grasses and scattered acacia trees (Plate I). Some ten percent of the area is afforested mainly with Eucalyptus and wattle while dryland scrub type of trees occupy at least 40 percent of the land (Water Assessment Study for Ndeiya and Karai Locations, 1983).

Most of the dominant natural vegetation (shrubs and bush) has been cleared to make way for cultivation and settlement (Plate 2). There are however, especially in the Nachu Grazing zone, remnants of scrub and bush with acacia trees. The swampy depressions are normally waterlogged and the only vegetation found there is species of grass which are resistant to water-logging.

4.5 RELIEF AND DRAINAGE

The area is divided by two major faults into two geomorphological zones. The area between Lari-Ondiri Fault and the Nguirubi Fault is the uppermost or higher zone and its height is between 2000 and 2200 meters above sea-level. This area is also relatively more densily populated. West of Nguirubi Fault is the sparsely populated grazing area which lies between 1900 and 2100 meters above sea-level. The Nguirubi Fault causes an escarpment and the ground elevation drops quickly via many ridges and steep slopes towards Rift Valley.



PLATE I : Natural Vegetation; mainly
acacia trees and xerophytic
grasses.



PLATE 2 : Natural vegetation cleared to give way for cultivation (background). In the middle is part of Nyakumu swamp.

The highlands area and the grazing zone have internal drainage, the most conspicuous basins being Riu and Nyakumu Basins. The bottom of these basins are waterlogged especially because the soils there are clayey and there are also no natural water outlets out of the depressions. Nyakumu swamp (depression) covers an area of 250 hectares while Riu swamp is almost half its size.

4.6 GEOLOGY AND SOILS

Almost all of Karai Location is underlain by Limuru Trachytes which are underlain by Precambrian Basement rocks. The depth of the Basement rocks is not known since no borehole in the area has reached the crystalline rocks. The trachytes are more than 200 meters thick and are rich in feldspars with interstitial quartz. They are also intercalated with clastic deposits, ranging from trachytic sands to conglomerates. In most cases the trachytic lava is weathered as a result of a long period of quiescence between periods of volcanic eruptions. In the area to the east of the study area, red loamy soils are found near the surface as a result of near surface weathering of the Trachytes.

The area is also characterised by a series of faults belonging to the so called "zone of rift faulting" which separates the gently eastwards dipping eastern highlands of the Rift Valley. On the eastern side of the study area is the Lari Ondiri fault system that runs more or less parallel to the Nairobi-Naivash road. West of this system,

the topography descends gradually along a multitude of north-south directed faults towards the main escarpment fault. West of this fault, the surface drops very steeply towards the Rift Valley bottom.

There are a series of prominent depressions which generally occur within the Rift Valley fault zone west of Nairobi area. These depressions range in size from 5-250 hectares, Nyakumu in the study area being the largest. The origin of these depressions is not well defined but they are thought to be volcanic centres or to owe their slopes to collapse of surface where it had been undermined by volcanic action (Saggerson, 1971). Detailed mapping has shown that these depressions are small downthrow blocks of country, often completely bounded by faults. Nyakumu for instance is a down-faulted block adjacent to the North-South trending faults and fractures and has been little modified by erosion. The underlying rocks in the depressions are still Limuru Trachytes of Upper Tertiary Quaternary volcanic period.

The moist-loving seasonal vegetation (in the higher parts) and the swampy vegetation (in the lower parts) gave rise to pedogenesis of which the presently encountered black clays are the end result (van der Wal, 1980). These black clays are of montmorillonite type which makes them shrink while drying and swell when wetted.

The soils in the depressions are mainly a mixture of poorly drained deep black cracking clays (vertisols) and poorly drained deep greyish mottled non-cracking soils (Gleisols and Vleisols). The soils of the swamps do not show any salination indicating adequate leaching so that more rain-water percolates than it evaporates. Due to overcultivation and depletion of natural vegetational cover, the hills surrounding the depressions are showing signs of soil erosion.

4.7 AVAILABLE WATER RESOURCES

Other than the negligible amounts of rainwater, other sources of water in Karai include groundwater and Bathi River water supply. The two are discussed in detail below and then compared with the water demand in the area. Finally a short discussion on suggested alternative sources of water in Karai is given.

4.7.1 GROUND WATER

So far, this has been the main source of water for Karai. Investigations by the Ministry of Water Development have shown that groundwater is usually confined in fault zones of Nguirubi and Lari-Ondiri fault systems. For development purposes, the Nguirubi zone is more promising but in practise the Lari-Ondiri zone has more boreholes. This is because:-

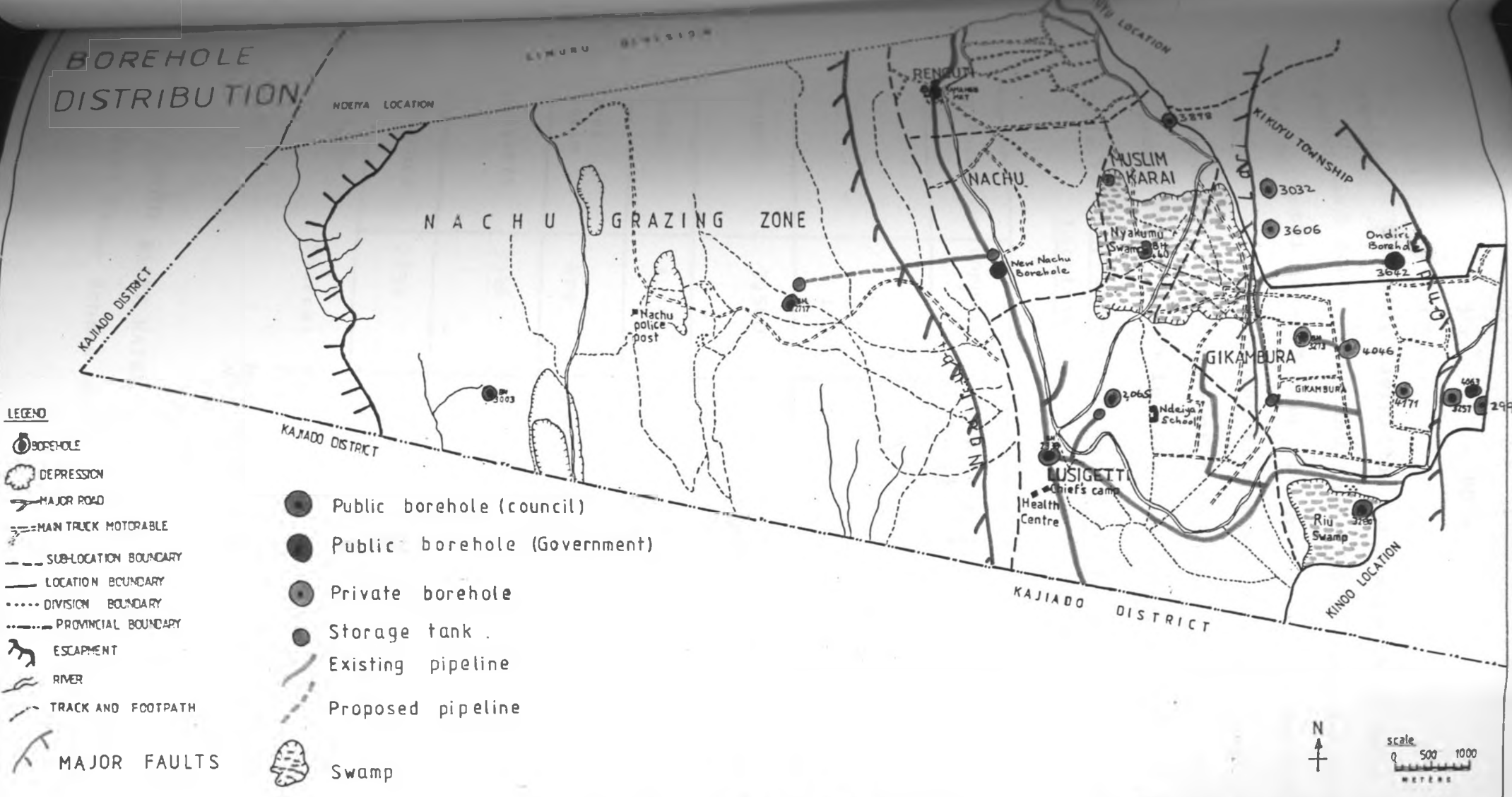
- i) In Nguirubi fault zone, the groundwater is very deep (more than 200 meters below the surface) which means high initial investments.

- ii) The ground elevation in Nguirubi zone is approximately 100-150 meters below the average ground elevation of the supply area, which implies that water has to be pumped with a booster pump over the escarpment.
- iii) Testing the only existing borehole in this zone (C 2758) showed that the yields are fairly high ($13.6\text{m}^3/\text{hour}$). However in 1983 the yield was only $8.8\text{m}^3/\text{hour}$, instilling the fear that this fault zone is more sensitive to overpumping than Lari-Ondiri fault zone.

This has resulted in more boreholes being sunk in the eastern side of Nguirubi Fault (Map No. 7). The quality of the groundwater is found to be good for domestic purposes needing no more treatment than safety chlorination. The boreholes are either owned by groups of few individuals, Kiambu County Council (KCC) or the Ministry of Water Development. In a few cases, people were found to have sunk individual boreholes in their "shambas". At the time of this study there was also the intension of the Government to take over the management and operations of the boreholes belonging to Kiambu County Council.

In the public boreholes, water is distributed via stand-pipes at various water kiosks while some people especially in Gikambura Sublocation have individual connections. Less

BOREHOLE DISTRIBUTION



- LEGEND**
- BOREHOLE
 - DEPRESSION
 - MAJOR ROAD
 - MAIN TRUNK MOTORABLE
 - SUB-LOCATION BOUNDARY
 - LOCATION BOUNDARY
 - DIVISION BOUNDARY
 - PROVINCIAL BOUNDARY
 - ESCARPMENT
 - RIVER
 - TRACK AND FOOTPATH
 - MAJOR FAULTS
 - Public borehole (council)
 - Public borehole (Government)
 - Private borehole
 - Storage tank
 - Existing pipeline
 - Proposed pipeline
 - Swamp

KARAI WATER SCHEMES

-89-

people in Renguti, Lusigetti and Muslim Karai have individual connections and those who do were connected to the Bathi Water Scheme rather than to the borehole supply. In Nachu Sublocation there were no individual connections at the time of this study. Table 7 shows consumption of borehole water per sublocation:-

Table 7: Population and Water Supply Data for Karai Location

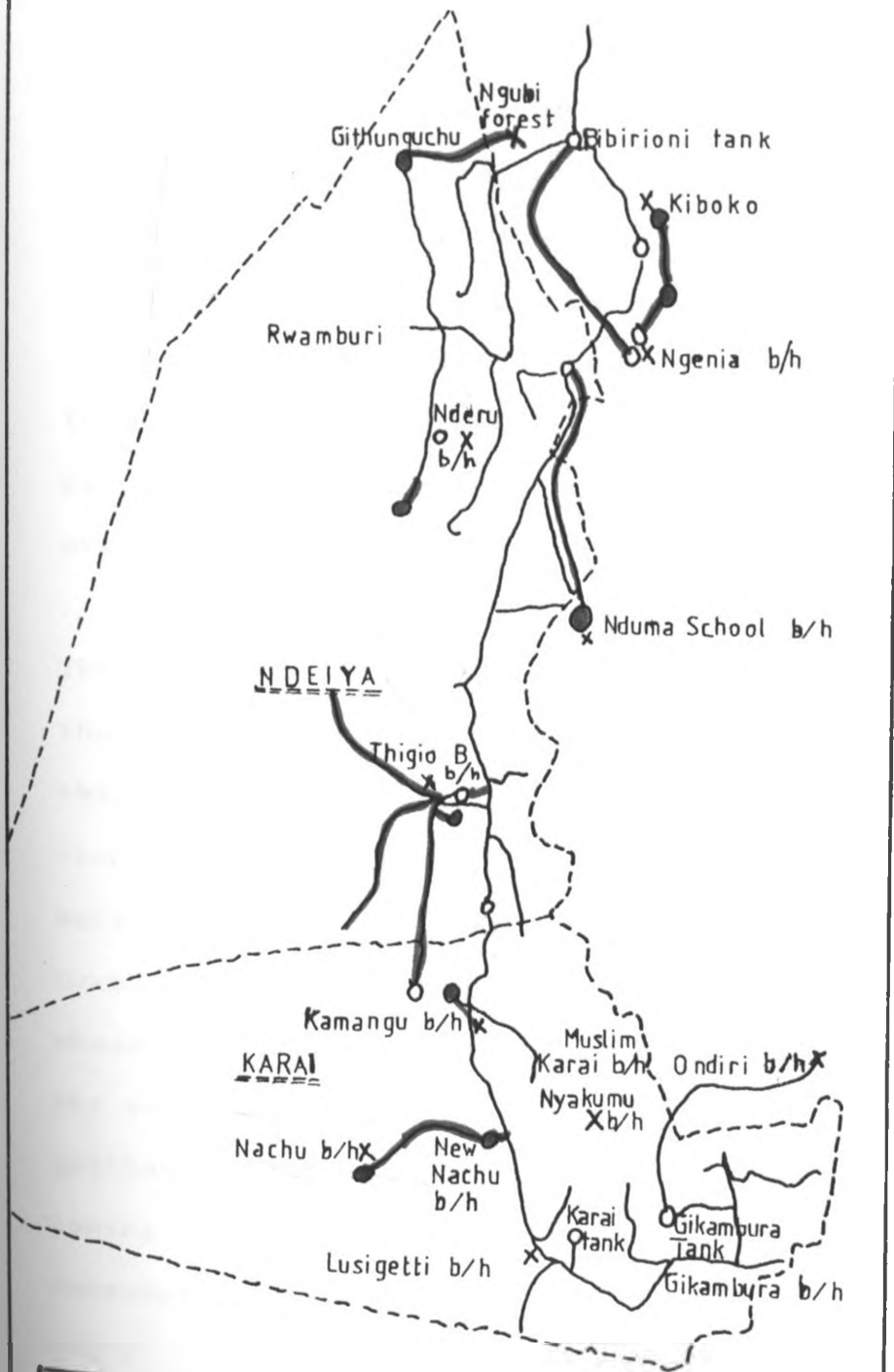
Sublocation	Population 1979	Data Estimate 1982	Water Supply Data				
			Production		Consumption l/c/d		
			Bore hole No.	m ³ /yr	%	m ³ /yr x10 ³	?
1. Renguti	3,560	3,900	C440	16,600	25	3.3	9.5
			C2758	38,500	33	10.2	
2. Nachu	1,556	1,700	C440	16,000	75	10.0	16.1
3. Karai Muslim	479	550	C3087	32,800	75	19.7	98.2
4. Lusigetti	5346	5,900	C2717	26,300	100	21	
			C2338	35,000	100	28	
5. Gikambura	7852	8,700	93	220500	80	741.1	44.4

Source: Water Resources Assessment Study for Ndeiya and Karai Locations (1983).
Ministry of Water Development,
Nairobi.

