TOWARDS APPROPRIATE SAFE WATER AND SANITATION SYSTEMS IN LOW-INCOME URBAN SETTLEMENTS: A CASE STUDY OF LANGAS IN ELDORET MUNICIPALITY, KENYA

BY

ROSE MUMBUA MUTUNGA

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

SEPTEMBER, 1996

DECLARATION

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

Signed _____

ROSE NUMBUA MUTUNGA
(Candidate)

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

Signed _____

MR. EVANS O. MAIRURA
(Supervisor)

DEDICATION

To

My Son, Mwendwa and Husband, Musyoka

and

Extended family

ACKNOWLEDGEMENTS

This work would not have been possible without the devoted help of my lecturers and fellow colleagues. I am particularly indebted to Mr. Mairura, my supervisor for his guidance.

I owe many thanks to Dr. Ndegwa and Mr. Maleche for their devoted assistance towards the development of this work. I am grateful to the Eldoret municipal personnel and the Langas area development committee for their co-operation during my fieldwork.

Finally, I wish to express my gratitude to my husband for his moral support and contribution towards this work.

ABSTRACT

Basic infrastructure, which includes water supply, sanitation, drainage and solid - waste disposal services is essential for safeguarding health, protecting the environment and promoting the efficient operation of human settlements. Where these services are lacking or inadequate, both health and environmental problems are likely to occur.

This study aims at examining the present water supply and waste management systems used in the area of study, with a view to establishing the factors that may have contributed to the present situation (of inadequacy) of the same.

The