4.7.2 BATHI RIVER WATER SUPPLY

The Bathi Water Scheme draws water from an artificial

NDEIYA - KARAI WATER SUPPLY SCHEMES



X	existing boreholes
—	existing County Council pipeline
●	existing County Council storagetank
—	existing Bathi pipeline
○	existing Bathi storagetank
○ X	proposed borehole
●	proposed storagetank
—	proposed pipeline

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KARAI WATER SCHEMES

MAP No.
 8

reservoir in the Bathi River in Limuru area over 40 km away from Karai Location (Map No. 8). Though the scheme was designed to supply water to Ndeiya and Karai Locations as well as a limited number of people in the upper scheme area in Lari and Limuru, most of the water produced is consumed in the upper zones and does not reach Karai. If and when it does, the flow is irregular in terms of quantity and continuity. The scheme has also been reported to be experiencing problems of pump breakdowns and bursting pipes making its position for delivery of water to Karai even worse.

The scheme was designed to be implemented in three phases, the first two serving the targeted population while the third phase was to cater for increased demand due to population growth and adoption of economic activities requiring water such as small-scale irrigation and keeping livestock. However, at the time of this study, although the first two phases have been implemented, the people of Karai and Ndeiya who were supposed to be served by this scheme were not getting the water. Many possible explanations to this short coming have been given; the most prominent ones being over-consumption of water by people in the upper part of the scheme in comparison to what was intended for them, mismanagement of the whole system and mechanical breakdowns. The third phase which should already have been started has never taken off which means that the original goal of the scheme being completed and meeting the intended population demand for water by 1990 may not be accomplished by them.

The water Assessment Study for Ndeiya and Karai Locations shows that Bathi Water Scheme was supposed to serve Ndeiya and Karai Locations as follows by 1995:-

Total clean water produced by scheme (1995) = $2,890\text{m}^3/\text{day}$

Upstream consumption in (1995) = $2550\text{m}^3/\text{day}$

Total amount left for Ndeiya and Karai Locations (in 1995) = $2890 - 2550\text{m}^3/\text{day} = 340\text{m}^4/\text{day}$. However, up to 1990 the water supply from this scheme was to be limited to $900\text{m}^3/\text{day}$ for the two locations.

4.7.3 FUTURE DEMAND VERSUS RESOURCES

The amount of water consumed in Ndeiya and Karai Sublocations from the Bathi River Water Scheme is not available in segregated form for the two locations. As a result the amounts consumed in Karai are not known and this has made it necessary to give a comparison of water demand and supply for the two locations together.

The present groundwater production from the existing public supplies within the area has been estimated at 445,000 cubic meters per year or approximately 1,200 cubic meters per day as shown in Table 8.

These figures were calculated on the assumption that there were not going to be more individual connections but the study also noted that individual connections had already started and hence the demand was even higher by 1985.

Table 8 : Future Demand versus Available Resources.

Year	Production Ndeiya/ Karai	Demand l/c/day	Total Demand m ³ /day	Borehole Supplies m ³ /day	Existing Resources Bathi Supply m ³ /day	Required Additional Supply m ³ /day
1982	48,250	35.3	1700	1200	900	-
1985	53,500	38.3	2100	1200	900	-
1990	63,500	45.0	2850	1200	900	730
1995	75,700	51.1	3850	1200	340	2,290

Source: Water Resources Assessment Study for Ndeiya and Karai Locations, 1983, p.6-13.

Table 8 shows that with the existing supplies in from boreholes in combination with the Bathi Supply functioning according to design, the total demand exceeded the available resources by 1985. This is a serious policy issue because as per findings of this study not only is the Bathi scheme not complete but it is also not delivering the designed share of its water to the study area. This problem calls for action to be taken to complete the scheme as designed and to ensure that once complete the scheme delivers water to the target population in the designed amounts.

4.7.4 ALTERNATIVE SOURCES OF WATER FOR KARAI

A few alternatives have been suggested:-

- a) Connection to new gravity schemes outside the study area: It has been argued that since such an alternative is at least 40 kilometers away (Bathi) the cost of such a scheme would certainly exceed the cost of groundwater

development. However extraction of too much water may result in lowering of water table necessitating deepening of the boreholes and possible drying out of some of them. This is therefore not a good final solution to this problem.

b) Water from Kikuyu Springs.

This water is at present being used to supply Nairobi area. Nairobi is to get more water from the planned and about to start being constructed Chania III water scheme from Tana River. Once this scheme is completed, the water from Kikuyu springs can be released to supply its immediate surrounding (Ndeiya and Karai Locations have been suggested as priority areas). However, this proposal has not been considered and doubts have been expressed as to whether the locations will be given such a high priority. In principle the amount of water produced by Kikuyu Springs would be sufficient to meet the requirements of these two locations beyond 1995 (Water Assessment Study of Ndeiya and Karai Locations), while existing borehole water can be left to be used to supply increased demand thereafter.

4.8 ECONOMIC ACTIVITIES

Like most parts of Kenya, agriculture is the most economic activity going on in Karai. Most of it is however subsistent and very little capital is generated from it for investment in other areas. Cultivation is combined with animal keeping where the animals kept are of indogenous type mainly because they are found to have adopted to conditions of low water availability. The animals are also kept in few numbers to

meet domestic needs and in some cases for prestige and not for the purposes of capital generation. The population of livestock in the location is as shown in Table 9.

Table 9 : Livestock Keeping

ANIMAL	NUMBER (1983)
1. Cattle	1080
2. Sheep (indegenous)	2275
3. Goats (")	4020
4. Exotic layers	4050
5. Broilers	950
6. Pigs	409
7. Indegenous hens	2500
8. Rabbits	362
9. Beehives (Bees)	38

Source: Karai Location Rural Development Study 1983/84.

There is no cash-crop in the area and the major crops grown are maize, beans, potatoes and bananas, and peas on a very low scale.

4.9 INFRASTRUCTURE AND COMMUNITY FACILITIES

Karai is served with a good network of class E roads and there is one class D road from Gikambura, through Lusigetti to Kamangu (Renguti). The minor roads (class E) serve the location up to averagely 0.3-05 km of every home except in

Nachu Sublocation where the network is not so good. Passability of these roads is however limited to dry season and even the class D road which was murrumed has not been well maintained making it also impassable in the wet season.

Karai seems to also suffer an energy crisis with sublocations such as Lusigetti, Nachu and Renguti relying on firewood, which is the main source of energy, from as far away as Kajiado district. Crop residue is used extensively with other sources like charcoal and kerosene being limitedly used because of their relatively high cost. Only small sections in Gikambura and Renguti are connected to national electricity grid system.

The only medical facility is a health centre near the chief's office and which serves the whole of Karai Location. A traditional herbalist in Muslim Karai and a private doctor in Gikambura shopping centre are also found to be practising.

The location has no post office but post office agents are found in rented premises in Lusigetti, Gikambura, Renguti and Kamangu.

Most of the recreation facilities, mainly games' fields, are to be found attached to schools and hence limited for use by school children during the term and very rarely are they used by the public or during the school holidays. Any public meetings like Chief's Barazas are held in the open-air markets found in the shopping centres.

Schools consist of nine primary schools, six secondary schools and twelve nursery schools. All the schools (Primary and Secondary) are government owned or assisted and six of the nursery schools are owned by the Kiambu County Council while the rest five are owned by individuals or groups of individuals. Enrollment is good in all schools at times exceeding the school's capacity. There are also two village-technical polytechnics which at the time of this study were not functioning. The location has also got facilities for adult education in Kamangu, Lusigetti, Gicharani, Mugumoini, Nachu, Kanyiha, Mai-a-ihii, Gikambura and Renguti. However enrolment in adult education is low, mainly of women, and the attendance is also irregular.

There are four trading centres in Gikambura, Lusigetti, Kamangu and Karai Muslim, each except Karai Muslim having facilities for an open-air market. The centres accomodate such facilities as provision stores, butcheries, bars, restaurants, hotels and postal services. Except in Gikambura and Renguti where most shops are open throughout the day, elsewhere quite a number of shops are found to be open only in the evenings or on weekends while others are permanently closed.

4.10 HISTORY OF SETTLEMENT AND WATER SUPPLY DEVELOPMENT IN KARAI

The first people to settle in Karai Location were those displaced by the Catholic Mission in Muthangari (Msongari) in 1944. These people first settled in Gikambura which had been a grazing zone for the Masai. At that time there were

no boreholes and the people fetched water from Mbagathi (Athi) River. Later on during the disturbances of the emergency more people especially the landless and squatters in the forest areas of Ngongo and Limuru were shifted to villages in Karai such as Lusigetti and Renguti. Others settled in these villages were those thought to be anti-colonial government for easier control. A borehole was sunk in Riu Swamp near Gikambura shopping Centre and was to serve people from Gikambura, Lusigetti and Renguti.

Later on in 1948 the colonial government, in abid to get rid of Africans who had settled inside and in the vicinity of Nairobi Town, moved the Muslims to a village in Karai today known as Muslim Karai. Karai borehole in Nyakumu Swamp (Plate 3) was sunk to serve these people and those others near there with water. Another borehole, Lusigetti borehole, was sunk near the emergency village of Lusigetti.

The 1958/59 Land Demarcation settled some of the people in emergency villages in larger plots. Around the same time 1959/1960 the African District Council (A.D.C.) gave 12-acre plots to the landless and those loyal to the colonial government, while those in emergency villages were given 4-acre plots.

In 1962 Kikuyu Area Council (which included the Chief, elders and KANU leaders) gave plots of 0.25 acres to those people who were still living in emergency villages. These plots were mainly in Gikambura and Lusigetti and they were given on lease of 5 shillings per year.



Plate 3: Borehole site showing the pumphouse (centre), power lines, water kiosk (left) and an attendant's house (right).

In 1974 to 1976 the Kiambu Country Council demarcated residential plots in Lusigetti and Kamangu villages as well as in Nachu grazing area. The plots, also 0.25 acres were allocated to those still living in the two villages and any excess were settled in the plots which were demarcated out of the Nachu grazing area. These people were not issued with title deeds but at the time of this study this was in the process of being done.

Because of the small sizes of the plots given the people have constantly complained that they were given residential plots, enough for their houses but not to grow enough food for subsistence. In fact they have coined the term "Nda-ca" for these plots especially in Nachu ("Nda" in Kikuyu means "stomach" and "ca" means "no" which together mean that their residential needs were taken care of but not their stomachs). In response to this outcry, Kiambu County Council has the intention of settling these people on 5-acre plots to be demarcated out of the Nachu grazing zone, which means further encroachment and settlement of people in this even more fragile ecosystem than the rest of Karai with no water bodies and very low rainfall. There is however one borehole (C2717) sunk in 1957, owned by Kiambu County Council but abandoned since 1981.

This borehole has 4 reservoir tanks, two water kiosks and a cattle dip as it was intended for use by the nomads in the grazing zone and by any of the people with 12-acre plots elsewhere in Karai who might have excess stock and wish to

to graze them in the grazing zone on communal basis where communal cattle bomas are found. Apart from a few distribution pumps missing, everything else seemed intact and little in terms of finance would be required to rehabilitate this source.

Due to increased population in Karai, demand for water has been rising and effort to cope with this increased demand include supplies from schemes outside Karai such as the Bathi Water Scheme and water from Ondiri boreholes. Also within Karai, new boreholes have been sunk in certain areas on self-help basis or by the Government. Self-help boreholes are only two, the Karai Muslim Community borehole and the Rumwe Scheme borehole in Ondiri. Others by the Government include the new Lusigetti borehole, and Kamangu borehole and private boreholes sunk on individual basis.

Other small scale schemes include a man-made dam in Nachu grazing zone (Plate 4) and a few farm ponds dug in individual plots. Besides all these efforts, water supply is still far from meeting the demand of the population in Karai Location.

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C H A P T E R V

FIELD DATA ANALYSIS

5.0 INTRODUCTION AND BACKGROUND INFORMATION ON
THE RESPONDENTS

A total of 134 people (one person per household) were interviewed in the whole location. Of the respondents, 41 (30.5%) were males while 93 (69.5%) were females. 36 (26.8%) of the respondents were heads of households while a total of 84 (62.7%) were wives of heads of households. Where none of the two were available their sons or daughters, aged over 18 years, were interviewed. This included 6 (4.5%) sons and 8 (6%) daughters of household heads. Most of those interviewed 120 (89.5%) were engaged in farming while only 14 (10.5%) were engaged in other economic activities such as wage earning employment and business. Their levels of education were found to range from nil to secondary school; with 48 (36%) answering to having had no formal education, 64 (48.0%) had attained some primary education, and 22 (16%) had attained secondary school levels of education.

The average household size was found to be 6.8 persons per household but further disaggregation showed this average to be different in the various sublocations as shown in table 10.

The average household (hh) size for the whole location was calculated using the total number of people in all households

visited for interview and then dividing that number by 134 (the total number of respondents interviewed).

Table 10 : AVERAGE HOUSEHOLD (HH) SIZE PER SUBLOCATION

Sublocation	Average HH size (persons per household)
Lusigetti	5.9
Muslim Karai	6.2
Renguti	6.3
Nachu	6.8
Gikambura	8.1

Of all the respondents interviewed, 82 (61%) were born in Karai Location, 38 (29%) were born in Kiambu District but outside Karai while 14 (10%) were born elsewhere in Kenya but outside Kiambu District.

5.1 SOURCES OF WATER

All the respondents, except two, reported to be making use of more than one source of water. The other two were individuals with their own boreholes, one in Muslim Karai and the other in Lusigetti. Public boreholes were mostly used followed by private boreholes, rain-catchment and neighbour's supplies trailing behind each other in that order. Table 11 summarises the sources mainly relied on by those people having no individual water connections in their homesteads.

Table 11 : Water Sources Relied on:

Source	Total Responses per Sublocation					Total No. of Responses Percent	
	Lusigetti	Renguti	Nachu	Muslim	Gikambura	Responses	Percent
1. Dam	0	0	2	0	0	2	1
2. Public boreholes	18	12	14	4	12	60	27
3. Private boreholes	18	14	14	4	10	60	27
4. Water Kiosks	0	8	2	2	0	12	5.5
5. Communal Water Points	2	0	0	0	0	2	1
6. Neighbour's Supply	4	0	0	2	14	20	9
7. Rain water	12	12	8	0	16	48	22
8. Water Vendors	4	8	4	0	0	16	7
9. Farm Pond	0	1	0	0	0	1	0.5
Total No. of Responses	58	55	44	12	52	221	100

The table shows that most people relied on either private or public boreholes or a combination of more than one of these. Rain-water was relied on as a third priority and it can rightly be assumed that this source is only used during the wet season and probably a few days thereafter. It is also important to note that the highest number of people responding to relying on rainwater and neighbours' supplies came from Gikambura where rainfall is relatively higher than the rest of the location. Gikambura has a relatively higher number of people with individual connections which they have improved by constructing water storage tanks for storing tap water and roof-catchment water (Plates 4 and 5). This makes their supply fairly reliable since the stored water is used if piped water fails. Neighbours with less reliable sources or who have no piped water then go to such homesteads to fetch water.

It is also important to note that it is only two respondents who admitted to using Nachu dam water for domestic and animal watering purposes (Plate 6). This happens when the borehole in Lusigetti is not functioning and the next borehole is in Nyakumu swamp which the people who live in the grazing zone find to be too far. These people (living in Nachu grazing zone) have even devised ways of cleansing the dam water for domestic purposes using locally available root-tubers which when left to stand in the water for at least ten minutes causes the suspended soil particles to coagulate and sink hence clearing the water which is then



Plate 4: Storage tank not connected to roof-catchment. Rubber pipe (under the tank) is used to fill the tank with water from the pipe (left) which is connected to a piped scheme.



Plate 5: Water tank used to store both rain-catchment water and piped scheme water. The pipe from the piped-water scheme is showing on the south-eastern corner of the photograph.



Plate 6: Part of Nachu Dam (foreground)
with the background of the natural
vegetation in Nachu grazing zone.

used in household chores including drinking.

Further disaggregation showed the top three priority sources relied on to be as shown in Table 12.

Table 12 : Priority Sources

Source of water	Percent Priority		
	1st Priority	2nd Priority	3rd Priority
1. Dam	0	0	4.5
2. Public borehole	54.54	24.24	13.5
3. Private borehole	18.18	51.51	9.0
4. Water kiosks	3.03	3.03	13.5
5. Communal water points	0	0	0
6. Neighbour's supplies	18.18	0	4.5
7. Rain water	6.06	21.21	26.5
8. Water vendors	0	0	26.5
9. Farm Pond	0	0	2.0
Total Percentage	100	100	100

Most people relied on public boreholes as their first priority source of water and only resorted to private borehole as a second choice if the public borehole failed. A few people did not even have a third priority but those who did gave rainwater, water vendors, public boreholes and water kiosks as the third alternative.

Of the 67 respondents who were interviewed who had individual water connections to their homesteads, 55 (82%) of them said that their supplies were irregular which caused them to rely on other sources of water. In some parts of Lusigetti and Renguti it was reported that some of the respondents who had made individual connections to the Bathi Water Scheme only got water once when the scheme was being tested and the taps have since been dry. They have therefore continued to rely on other sources of water the alternative sources were reported to be as shown in table 13.

Nachu sublocation is not shown on the table because no one in Nachu had individual connection at the time of this study. Also the total number of responses (81) is more than the respondents (65) because some of the respondents reported that they relied on more than one source. This also distorted the percentage figure to add up to more than 100 percent.

5.2 DISTANCES COVERED TO THE FIRST PRIORITY SOURCE OF WATER.

Of the 56 respondents who gave an answer to the distance they had to cover to the nearest or the first priority source of water, the average distance covered was calculated to be 2.62 kilometers. The distance was however ranging from 0.06 to 6 kilometers as shown in table 14.

The actual figures show that 27 (48.2%) of the 56 respondents

Table 13 : Alternative Sources of Water Relied on.

Source	Lusigetti	Total Responses per Sublocation			Total	Percent out of all 65 respondents
		Renguti	Muslim Karai	Gikambura		
1. Roof catchment	10	8	2	13	33	49.2
2. Public boreholes	9	4	2	7	22	32.8
3. Water kiosks	4	6	1	1	12	17.9
4. Water Vendors	4	3	1	2	10	14.9
5. Neighbour's Supply	0	0	0	4	4	6.0
Total No. of responses	27	21	6	27	81	120.8

covered a distance between 2.5 and 6 kilometers, while 20 (36%) had to cover a distance greater than the 2.5 km as targeted for by the Government Policy on water.

Table 14 : Distances covered to first priority water source.

Distance covered to the first priority source (km)	Total no. of Respondents	Percent
0.0 - 1	14	25.0
1.1 - 2	13	23.2
2.1 - 3	12	21.4
3.1 - 4	7	12.5
4.1 - 5	8	14.3
5.1 - 6	2	3.6
Total	56	100

5.3 TIME SPENT ON FETCHING WATER

The average time spent to make a round trip to the priority source was found to be on average 1.8 hours (1 hour 48 minutes). However this was found to range from ten minutes to five hours as shown in table 15.

Table 15 : Time spent on one round trip

Time spent (in hours)	No. of Respondents	% Respondents
0 - 1	23	40
1.1 - 1	20	35.1
2.1 - 3	7	12.3
3.1 - 4	5	8.8
4.1 - 5	2	3.5
Total	57	100

Only 57 respondents answered to this question, out of which 14 (25%) spent more than two hours to make a round trip.

Only 23 (40%) spent less than one hour.

This study also found out that those using human labour (using debes and jerry cans to fetch water on human backs or heads) to make an average of two trips per day.

If each trip takes an average of 1 hour 48 minutes as seen earlier, then the average time spent by each such household is about 3½ hours per day on fetching water only.

5.4 MODE OF TRANSPORT

Responses showed that the most important mode of transport used is human labour (48%) while donkey and donkey carts came second with 30%. Another 22.6% of the household depend on water vendors to transport their water using either of the two modes described above. Only 2% of the

respondents reported using other means like wheelbarrows, home-made carts, bicycles or vehicles. Debes (capacity of 24 litres) and jerry cans were used by those carrying water on human backs or heads, on donkeys without carts, on bicycles, wheelbarrows and on home-made carts. Drums (capacity 144 litres) were mostly used by those relying on donkey carts or on vehicles (Plate 7).

5.5 NUMBER OF TRIPS MADE

The table 16 summarises the number of trips made per day using either drums or debes.

Table 16 : Trips made

No of trips made	Total using debes	Total using drums	% using debes	%using drums
1	4	8	17	72.7
2	8	2	33	18.2
3	7	1	29	9.1
4	1	0	4	0.0
5	2	0	8.5	0.0
75	2	0	8.5	0.0
		Total	100	100

Majority (83%) of those using debes made more than two trips. Those who made more than three trips were explained by more than one member of the household having to make one to two trips per day. Majority (72.7%) of those using



Plate 7 : Donkey-Cart; the most popular mode of water transportation.

drums only needed to make one trip. Whichever way, whether donkey carts or other modes of transport were used, some form of human labour is found inevitable as even the donkeys have to be driven to the water points by at least one person (Plates 8).

5.6 DRAWERS OF WATER

Responses as to who went for water showed that women and children or a combination of the two went to fetch water (83% of all the respondents). Women alone accounted for 46 percent while cases of women and children fetching water together was 37 percent (Plate 9). In 15 percent of the cases the men (heads of households) were used while only 2 percent of the respondents relied entirely on water vendors.

5.7 PER CAPITA WATER CONSUMPTION

According to the Water Resources Assessment Study by the Ministry of Water Development, people served by communal water points are expected to consume 25 litres of water per capita per day. Those served by individual connections can consume as high as 50 litres per capita per day. While it was not possible to calculate the amount of water consumed per day by those people in Karai having individual connections, the same was done for those who drew water from a communal water points.

It was found out that an average household of 6.8 persons consumed an average of 112 litres per day. This makes per capita consumption per day to be 16.5 litres. This is on



PLATE 8 : Women ferrying water home from a water kiosk using drums mounted on donkey-carts.



X Plate 9 : Use of human labour to transport water. A woman and her children carrying water home from a water kiosk.

the assumption that all the water drawn is used for domestic purposes and not to water the animals. Consumption rates were however found to range from 24 litres per household of five which makes the lowest per capita consumption per day only 4.8 litres. The household responding to using most water used 144 litres in a household of 7 persons bringing the highest per capita consumption per day to 21 litres. This shows that even the highest consumers from the communal water points consumed less than the expected 25 litres per capita per day.

Further to this, it was found out that 51 (76%) of the 67 respondents kept livestock on their farms or in a few cases in Nachu grazing area. Of those who kept the livestock on their farms, 74 percent responded that some of the water they drew was fed to the animals while the rest took the animals to communal water points for watering. The total amounts of water consumed by animals was estimated to be 1,356 litres out of the total 3,812 litres drawn daily by those interviewed. If the amount of water consumed by the animals is subtracted from the total amount drawn, this reduces the human per capita consumption to 12 litres per day.

Although not quantified it was found out that those who watered their animals at home kept mainly poultry, goats and sheep which they fed with clean water while sheep, goats and indigenous cows were normally taken

to communal water points for watering or fed on waste water from domestic chores like washing.

Table 17 shows the number of households out of the total 67 that keep each type of animal as named in the table.

Table 17 : Animals kept.

Type of Animal	% out of 67 households keeping this animal
1. Grade cattle	20
2. Sheep/goats	50
3. Indegenous cows	15.7
4. Poultry	70
5. Others (e.g. pigs, rabbits and donkeys)	30

5.8 PROBLEMS EXPERIENCED AT WATER SOURCES

Most of the problems (40%) reported being experienced at water sources had to do with the source being too far. This consumed too much time (refer to table 15) as well as causing tiredness to those who have to draw the water, especially the women. 26 percent of the respondents also found the source to be unreliable so they occassionally had to rely on other sources which were even further away and hence even more inconvinient.

Other problems, not necessarily to do with the source,

included the cost of the water being too high as perceived by 50% of the respondents while 38% found the cost high and only 12% thought it was low. On the efforts employed in fetching water, 54 (80%) of the respondents thought it was too much, 9 (14%) thought it was normal while only 4 (6%) thought the efforts to be little. Sickness of donkeys used to transport water as well as the regular puncturing of donkey -cart wheels were regular problems reported to do with water transportation.

5.9 PERCEIVED CAUSES OF WATER SHORTAGE IN KARAI

In response to what they considered as the major causes of water shortage in Karai, 92 out of 134 respondents (i.e. 69%) answered that natural conditions such as dryness, inadequate rainfall and lack of surface water bodies are the leading explanations given. While not refuting that the natural conditions prevailing in Karai locations are the major causes of water shortage, others thought that the problem could be eliminated if the people were united and the Government was assisting fully.

Lack of stewardship and leadership so that the community could be well organised in solving this problem came up clearly as one of the major problems that has added to the acuteness of this problem. The community was also found to be disunited and suspicious of each other so that formation of self-help groups, that could be used to solve this problem, has been very difficult. Where the community has succeeded in forming a self-help group, lack of stewardship, leadership

and follow-up has resulted in the group members becoming gradually disillusioned and the group being disbanded.

A few people thought deforestation had brought about the dryness while others thought their poverty had reduced them to a level where they could not contribute towards the solution adopted for this problem - unless they could contribute in terms of labour only.

The people saw water as a social good which should be provided for by the Government but their leaders had not made the Government aware of the acuteness of this problem and hence the low levels of Government effort to assist them in this respect.

Where water is available, other human factors have come in to make the problem even worse for some and better for others. Because the water available is not enough to meet the demand, rationing has been resorted to and it is in this rationing that other problems have arisen. Those employed by the Kiambu County Council or by the Government were reported to be lax and inefficient so that they do not report mechanical breakdowns of the systems in time and this results in delayed repairing of the systems and prolonged suffering of the clientele. Others, in search of unofficial income, were reported to be involved in malpractices such as requesting favours and gifts from the well-to-do clientele so that they can serve them with more water than their rightful share as allowed by the rationing. Once an employee

receives such a favour (in cash or otherwise), he agrees to serve the client with as much water as the client requires. In the meantime while the favoured client or clients are getting a constant flow of water, a whole lot of other deserving people have to go without. This case was particularly found to be serious in Gikambura and parts of Lusigetti which get their water from Riu, Ondiri and old Lusigetti boreholes.

Besides laxity of the workers, other forms of inefficiency reported were the occasional pump breakdowns, lack of power to run the pumps and what the residents thought was too small pumps having been installed in boreholes having higher amounts of water than the capacity of the pumps to pump out. They argued that these pumps had been installed when the populations they were to serve were low but have not been changed to cope with higher populations that are depending on the same source of water.

In cases where one borehole serves both individual connections and water kiosks, it was alleged especially in Lusigetti that those employed at the borehole make arrangements with some people with individual connections so that the flow of water is allowed at night and the few people with storage tanks store water. The following day the attendant closes the pump and pretends it is broken down so that people go to buy the water from those people who stored some in the night. The water is of course sold at a profit (Sh. 1/= a debe and Shs. 5/= a drum). The profit is then shared by the

pump attendant and the then "water-seller".

Other causes of water shortage in Karai were mentioned as people in the upper areas consuming more water than their designed share especially in the case of Bathi Water Scheme and Karai Water Scheme which gets its water from Riu Bore-hole. In other cases, local politics are believed to cause the shortage where one group of people denies another group water because of the advantage that the first group loses when the second group gets water. This was the case in the Rumwe water scheme which gets water from Ondiri swamp. The people believe that there is enough water to serve Rumwe and Kahero groups. This had been started and functioned for more than two years before the people of Rumwe realised that since the people of Kahero got water, the people of Rumwe were having problems with availability of labourers which before then used to come from Kahero. Influential people therefore engineered and succeeded in closing down the water supply to Kahero people on the pretext that the people of Kahero had refused to pay for the water. While the people of Kahero do not refute that they had refused to pay a monthly rate for the water, they believe that even if they had, another excuse would have been found to cut the supply to them because they were needed by Rumwe people for labour.

Asked why they thought the existing supplies were not meeting the demand, the following responses were given

by 112 respondents.

- i) Inadequate boreholes (few boreholes with limited amounts of water (by 56 (50%) of the respondents).
- ii) Scheme mechanical breakdowns (29 (26%) respondents).
- iii) Over-use in upper areas (22 (20%) of respondents).
- iv) Mismanagement, corruption and costs (5 (4%) of respondents).

5.10 PERCEIVED SOLUTIONS

In response to the question on what the respondents thought was or were the solutions to the problem of water shortage in Karai, the answers given tend to imply that by increasing the amounts of water all other problems would be eliminated. The answers given were that with the assistance of the Government, more boreholes should be sunk by individuals or by the Government. This response was given by 68 (61%) of the respondents. Others thought that water should be brought in from sources outside Karai from areas such as Kikuyu springs, Kang'ongo borehole and alleged boreholes in Ngong forest which were abandoned since the end of the colonial era. Rehabilitation, completion of Bathi Water Scheme and other small borehole schemes should also be undertaken but this time the Government should also ensure that the people of Karai get their designed share. The people also thought that women who understand the plight of fellow women should be employed to man the pumps and water distribution.

5.11 PREFERRED WATER SUPPLY SYSTEM AND PAYMENT METHOD

Out of the people interviewed who did not have individual connections, 63 (94%) preferred individual water connections while 4 (6%) preferred communal water points. However 115 (86.6%) of all the respondents preferred the metered method of payment which ensured that one paid only for what one consumed as opposed to flat rate payment which one pays whether one has consumed an equivalent amount of water or not.

5.12 PREFERRED ALTERNATIVE USES OF TIME AND WATER

In response as to how they would use the time released if adequate water was provided, 36 (54%) of those without individual connections said they would use the time in farming, 27 (41%) of the respondents said they would spend the time farming and looking after their families while the rest 4 (3%) said they would engage in other income generating activities such as buying vegetables and fruits from markets in Dagoretti and Nairobi and selling them in Karai. Those who answered to spending more time in their farms also thought they would keep more livestock. The children said they would spend the time playing or doing school work.

These results compare well to those obtained from the respondents who had individual piped-water connections who said they had more time for farming; 64 (94%) of the 67 such respondents. Also out of the 67 respondents, 41 (61%) responded that they now had more time to look after their farms and families.

Table 18 summarises responses from the residents as to why they thought the solutions they suggested had not been instituted.

Table 18 : Why suggested solutions have not been instituted.

	Response	% respondents of this opinion
1.	Lack of unity among residents	24
2.	Lack of funds	16
3.	Lack of leadership	16
4.	Government not committed to help	16
5.	Government unaware of problem	8
6.	Mismanagement, local politics and Government awaiting local initiatives	13.5
7.	Not known or no response	6.5

Besides the Government other agents perceived as helpers towards solving the problem of water shortage in Karai were self-help groups with the assistance from the Government (31% of the respondents). Others, 2%, thought that the Ndeiya-Karai Integrated ASAL Development Programme, sponsored by the Royal Netherlands Government, and which was working in the area rehabilitating old schemes and sinking more boreholes had come to their rescue and should continue until they ensured that everyone was well catered for.

All the respondents answered that if adequate water was available they would use it to intensify their farming by keeping more livestock and growing horticultural crops by irrigation. Further to this, the respondents, especially those without individual connections, wanted it noted that they would use the water in keeping and maintaining higher standards of cleanliness and hygiene which was not possible now due to the limited amounts of water available. The school heads/teachers particularly complained that shortage of water was making school administration very difficult since children who went to school dirty could not be sent home to wash, because the homes had no water. Activities such as cleaning classrooms, teaching subjects like home science and so on were limited by the shortage of water and children had to carry water to school for such activities or the school had to buy it. Either way costs of getting water were limiting such activities.

5.13 PRIORITY PROBLEMS

For those people who had to rely on communal water points for water, water was given as priority problem number one except by a negligible few who were mainly those living near such points. Other problems were transport, energy and schools/training facilities as shown in table 19.

Of the 67 respondents having individual connections water was given as priority problem number one by 53 (79%) of the respondents while 10 (15%) gave water the second priority

and 4 (6%) gave it a third priority. The second priority was given to transportation by 51 (76%) of all the respondents in this group while 9 (14%) gave fuelwood/energy the second priority and the the rest gave it to education and training facilities.

Going by these figures therefore, whether one has individual connections or not, water is still priority problem number one in Karai Location.

Table 19 : Perceived First Priority Problem (other than water).

	Problem	No. of Respondents	% of all Respondents
1.	Transportation	15	22
2.	Energy shortage	18	27
3.	Landlessness	8	12
4.	Medical Facilities	3	4
5.	School/Training Facilities	16	24
6.	Food	5	8
7.	Others	2	3
	Total	67	100

5.14 PUBLIC PARTICIPATION

From literature review (Robins, C. 1985), the people of Karai had been reported as being individualistic and not

being interested in forming self-help groups as in other parts of the country. In a bid to find out to what extent this phenomenon would affect the part that the Government expects any beneficiaries to play in the "cost-sharing" strategy, two indicators were used in this study. Assuming that self-help groups are easy to reach and use in this strategy, the study wanted to find out how many people in Karai were members of self-help groups. The other indicator used was their willingness to contribute in cash and labour for any proposed water scheme in Karai.

This study found out that only 49 (34%) of the total respondents (134) were members of self-help groups which were mainly P.C.E.A. Church Women's Guild. However, all respondents were willing to contribute any agreed amount of money or labour by the community.

Further probing showed that 24 (19%) would want to form self-help groups not just for water projects but for any other community project while the rest 110 (81%) would want to work together with fellow villagers or communities for water then go their own ways once the scheme was completed. This shows that majority are still individualistic as reported earlier - an important fact to bear in mind when formulating any policy that requires some community participation.



















KAJIADO DISTRICT

NACHU GRA

Nachopolis Post

KAJIADO DISTRICT

LEGEND

-  BOREHOLE
-  DEPRESSION
-  MAJOR ROAD
-  MAIN TRUCK MOTORABLE
-  SUB-LOCATION BOUNDARY
-  LOCATION BOUNDARY
-  DIVISION BOUNDARY
-  PROVINCIAL BOUNDARY
-  ESCARPMENT
-  RIVER
-  TRACK AND FOOTPATH
-  Area to be subdivided into 5-acre settlement plots
-  Swamp
-  Area not suited to be in ASAL category
-  Area worst hit by lack of facilities
-  600 Rainfall isohyet
-  Borehole not functioning
-  Kikuyu springs

KARAI WATER



-134-

SCHEMES

NGARI, P.N. (MRS) MA. (PLANNING) II 1987/88
 UNIVERSITY OF NAIROBI
 DEPT. OF URBAN AND REGIONAL PLANNING

MAP No
9

C H A P T E R VI

STUDY SYNTHESIS

6.0 INTRODUCTION

Kenya's national growth and development strategies before independence were such that the interests of the rural areas were relegated to the progress of urban and the export market. As a result urban areas were better provided with services than the rural areas. Housing, infrastructure, water and sanitation, health and education facilities were far better in the urban than in the rural areas. With the coming of independence, people started to migrate into the urban areas not just because the above named facilities were better there but also because the cities offered better employment opportunities than the rural areas. The rate of rural-urban migration was so high that the facilities could no longer cope with the high population and the Government could also not increase the facilities at the same rate as the population growth in the cities. A decision was therefore reached to check this rural-urban migration by making the rural areas as attractive as the urban areas.

For this purpose, a rural development programme was launched in the late 1960s. It's objective was to improve the overall standards of living in the rural areas by mounting programmes that would raise incomes of the rural people and also provide the other facilities. This, it was hoped would check the need to migrate to the urban areas.

For each region the services required were prioritised and the first priority problem was tackled first and so on. Nationally the worst hit regions would be given priority. In this respect water deficiency had been noted everywhere in the country as discussed in chapter III Section 3.2. A Rural Water Supply Programme was launched whose objective was to provide safe and adequate water to the whole Kenya population at convenient distances by year 2000 A.D.

Four groups of people were identified as suffering particularly from deficiency in water supply (chapter III section 3.2). Amongst these were the small land holders in low potential areas of North Eastern Province and the ASAL areas such as this study area. In such areas, usually occupied by people with the lowest incomes, water was provided freely at communal water points which were to be located five kilometers apart so that no household would be more than 2.5 km away from a water point. Where such populations were found to be dense enough to justify charges, water was sold to them at the communal water points and the revenue so collected supposed to be used in meeting the maintenance and operation costs.

Where an area was found to have no perennial water sources, water was supplied using groundwater resources by sinking boreholes. If such a resource was found to be insufficient, water was brought in from perennial sources outside the

suffering area. It has been found out that such schemes require so much initial capital investment that supply is restricted to non-luxury domestic use, livestock watering and limited extension irrigation where possible.

6.1 THE PROBLEM SUMMARY

Whatever rural development activity is recommended for ASAL, water is a key input without which the success of such an activity is uncertain. In Karai location, many studies have shown that water is a constraint to development which leads to the speculation that there is shortage of water there. This study confirmed that, as reported in other studies, there are no surface water bodies there except a small man-made dam in Nachu and a small lake in the North-Western corner of Nyakumu swamp which are both fed with rain-water (Map No. 9). Since rainfall is also low, prolonged drought may result in the two dams drying up as happened once to the Nachu dam in 1981. The water of these sources is also found to be contaminated and unfit for human consumption. It is normally reserved for watering livestock and wild animals.

However, besides the low rainfall and lack of perennial water bodies many small water schemes are found in Karai of which all except one utilise the only naturally occurring water - the groundwater. Kiambu County Council owns four boreholes, the Ministry of Water Development owns four while two self-help groups namely Karai Muslim Community

and Rumwe self-help group also own a few boreholes. Few individuals have also sunk private boreholes in their plots especially in Gikambura (Map No. 7).

The water table is found to be very deep, 150-200 m below the surface, and besides being heterogenous it is also found to be sensitive to overpumping. Overpumping can result to lowering of water table which would necessitate deepening of any boreholes or wells and installation of more powerful pumps. It may also result in the depletion of the groundwater.

Because of the sensitive nature of the water table and the high costs of the schemes due to the water table being so low, the Government has attempted to cope with the demand by bringing in water from Bathi River Water Scheme whose reservoir is more than 40 km outside Karai Location. All the water from both boreholes and Bathi is collected together in reservoir tanks and distributed to the public either by sale at water kiosks or stand-pipes or through individual connections who pay a flat rate of fifteen Kenya Shillings a month. It has been reported that at least half the households in Karai have individual connections while the rest are provided with water at communal water points (CWPs). The two schemes, Bathi and Boreholes, were designed to meet the demand for water for the whole of Karai Location until 1990 when production would need to be increased (Water Assessment Study for Ndeiya and Karai Locations - 1983).

The problem noted and which prompted this study is that all the above described schemes are not meeting the demand for water in Karai as indicated by the irregular or no flow of water through the individual connections' (IC) taps and the long queues observed at communal water points. This means that although a lot of resources have been invested in water supply schemes, the resources are underutilised or in some cases lying idle and are subject to going to waste. The study therefore set out to find out the possible causes of this problem, their implications and from the information so gathered, to suggest possible solutions.

6.2 WATER DEMAND VERSUS SUPPLY

Table 8 in Chapter IV Section 4.7.3 shows that the total demand for water ($2850\text{m}^3/\text{day}$) exceeded the supply ($2120\text{m}^3/\text{day}$) in 1985 by $730\text{m}^3/\text{day}$. The situation could have been more serious as these calculations were done earlier on in 1982 by the Water Resources Assessment Study for Ndeiya and Karai Locations on the assumption that no more individual connections (ICs) whose per capita consumption (50 litres) is more than from communal water points (25 litres). The same study had however noted that the exercise of constructing individual connections was still going on which means the demand was increasing with the increase in ICs.

At the same time it was also doubtful whether the said $900\text{m}^3/\text{day}$ designed for Ndeiya and Karai Locations from the Bathi Water Scheme was reaching the people. Those who had made ICs directly from the Bathi pipeline reported very

irregular flows while others in Renguti and Lusigetti reported having received the water only once when the scheme was being tested and the taps have since been dry. Those communal water points connected to Bathi have been abandoned and are now lying idle and unattended which subjects them to vandalism. This implies that on top of the $730\text{m}^3/\text{day}$ deficit calculated for 1985 a further $900\text{m}^3/\text{day}$ may also not have been reaching the people which brings the deficit for Ndeiya and Karai to $(730 + 900\text{m}^3/\text{day}) 1630\text{m}^3/\text{day}$ by 1985.

From the household questionnaire administered for this study it was found out that the minimum per capita water consumption for those without individual connections is 4.8 litres per day while the maximum is 21 litres per day. The average consumption for the same group was calculated to be 12.0 litres per capita per day. This means that both the maximum and the average per capita consumption are below the designed 25 l/c/d designed for consumers of water from CWP's.

Because the individual connections (ICs) are not metered, it was not possible to calculate the per capita consumption of water. But from the responses given, that the flow is irregular and that these people have also to rely on other sources of water, it is then obvious that the water they receive from the ICs is not sufficient. Most people who have ICs have also got storage tanks which are also

connected to the tanks and when water flows through the taps it is also collected into the storage tanks for use when the taps are dry.

While most people rely on water from the public or private boreholes other sources have also been necessary when these two are for one reason or another found unreliable or inconvenient. Such other alternatives that have been resorted to include rainwater, water bought from vendors, farm ponds and in some cases water from Nachu dam and Lake Nachu are cleansed using traditional herbs and used in household chores including cooking and drinking.

6.3 COMMUNAL WATER POINTS

Although the Government policy is to provide water to all rural households in low potential areas at a distance not more than 2.5 km away from any household, and although the 1984/1988 Development Plan stipulates that no household is now found to be more than 1.8 km away from a water point in the dry season, the average distance that people in Karai have to cover to the preferred water points is 2.62 km. Some households are as far as 6 km away from such points and in case there is a problem the next preferred water point may be as far as 10 km away.

At least 35.7 percent of the respondents who had no individual connection for water were found to be covering more than the said 2.5 km. Even those within 2.5 km. radius occasionally had to cover more distances when

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there are breakdowns or when the queues are too long at their nearest water points because of problems in other water points. Whichever way it is looked at, any one point at some time in the year serves more people than it can cope with resulting in inconveniences and wasted time.

In this respect, the Ministry of Water Development has further stipulated that a communal water point should serve a 480 people*. If it is considered that the projected population for Karai in 1987 was 24,800 people and assuming that the figure of 50 percent being served by communal water points is correct, then the number of communal water points required in Karai in 1987 is 26. These were found to be only 14, one of which in Nachu grazing zone was out of order while 9 were newly constructed by the Ndeiya and Karai Integrated ASAL Development Programme. The rest had been reported as requiring repairs and upgrading since 1982 but nothing has so far been done.

It is therefore no wonder that the people have to wait for long hours at these points and there is therefore the dire need to increase the number of CWPs and the efficiency of the existing ones.

6.4 TIME SPENT ON COLLECTING WATER AND ITS IMPACT ON ECONOMIC ACTIVITIES

It was found out that at least 1.8 hours were being spent

*Source: Water Assessment Study for Ndeiya and Karai Locations p. 6-17.

on a round trip by those depending on CWP's for water. For those people who were using human labour, they had to make at least two such trips or two people in the household and to fetch the water which brought the total number of hours spent per household per day to at least 3½ hours. Because of the long distances covered, and the physical strain of carrying water the drawers of water complained of tiredness which reduced the efficiency with which the same people can engage in other economic activities. Other problems associated with water transportation included donkey sickness and bursting of donkey cart wheels which reduced the efficiency of such means of water transport.

Where children in the households were also involved in drawing water they responded that because of tiredness and lack of free time, they could not study or do school related work properly neither did they have enough time to play and engage in other social activities. If time was to be released from drawing water, the grow-ups would engage in economic activities such as farming, and looking after the families while the children's needs would also be catered for.

The most desired economic activities if enough water was to be provided included the use of water in intensifying agriculture especially in growing horticultural crops and using the water to grow rainfed crops in case of rain failure. Other respondents reported that they would keep more of the animal breeds that yield more output such as

grade cows for meat and milk. Others could rear pigs and keep poultry which are at the moment not possible due to lack of enough water.

Because of the removed physical strain if water were to be provided adequately, less resources would be spent on medical services due to the reduced instances of sicknesses associated with such physical strain. The women particularly complained of weaknesses and back-aches which they associated with the constant strain of having to carry water on their backs. One other reported use of water was that of maintaining better hygiene, cleanliness and sanitation standards. This means that instances of diseases occurring due to lack of enough water would be reduced resulting in a healthier population able to participate more efficiently in rural development activities. With reduced sicknesses there would also be less expenditure of national resources on medical services.

6.5 PERCEIVED CAUSES OF WATER SHORTAGE IN KARAI

In general scarcity of any commodity can be caused by natural factors whereby the physical supply available is deficient in its natural occurrence. In the case of water, such factors include low rainfall, geological formations, low water tables, lack of perennial or surface water bodies like rivers, lakes and springs, and unsuitability of water for human or animal consumption or other economic activities.

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In Karai the low rainfall and lack of perennial and suitable water bodies has been seen as the major cause of water shortage in the location. There are only two water sources which include the groundwater and the piped water from Bathi, a scheme outside the study area.

Even when a commodity is available in sufficient quantities, it can still be perceived as being in short supply depending on efficiency with which it is converted from raw to consumer good. Leakages can occur so that the final consumerble product is less than the demand even if the raw material had been designed to meet the demand after processing. The method of conversion from raw to consumer good may be so inefficient that the proportion of the final good is very low compared to the raw initial material.

Similarly, human factors may also come into play so that even if the supply is adequate inequitable distribution may lead to perceived shortage. Such inequitable distribution can be brought about by institutional arrangements that exist as well as unequal income distribution which may result in unequal accessibility to a commodity so that some people consume more than they need or than their designed share. Poverty can also result to people not consuming a commodity because they do not have the power to purchase it.

In water development, it has been stated that instituting

rational management practises rather than impending scarcity are possible causes of shortage (Kulp, E.M.). The World Bank Working Staff Reports have also warned that influential clientelle can be antagonised and the staff can be deprived of a source of an unofficial income if there is increased effectiveness of water distribution staff. This is particularly serious where supply is less than demand and fair share is only possible if rationing is honestly done. Favouritism in the case of rationing of a scarce commodity can only result to one group having access while the other groups go without.

Mismanagement of schemes, under-capacity installations (pumps and other accessories) as well as apathy amongst the staff can also lead to a commodity being hard to come by.

The household questionnaire administered for this study revealed that besides the area having shortage of naturally occurring water, human factors have come to play and rendered the little water available more "scarce". First and foremost, it was perceived that the existing schemes were inadequate by 68 (61%) of the respondents, who thought that sinking more boreholes would solve the problem of water shortage in Karai. The Bathi Scheme was perceived as delivering little or no water to Karai because people in the upper areas of the scheme were allegedly consuming more water than their designed share and hence depriving the lower areas of Ndeiya and Karai Locations of their "rightful" share.

The borehole schemes were also reported to be operating below capacity (it was alleged that the pumps installed in the boreholes were small and that the boreholes had more water to offer than could be pumped out by those pumps) and the suggestion that bigger pumps should be installed came up quite vividly. The pumps are also associated with many problems such as breakdowns and lack of power either in form of diesel or electricity. This has resulted in the schemes having to close down occasionally.

When breakdowns occur, the staff employed to man the pumps are not skilled enough to repair them and have to send for more qualified staff to come from the headquarters in Kiambu town to do the repairs. This, together with the delay in reporting such breakdowns results in prolonged periods elapsing before the pumps are repaired. During such periods, the people have to rely on other sources of water - an added inconvenience.

Apathy, laxity and corruption amongst the employees were reported as additional causes of water shortage in Karai. Influential and rich people were reported to be offering the operation and distribution staff gifts in return for them being supplied with more water than their ration allows.

In another instance, one self-help group (Rumwe) which has its own water scheme had allowed another group (Kahero) to use their scheme water. It was alleged that Rumwe group after sometime discontinued the supply to Kahero group. The reasons given by people of Rumwe is that Kahero group refused to pay for the service and hence the discontinuation. The Kahero group however allege that Rumwe group had discontinued the supply because after the Kahero people got water they got involved in other activities such as farming and did not go to Rumwe to seek casual employment as was the case before they got the water. Hence Rumwe people cut their supply to ensure that they return to them as casual labourers. This happening has resulted in a lot of hatred between the two groups and is a good indicator of how water shortage can affect local politics.

6.6 PLOT SIZES

Besides water, one other constraint to development which featured in the responses given by those interviewed is the small plot sizes. Chapter IV Section 4.10 describes how people came to have plots as small as 0.25 acres. Others have plots which are 4 acres while a minority have 12-acre plots. Except for the people living in the 0.25-acre plots, the average plot sizes have been found to be 2 acres (Robins, C. 1985). Those who have the smallest plot sizes were reported to be relying on rented plots for growing food crops to meet their subsistence requirements. As such the plots have not been used for production of cash

crops or surplus food which can be sold to bring higher incomes. Infact Karai was noted during this study as having no cash crops.

Landlessness was reported as priority problem number one by some people in Gikambura who had more reliable sources of water. The same applied to Nachu Sublocation but here it was because all the people are on 0.25-acre plots. While they have plenty of time to spend on fetching water as their labour is not in so much demand due to the small plot sizes, they would rather have larger pieces of land and have to squeeze in the task of fetching water into a busy farming schedule. As such, this group has been a pressure group, demanding the local authorities to look for solutions to their problem. At the time of this study, the Kiambu County Council was in the process of organising for these people to be given 5-acre plots per household which were to be subdivided out of Nachu Grazing Zone.

One foreseen problem is that if these people are settled on larger pieces of land in the grazing zone which is very fragile, and if no extension services are provided to guide the people on appropriate land use, they are likely to continue with the same farming activities as they are used to in the well-watered areas. This could result in serious environmental degradation and gradual desertification. This issue is discussed further in the next chapter.

6.7 EFFECTIVE PUBLIC PARTICIPATION

Except for the two self-help groups (Rumwe and Karai Muslim Community) all the other water schemes in Karai are owned by the Central Government either through the Ministry of Water Development or through Kiambu County Council. The Government has constructed the primary and even part of secondary installations (i.e. the sinking of boreholes, installing pumps and distribution pipes as well as the secondary installations of standpipes and/or water kiosks). The only time that the public has been involved is in the installation of individual connections whereby individuals do this at their own cost or on self-help basis. Of those interviewed, no-one installed their individual connections on self-help basis besides the option having been there.

It was also found out that at no time were the beneficiaries of the public schemes involved in the preparation of the schemes' plans. It is therefore no wonder that the people have not identified themselves with the schemes but rather see them as Government property. In addition, this may also have given them the opinion that it is the Government's responsibility to provide them with water and that water should also be "free" like other facilities such as health and education. This study found out that the cost of 20 cents per debe and one Kenya shilling per drum is considered to be too high or high by up to 86 percent of the respondents. Under normal market circumstances such a price would be considered to be too low.

The people of Karai were reported by earlier studies as being individualistic and lacking social cohesion. The recent settlement into the location from different parts of the district and country has been blamed for this. To confirm this, this study found out that 40 percent of the respondents were born outside Karai while those born in Karai were mostly born elsewhere outside the sublocations they are settled in. The main reasons given for this migration were marriage and search for land.

The people were also confirmed to be less interested in formation of self-help groups with only 19 percent of the respondents answering to be members of self-help groups. Of these, most were members of the P.C.E.A. Church Women's Guild, an organisation whose major functions are for spiritual or religious purposes and are oriented towards social satisfaction rather than for self-help purposes.

The people are however aware that they are not united as a community and attribute this to lack of committed leadership for guiding them on how to form self-help groups. A few cases were reported where self-help groups had been formed (e.g. a tannery co-operative in Renguti) but, due to lack of commitment and goodwill, there was gradual disillusionment and final collapse of the group. The fact that the people are so strange to each other has also brought about suspicion so that anybody who has the initiative to guide formation of a self-help group is first subjected to a lot of suspicious scrutiny.

However, for the purpose of a one time project, say in this case a water project, all the people said they would be willing to contribute in cash and labour towards a project that would provide them with water. But only 34 percent reported that they would be willing to form self-help groups even after the initial water project is completed. The rest considered working together as a community or with fellow villagers then disbanding once the water project was over to be the best. While this situation appears grave, there is still hope that these "one-time" community groups could be developed into self-help groups once the people know each other and are less suspicious of each other.

Formation of self-help groups is very important as such groups are easy to reach and to work with on any project that requires public participation. The Government's strategy of "cost-sharing" also counts on co-operation of such self-help groups.

6.8 EXCEPTIONAL CASES IN KARAI

During the course of this study one sublocation was found to be a "misfit" in Karai when ASAL characteristics are considered. Whatever indicators are used, Gikambura sublocation seems to be better served than the other sublocations. The Kenyan classification of ASAL areas into those areas receiving less than 800 mm of rainfall per annum would exclude Gikambura as it receives more than 800 mm (Map No. 9).

The soils in Gikambura are mainly rich agricultural red loamy soils which are different from the soils elsewhere in Karai which are mainly montmorillonitic clays. As a result of the rainfall totals and these soils, the natural vegetation is found to have more luxuriant foliage of trees, grass and scrubs which have however been cleared for crops, while the rest of Karai has xerophitic grasses and scattered trees. In this respect, Gikambura is found to have higher agricultural potential than the rest of Karai.

The level of services is also as high as that in the rest of Kiambu district whereby, for example, roads are comparably in a better condition and the accessibility to plots is better than in the rest of Karai. Water services, schools, electricity and even housing structures are apparently better in Gikambura than elsewhere in Karai.

For these reasons, this study came to the conclusion that it is only by virtue of its being inside the same administrative boundaries as the rest of the sublocations that Gikambura is classified as ASAL. This issue is crucial as this sublocation is found to be benefiting from resources earmarked for ASAL programmes while in reality it is not an ASAL area.

On the other hand, Nachu Sublocation was found to be worst hit whereby accessibility to the area and its plots is poor. Plot sizes are small, the only borehole in the sublocation is far inside the grazing zone and was not functioning at the time of this study. No one in the sublocation had an

individual piped water connection to their homesteads. In the grazing zone the environment was found to be detereorating fast due to a certain type of ant which was clearing the only available grass wherever it is found. Yet it is in this same zone that the County Council is demarcating the 5-acre plots to settle the landless or near landless.

C H A P T E R VII

SUMMARY, RECOMMENDATIONS AND CONCLUSION

7.0 SUMMARY OF FINDINGS

This study has come up with the following findings which have been used to guide the recommendations in section 7.1.

- a) The physical supply of water in Karai under the existing schemes was found to be less than required to meet the demand for domestic and livestock watering. The major factor which has contributed to this shortage is the fact that the location lacks perennial water sources while the rainfall is also low. Water has therefore been availed from groundwater schemes or from Bathi River water scheme which is from outside the location. These two schemes require heavy initial capital investment which has been a limitation to the water supply for the location.

- b) There were only 14 communal water points (CWPs), which were serving a population of 12,434 people if it is assumed that at least half of the people in Karai get their water from CWPs while the rest were served by individual connections (ICs). This means that on average each point served 888 people while the policy as per design by Ministry of Water

was that each such point should serve not more than 480 people. For the population in Karai to be served at the rate of 480 persons per every on CWP, another 12 CWPs would be required.

- c) In relation to (b) above, the Government policy is to provide water for ASAL areas such that no household is more than 2.5 km away from a water point in the dry season. In Karai, at least 36 percent of those who relied on such points covered a distance greater than 2.5 km.

- d) Even those who were within 2.5 km of a water point were not so well catered for as they had to wait for long hours at the CWPs before being served because one such point served more people than it was designed for. In other circumstances when mechanical breakdowns of the schemes or at CWPs occur, such people had to walk to other points or alternative sources which maybe more than 2.5 km away from their homesteads.

- e) For those people served with individual taps connected from the main water schemes, the flow of water was unreliable so that they too had to rely on other sources occasionally. For such people the lucky ones got water flowing through their pipes once or twice a week. The flow was also in smaller quantities than expected. Others

reported that since they made the piped connections to their homesteads, they only received water once when the Bathi River Water Scheme was being tested and their taps have since been dry. For such people the individual piped water connections are useless as they have had to continue relying on public standpipes just like those who have no individual connections. Their pipes, and hence invested capital, lie idle and are subject to vandalism which was also reported.

f) While physical supply of water was not enough distribution of the little water available was supposed to be done fairly using planned rationalisation methods. However due to laxity and dishonesty of the employees engaged to man the schemes and to distribute the water some of the clients were reported to be offering gifts to the employees in order to get more water than their ration. This has resulted in unequitable distribution of the water with the poor and less influential clientelle being subjected to even more inaccessibility to water.

g) Groundwater and water brought in from an outside scheme (Bathi) are the only sources of water in Karai. Each of these schemes was found to be faced with certain limitations. Extraction of

groundwater was affected by the low depth of the water table and its sensitivity to over-pumping while Bathi scheme was affected by overconsumption of water in areas outside Karai and constant mechanical breakdowns. As such neither of the two schemes were delivering as much water as they were designed to and there was therefore need to rehabilitate them or to search for alternative sources of water for supply to Karai Location.

h) People's incomes were found to be low on the average while there are limited number of economic activities going on in the area. Because of the small plot sizes, the low rainfall and shortage of water, there are no cash-crops. Farming is for subsistence purposes only, while livestock keeping is limited to a few numbers of animals that have adopted themselves to drought conditions such as indigenous cows, chicken, goats, sheep and rabbits. In a few cases bee-keeping was also being practised while the donkey is reared as a beast of foe whose purpose is to transport goods especially water.

i) Because of the recent settlement of people in Karai and the fact that the people have come from a different origins, the people were noted to be very individualistic and to lack social cohesion. As a result, many were not involved in self-help groups,

a condition useful in public participation, but they reported willingness to work together as a community for their own water project.

- j) Because of being in ASAL, having low incomes and being used to help from the Government relief agencies, charitable organisations and crash programmes that only remove the symptoms rather than the essential causes of any problem, the people tended to expect a lot of free service from the Government; an expectation that contradicts the Government policy of "cost-sharing" and public participation.
- k) Two exceptional areas were identified whereby Gikambura sublocation was found to have no characteristics of ASAL areas but continues to benefit from resources earmarked for ASAL areas by virtue of its being administratively in Karai, a location classified under ASAL. On the other hand, whatever indicators are used, Nachu Sublocation seemed to be worst hit and should be the area to be given first priority if and when any projects or programmes are designed for Karai Location.

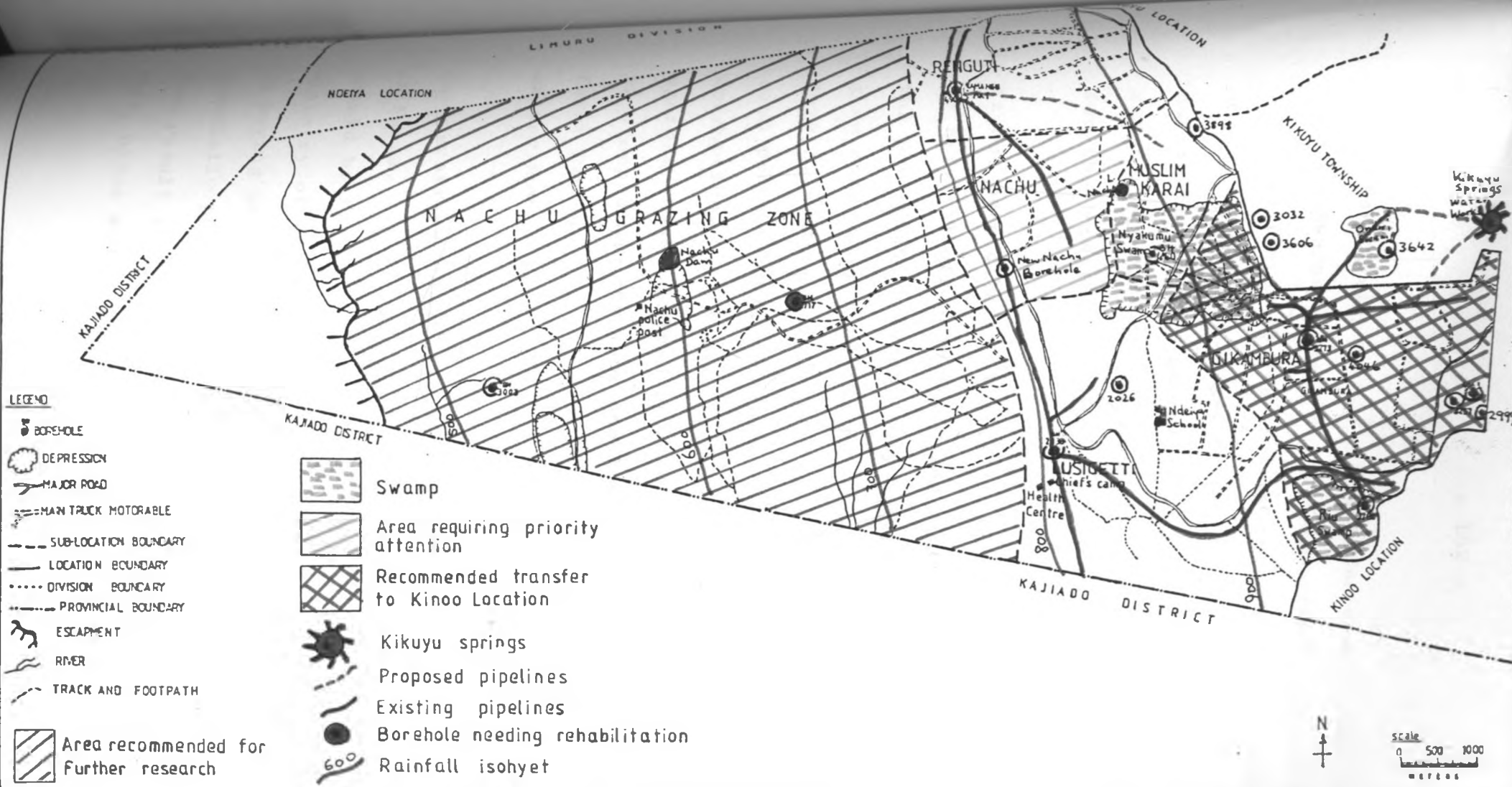
7.1 RECOMMENDATIONS

It is obvious that almost all the problems identified as affecting water supply in Karai can be solved by simply

increasing the amounts of water available to meet the demand. While this may be too an ambitious task it is possible to improve the situation by implementing such policy recommendations as are discussed henceforth. Some of the recommendations can be implemented immediately and would require a short time while others require more time and resources and cannot be instituted immediately. For these reasons they are subdivided into short and long-term policy recommendations.

7.1.1. SHORT-TERM POLICY RECOMMENDATIONS

Since implementation of a water scheme that will ensure enough water is obtained for Karai would require a long time (Section 7.1.2) it is important that the existing schemes are rehabilitated immediately so that they at least provide as much water as they were designed to produce. In particular the borehole in Nachu Grazing Zone (Borehole Number 2717) which was not functioning at the time of this study should be rehabilitated so that it begins to function once again. Some of its water can be directed to the storage tank in Nachu from where it can be distributed to the people. The rest of the water should be retained at the storage tanks near the borehole for use by those people living in the grazing zone to water their animals and for domestic purposes. This will also be an important source of water if and when the Kiambu County Council succeeds in settling people in the 5-acre plot settlement scheme that is being proposed for the grazing zone.



LEGEND

- BOREHOLE
- DEPRESSION
- MAJOR ROAD
- MAIN TRUCK MOTORABLE
- SUB-LOCATION BOUNDARY
- LOCATION BOUNDARY
- DIVISION BOUNDARY
- PROVINCIAL BOUNDARY
- ESCARPMENT
- RIVER
- TRACK AND FOOTPATH
- Area recommended for further research
- Swamp
- Area requiring priority attention
- Recommended transfer to Kinoo Location
- Kikuyu springs
- Proposed pipelines
- Existing pipelines
- Borehole needing rehabilitation
- Rainfall isohyet

KARAI WATER SCHEMES

Other boreholes especially the older ones in Riu and Nyakumu Swamps as well as the Lusigetti boreholes should be investigated to see if they can produce more water if more powerful and larger pumps are installed. If this is viable then the larger pumps should be installed immediately to help increase the amounts of water supply for the location.

It has been alleged that activities that are tantamount to criminal offences are being practised by employees of the Government, whereby they accept gifts in order to give more water than the ration allows to certain clients. This allegation should be investigated immediately and such people should be taken to court and charged with corruption. It is only by taking stern disciplinary action against those involved in such malpractices that they can be stopped and the poor and less influential people in Karai can be assured of their rightful share of water no matter how little.

Co-operatives and self-help groups were found to be missing in Karai. It is therefore recommended that co-operatives should be formed with the assistance of Ministries such as Ministry of Co-operatives. Such co-operatives can start by buying products to feed and improve their livestock, especially poultry, goats and indigenous cows, which would then result in more production of products such as milk, meat, hides and even live animals. These can then be sold

together through the co-operatives. Here it is stressed that to avoid gradual disillusionment there will be need for close supervision and extension services and of course an efficient marketing system that ensures tangible results fairly quickly. Quick results will encourage the people to stick to the co-operatives while at the same time they will become more confident in their leaders.

Self-help groups should also be started; at first on very humble basis such as women's groups getting together on a project such as poultry keeping, making handcraft items for sale, planting and weeding each others gardens or weeding non-members gardens for a fee, Mabati Women's Group and so on. For the purposes of ensuring better water supply for everybody such Mabati Women's groups can construct water storage tanks for each other, doing one at a time until everyone in the group has one. Once there is rain, then each member will store water to last them a longer period than if they had no storage tanks. For those with individual connections they can store water in their tanks on the days that water is flowing in their favour. These kinds of groups have succeeded elsewhere in Central Province and there is no reason why they should not succeed in Karai. All that these people need is honest and committed leaders who will not fail them once the self-help groups are formed.

The final short-term recommendation concerns the fact that Gikambura sublocation which was found to be in ASAL

classification by "mistake" (Chapter VI - Section 68). It is therefore recommended that Gikambura Sublocation be transferred from Karai Location to the neighbouring Kinoo or Kikuyu Locations. Not only would these be the right ecological zones for Gikambura but it will ensure that whatever resources are set aside for the ASAL zone (in Ndeiya and Karai Locations) are used for the betterment of the deserving areas or sublocations. This will of course require boundary changes and should be undertaken by the Office of the President.

7.1.2 LONG-TERM POLICY RECOMMENDATIONS

It can never be overstressed that the problem of water shortage in Karai has its roots in the supply being far less than the demand. Most of the other problems have come about due to this shortage. If therefore adequate supply of water is ensured then all the other problems would be eliminated or reduced significantly. It has also been ascertained that the current schemes are not supplying enough water and there is no hope that they will in the future even after their rehabilitation. There is therefore need to look for alternative sources of water if the demand is ever to be met.

Sinking more boreholes is limited by the fact that the water-table is sensitive to overpumping and underground water could in the long run be depleted or levels lowered so much that more and more powerful pumps would have to be installed as the boreholes are deepened. This is therefore

not a lasting solution for water problems in Karai. The Bathi River Water Scheme, like many other well-known schemes is likely to continue with the problem of overconsumption in the upper areas of the scheme so that even if it was fully functional, its water would never reach Karai in adequate amounts.

It is therefore suggested that the Bathi scheme continues to serve Karai only for as long as no other scheme is installed for Karai. Once another alternative source is found and its water used to supply Karai, then Bathi water supply should be left to serve Lari and Limuru areas.

The only possible alternative source of water for Karai is a perennial source outside the location. The Kikuyu springs whose water is currently being used to serve Nairobi area is the nearest and the easiest source for Karai. Once the Chania III Water Supply Scheme which is about to be started for Nairobi water supply is complete, water from the springs should be released to serve the adjacent locations of Ndeiya and Karai. It had been calculated in 1982 that this source could serve the two locations up to the year 1995. This source together with the borehole schemes should be able to supply water in Karai for intensive livestock keeping and for domestic purposes up to the planned year 2000 A.D. and beyond.

It is therefore recommended that even if it means using political pressure, this water should be released for use

in Ndeiya and Karai Locations. Fear has been expressed that these two locations may not be given the first priority but this study has shown the desperation with which such water is needed for use in Karai and that is why it is being recommended that the politicians from these areas should convince the necessary authorities that Ndeiya and Karai Locations deserve this water more than anybody else.

Once the water from the Kikuyu springs is availed for Karai, the pipe layout in the location would have to be reorganised by disconnecting it from the Bathi scheme and connecting it to the Kikuyu springs scheme. The same individual connections and storage tanks can continue to be used as well as the pumps at the springs. This reorganisation should not cost a lot of money and harambee and self-help efforts should be utilised to supply both capital and labour for this purpose. The Ministry of Water Development can provide the necessary technical assistance.

It is further recommended that no more individual connections are allowed as this encourages luxurious use of water. All other people should be served through communal water points such as water kiosks which should be increased in number according to necessity and availability of funds.

To raise levels of income, it is recommended that due to the small plot sizes only those animals that require less space for grazing should be kept. Amongst these are poultry,

rabbits, pigs and bees. However, for such livestock keeping to succeed in raising levels of income, their production should be intensified and extension services from qualified staff on best methods of livestock keeping, rearing of only those animals that have adapted to dry conditions such as in Karai is highly recommended. Zero-grazing together with agroforestry should be encouraged and intensified as suitable methods of intensifying the rearing of livestock.

To go with livestock keeping should be small-scale industries such as leather curing, slaughter-houses and dairies. Small scale business to sell products such as eggs, chicken, honey and so on should be set up; with those requiring small loans for such activities being allowed to use their plots as collaterals.

The two village polytechnics that were not functioning at the time of this study should be converted to training schools where courses on best methods of keeping livestock are taught as well as other related courses in slaughtering animals, leather curing and bakery. This will ensure that the youth, who are the ones mainly affected by unemployment, are equipped with skills that can be employed in the small scale industries suggested before. At the same time courses in book-keeping and business management should also be taught in these schools so that anyone wishing to start a business is also well prepared for it.

7.1.3 FURTHER RESEARCH

As stated earlier, there are plans to settle people in the Nachu Grazing Zone an area of very fragile ecosystem. Previous experience has shown that unless otherwise instructed such people are likely to continue with the same type of agricultural activities as are appropriate for better watered areas. This is likely to be unsuitable for Nachu and would just destroy the ecosystem and threaten desertification. It is therefore recommended that further research is done to find out which economic activities would be suitable for this grazing zone and that the people to be settled there are instructed beforehand on the only activities that they would be allowed to practise. These activities should be such that they would at least protect the environment there if not improve it.

The insect (ant) noted to be destroying grass in the Nachu Grazing Zone should be researched into in a bid to controlling it before the situation gets out of hand and no more grass is left for grazing the animals.

The commendable role played by the man-made Nachu Dam (found in Nachu Grazing Zone) in the development and sustenance of livestock keeping can not be exaggerated. If anything it serves as an encouragement for more such dams to be constructed everywhere within Karai. This study is therefore recommending that further research should be done to locate suitable sites for such dams which can be constructed by the People of Karai themselves as happened in the previous case.

In this respect, Nyakumu swamp should be one possible site for such a dam. Previously, a lot of water has been found to collect in the swamp during the rainy season so that passability through the swamp was only by use of dug-out canoes (this happened during the rainy period of January to April 1988). However, such water whose depth maybe as high as half a meter is quickly lost after the rains so that two or three weeks later it is possible to walk through the swamp, although still muddy.

It has previously been stipulated that the water in the swamp disappears so quickly because it infiltrates through the faults that criss-cross the bottom of the swamp. If these passages can be sealed, then such water can be retained in the swamp for long periods, the one in Nachu Dam has been found not to dry up even during prolonged drought periods like that of 1984. Since this would be an even larger dam, its water would be expected to last even longer even if used for other purposes not just watering the livestock.

The water from Nyakumu swamp can be used at first for watering the animals only but later, on if need be, it can be treated and used for domestic purposes. While this suggestion may sound repugnant, reassurance should be taken from the fact that in most developed countries, tap-water is usually recycled from sewers and after treatment it is as good as any potable water from the so called "acceptable" sources. After all the people of Karai have demonstrated

this trend when those in the grazing zone admitted that after using locally available herbs to cleanse the dam water, they use it for domestic purposes including drinking.

7.2 CONCLUSION

The problem of water shortage in Karai has been shown to originate from the fact that Karai has no perennial water sources while the only naturally occurring water resource is groundwater. Because of the low water table as well as its heterogeneity, extraction of this groundwater requires heavy capital investment; a major limitation to its extraction. The rainfall is also low and cannot be counted on as an adequate source of water.

Water supply for Karai is therefore obtained from few small scale borehole schemes and Bathi River Water Scheme whose source is outside the location. Still, the supply from these schemes is inadequate necessitating rationing of the available water in a bid to ensure fairness in water distribution so that everyone is served according to the planned ration. However due to institutional arrangements, and unequal income distribution, accessibility to the water has been noted to be unequal so that the rich and influential get more water than their fair share while the poor and less influential get less and less. Corruption and favouritisms are some of the malpractices reported as affecting fair distribution of the available water.

As if to add insult to injury the existing water schemes are also faced with problems such as regular mechanical breakdowns, irregular supply of power to pump water from boreholes and fluctuating groundwater levels. This results in irregular flow of water from the schemes, making it necessary for the residents to rely on more than one source. The people are therefore always uncertain of their water supply and have to spend a lot of time and money on water.

This affects the kind of economic activities that the people can engage in not only because of the short supply of water but also because of the exercise of fetching water leaves the people tired and having little time for such activities. The small land sizes have also added to the seriousness of the economic activities that are undertaken such that no cash crops are grown and only a few animals can be maintained per plot.

Lack of water (or shortage of it) has also limited other economic activities such as intensive agriculture by irrigation, tannaries and dairies.

The crucial problem that therefore needs to be tackled is that of ensuring that enough water for domestic and livestock watering purposes is availed. This would remove all the other consequent problems that have come up as a result of the necessity to ration water. It would also enable the people to engage in more economic activities as water

would be one of the inputs and more time and money would be available for such. This would also raise the levels of income of this rural group which would be in line with the Government's policy for rural development which requires that such projects or programmes to be undertaken if they raise the people's levels of income.

It can therefore never be over-emphasised that by providing enough water to Karai for domestic purposes and limited economic activities such as livestock keeping many problems would be solved. Better health standards, income improvement and reduced social anguish are a few of the benefits that would accrue from improving the poor state of water supply in the location.

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APPENDICES

QUESTIONNAIRE - 1

FOR THOSE WITHOUT PIPED WATER IN THEIR HOMESTEADS:

Sub-location-----

Date -----

Interviewer -----

A. BACKGROUND INFORMATION

1. a) Name of Respondent -----

b) Sex: Male -----

Female -----

2. a) Age -----

b) Place of Birth: -----

c) Village: -----

3. Occupation -----

4. Level of Education -----

5. a) Household Head: Yes -----No -----

b) If no, relationship to household head:

i) wife -----

ii) son -----

iii) daughter -----

iv) other (specify) -----

6. a) Household size -----

6. b) Information about household members:

Table I

	Relation	Age	Sex	Level of Education	Occupation (and where)	Place of Birth
1.						
2.						
3.						
4.						

B. SOCIO-ECONOMIC INFORMATION

7. Where do you get your water from?

Table II

Source	Put a tick () against the response
1. Spring	
2. River	
3. Well	
4. Dam	
5. Public Borehole	
6. Private Borehole	
7. Water Kiosk	
8. Communal Water Point	
9. Neighbour's Supply	
10. Rain-Catchment	
11. Water Vendors	
12. Other (specify)	

8. From the sources mentioned in 7, which ones are more important to you than others (rank them).

Table III

Rank	Source
1	
2	
3	

9. How far do you go for water and how long does it take?

Table IV

	Source	Distance from house to source	Time spent
1.			
2.			
3.			

10. What means do you use for fetching water?

- i) People (backs and heads) -----
- ii) Donkeys and other animals -----
- iii) Purchasing from water vendors -----
- iv) Other means e.g. vehicles, bicycles, wheel
barrows -----

11. Who goes for the water?

- i) household head -----
- ii) spouse -----
- iii) children -----
- iv) others (specify) -----

12. How many trips does the person make per day and what is the capacity of containers used?

Table V

	No. of Trips	Containers used	Estimated Capacity	Daily Trips
1				
2				
3				

13. Do you keep livestock? Yes -----No -----

If yes, specify:

<u>Type</u>	<u>Number</u>
Graded Cows	-----
Sheep and Goats	-----
Traditional Cows	-----
Pigs	-----
Poultry	-----
Other (specify)	-----

14. Where are your animals kept?

- i) On the property (farm) -----
- ii) Elsewhere (specify) -----

15. Do you fetch water for the animals? Yes ----- No -----

If yes, how many debes per day? -----debes/drums

16. If you do not fetch water for the animals, where do they go for watering?

Name the place and source -----, -----

17. How far is this place and how long do the animals take to drink?

-----Km.

-----Hours.

18. Do you consider the water you use to be of good quality for:

	Yes	No
i) Drinking	-----	-----
ii) Cooking	-----	-----
iii) Washing	-----	-----
iv) Animal watering	-----	-----

19. If answer to 19 is no, give the reasons.

- i) -----
- ii) -----
- iii) -----

20. Do you at any time use rain-catchment water? Yes---- No --

21. If answer to 20 is yes, what type of containers do you use?

- i) Pots and pans -----
- ii) Debes -----
- iii) Drums
- iv) G.C.I. Tank -----

21 (contd.)

v) Concrete tank -----

vi) Other (specify) -----

22. If tanks are used, what type and capacity?

Concrete -----; ----- litres

G.C.I. -----; ----- litres

Blocks -----; ----- litres

23. How long do the supplies last? ----- days

24. What was the initial cost of constructing the tank(s)
and their accessories? KShs. -----

25. Do you consider this source reliable? Yes ----- No -----
Why? -----

26. From the other sources you use, do you experience any
problems?

Yes ----- No -----

If yes, what are the problems?

i) Source too far -----

ii) Source unreliable -----

iii) Water unsuitable -----

iv) Too much money paid for water -----

v) Other (specify) -----

27. If you pay for water you presently use, do you think
the cost of water is,

High -----, normal -----, low -----

28. Do you believe the time, effort and money employed in obtaining water is:

Too much -----, normal -----, little -----

29. If the answer to 29 is "Too much", how would you spend time released from fetching water?

In agriculture -----

In looking after the house -----

Other (specify) -----

30. a) What other factors may have contributed to shortage of water in this area?

i) -----

ii) -----

iii) -----

b) Why do you think water from schemes such as Bathi has not reached you up to now?

i) -----

ii) -----

iii) -----

31. Do you have any idea of what could be done in order to help you obtain a good quality of water at a close distance?

Yes ----- No -----

If yes, what is (are) your idea(s)?

32. Why do you think this has not been done before?

33. Do you have any idea on who should be involved in bringing tapped water to your area?

- i) Government -----
- ii) Self-help groups -----
- iii) Both the above -----
- iv) Other (specify) -----

34. Are there self-help activities in the area in which you are involved?

Yes ----- No -----

Office held -----

35. Would you be willing to work with other people to improve water supply in your area?

Yes ----- No -----

If yes, whom? i) Self-help groups -----

ii) The community (villagers) -----

iii) Other (specify) -----

36. Would you be willing to contribute towards a water supply scheme for this location?

Yes ----- No -----

If yes, how much money? -----KShs.

how much in terms of labour -----days/week

37. What type of water supply would you prefer?

i) individual connection -----

ii) water kiosk (5 Km. apart) -----

iii) communal water point -----
(spaced 1 - 2 Km. apart)

iv) Other type (specify) -----

v) no connections (give reasons) -----

38. How much would you be prepared to pay for
- i) individual connection? -----KShs.
 - ii) communal water point? -----KShs.
 - iii) Water kiosk? -----KShs.

39. If individual connection, would you prefer to pay a flat rate or at a rate depending on the amount of water you use? (Metered)

Flat rate -----

Metered -----

40. For communal water point would you prefer to pay individually or as part of a group?

individually -----

part of a group -----

41. How far would you be prepared to walk to a communal water point?

----- Km

Why? -----

42. If water were available in adequate quantities, how else would you use it other than for domestic and livestock watering purposes?

i) -----

ii) -----

iii) -----

43. Do you own this land? Yes ----- No -----

44. How big is it?-----acres.

45. What crops do you grow?

46. Where are the nearest services and how long does it take to reach them?

	Facility	Where found	Time to reach them
i)	Shops		
ii)	Market		
iii)	Post-office		
iv)	Bus		
v)	Health care/dispensary		

47. a) What other problems do you have in Karai Location?

i) shortage of energy (e.g. fuelwood and kerosene)

ii) Landlessness -----

iii) Medical facilities -----

iv) Schools and training centres -----

v) Transport -----

vi) Others (specify) -----

b) Which are the three most acute problems?

i) -----

ii) -----

iii) -----

(Fill in answers in order of magnitude or importance)

c) How does water rank amongst these problems?

1st -----, 2nd -----, 3rd-----position

DRAFT QUESTIONNAIRE - II

FOR THOSE WITH PIPED WATER IN THEIR HOMESTEADS

1. Sublocation -----
Date -----
Interviewer -----

BACKGROUND INFORMATION

1. a) Name of Respondent -----
b) Sex: Male ----- Female -----
2. a) Age -----
b) Place of Birth -----
c) Village -----
3. Occupation -----
4. Level of Education -----
5. a) Household Head? Yes ----- No -----
b) If no, relationship to household head:
i) Wife -----
ii) Son -----
iii) Daughter -----
iv) Other (specify) -----
6. a) Household size -----

b) Information about household members:

Relation	Age	Sex	Level of Education	Occupation (and where)	Place of Birth

B. SOCIO-ECONOMIC DATA

7. Where do you get your water from?

- i) Private borehole -----
- ii) Well -----
- iii) Spring -----
- iv) Bathi water scheme -----
- v) Public boreholes -----
- vi) Other (specify) -----

8. How long have you been using this water?-----years

9. Did you have to do the individual connection yourself?

Yes ----- No -----

If no, who did it for you? -----

10. What was the cost of installing the connections?

-----KShs.

11. If the source is individual borehole:

- a) When was it dug? -----
- b) By whom? -----
- c) What was the cost of digging the borehole?-----KShs

12. If the borehole is fitted with a pump,

- a) Type of pump -----(diesel) engine, electric
etc.)
- b) Initial cost of pump and pipes -----

13. Are there piped connections:

- i) Inside the house -----
- ii) Outside the homestead -----
- iii) Both -----

14. Do you at any time have any problems with your supply?

- If yes which? i) -----
- ii) -----

15. a) Do you make use of other sources? Yes----- No -----

- b) If yes, which ones? i) roof-catchment -----
- ii) public boreholes -----
- iii) communal water points -----
- iv) water kiosks -----
- v) buy from vendors -----
- vi) other (specify) -----

c) Why is it necessary to use water from other sources?

16. a) Do you at any time sell water? Yes----- No -----
b) If yes, to whom? -----
----- (eg. neighbours,
water vendors)
c) At what prices do you sell the water?
-----KShs./drum/debe.
17. Does the sale of water help to recover the initial cost
of installing the piped water?
Yes ----- No ----- Negligibly -----
18. Do you own this piece of land? Yes -----No -----
19. How big is it? ----- acres.
20. What agricultural activities do you involve yourself in?
i) Subsistence crop growing -----
ii) Cash-crop growing (specify) -----
iii) Livestock Keeping (name the types) -----
iv) Others (specify) -----
21. Has the availability of water helped in releasing more
time for:
i) farming -----
ii) other capital generating activities e.g. business-----

iii) looking after the family -----
iv) recreation and social activities -----
v) other (specify) -----

22. Are there any activities in your land which are only possible due to the water supply?

Yes ----- No -----

If yes, which ones? -----

23. What advantages do you think you have over those who have no water?

i) More time for other activities -----

ii) Increased income for sale of water -----

iii) Increased income from use of water for agricultural purposes -----

iv) Better health and cleanliness -----

v) Other (specify) -----

24. If your water supply is unreliable (irregular flow, or unsuitable), what do you think can be done to improve the situation?

i) -----

ii) -----

iii) -----

25. a) Do you pay for your water? Yes ----- No -----

b) Do you consider the cost to be:

High ----- Normal ----- Low -----

26. Would you be willing to spend more money in order to obtain more water for drinking and other purposes?

Yes ----- No -----

26. Contd.....

If No, why? -----

If Yes, how much? Little more: -----
Much more: -----

27. In your opinion, what do you think has contributed to shortage of water in this location?

- i) -----
- ii) -----
- iii) -----

28. Why do you think the existing sources of water have failed to meet the demand of water in this area?

- i) Inadequate supplies from source -----
- ii) Breakdown of pipes -----
- iii) People in upper area using more water than their share -----
- iv) People in this area are not able to pay for the water -----
- v) Others (specify) -----

29. How do you think the problems can be solved?

- i) -----
- ii) -----
- iii) -----

30. Why do you think this has not been done before?

- i) -----
- ii) -----
- iii) -----

31. In your opinion what are the most serious problems that face "Wananchi" in this location?

(List them in order of importance)

- i) -----
- ii) -----
- iii) -----
- iv) -----
- v) -----

32. Any other comments from respondent or observations by the interviewer:

QUESTIONNAIRE - III

FOR SELLERS OF WATER

Sublocation -----

Date -----

Interviewer -----

1. a) Name of Respondent -----

b) Age -----

c) Sex: Male ----- Female -----

d) Place of Birth -----

e) (i) Employed to man the water point -----

(ii) Owner of the water point -----

2. a) Village (situation of the water point) -----

b) Ownership:

(i) Government -----

(ii) Kiambu County Council -----

(iii) Individual -----

(iv) Other (e.g. institution) -----

3. Source(s) of water:

(i) borehole -----

(ii) Government supply scheme -----

(iii) Other (specify) -----

4. If the source of water is a borehole or well,

a) What is the depth of the borehole or well? -----m.

b) What is the capacity of the pumping devise? -----m³/hr.

c) Maximum output of source per day in dry season

-----m³.

d) Maximum output of source per day in wet season

-----m³

5. Is the water pumped from the source? Yes ----- No -----

If Yes, what sort of pump has been installed?

i) Diesel pump -----

ii) Electrical pump -----

iii) Hand-pump -----

iv) Other (specify) -----

6. In what sort of premises is the water sold?

i) Water kiosk -----

ii) Tap in the open -----

iii) Other (specify) -----

7. What was the initial cost of installing the pump (and other equipment and facilities)?

-----KShs.

8. When was the sale of water started from this point?

Year: -----

9. a) Do you have a constant supply throughout the year?

Yes ----- No -----

b) If no, how does the supply fluctuate?-----

c) Is there any time when the taps are completely dry?

Yes ----- No -----

If Yes, when? -----

10. a) Do you sell water throughout the year?
Yes ----- No -----
- b) If no, why? -----

- c) If yes, are there any seasons in the year when you
sell more than others?
- i) During wet season -----
 - ii) During dry season -----
 - iii) Other (specify) -----

11. How much do you sell your water?
- i) -----KShs. per debe
 - ii) -----KShs. per drum

12. a) Are your prices the same throughout the year?
Yes ----- No -----
- b) If no, give reasons for the variation
- i) -----
 - ii) -----
 - iii) -----

13. Who comes to buy the water from here?
- i) Men -----
 - ii) Women -----
 - iii) Children -----
 - iv) Water vendors -----
 - v) Other (specify) -----

14. How far do the buyers come from?

Approximate distance in Km. is -----to -----

15. a) What means of transport are mostly used?

- i) Human (heads and backs) -----
- ii) Donkey carts/donkeys -----
- iii) Wheelbarrows -----
- iv) Bicycles -----
- v) Motor-vehicles -----
- vi) Other (specify) -----

b) What sort of containers are mostly used for carrying the water?

- i) Drums -----
- ii) Debes -----
- iii) Pots -----
- iv) Others (e.g. jerry cans, plastic tins etc.) -----

16. How many times on average do you sell the water to an individual per day?

- i) those using human transport;-----times per day
- ii) those using wheelbarrows; -----times per day
- iii) water vendors; -----times per day
- iv) those using bicycles;-----times per day
- v) those using vehicles; -----times per day
- vi) others (specify) -----times per day

17. How much water do you sell on average per day?

- i) During the wet season;-----litres per day
- ii) During the dry season;-----litres per day

18. When is the peak hour for selling water from here?

- i) early in the morning -----
- ii) later in the morning -----
- iii) lunch hour -----
- iv) in the afternoons -----
- v) in the evening -----
- vi) throughout the day -----

19. Are there any times during the day (or a period in the year) when people have to queue up waiting to buy the water?

Yes ----- No -----

If yes, when? -----

20. Are the people who buy water from this point the same people throughout the year or do you sometimes get people from different areas?

- i) same people throughout the year -----
- ii) varies with seasons -----

21. Do you have any problems with your water point:

- i) from the mechanical installations: Yes----- No -----
- ii) from the buyers Yes ----- No -----
- iii) Others Yes ----- No -----

Explain:-----

22. If the respondent owns the water point:

a) Has the sale of water assisted you in recovering the initial cost of the installations?

Yes ----- No -----

b) How else do you earn your income?

i) Agriculture -----

ii) Salary -----

iii) Business -----

iv) Others -----

23. Are there people you know who cannot afford to buy water?

Yes ----- No -----

If yes, in what ways are you able to help them?

i) By giving them water free of charge -----

ii) Allowing them to do certain jobs for me in exchange of water (e.g. to cultivate my land) -----

iii) Other ways:

Explain -----

24. Further comments from the respondent and/or observations by the interviewer:
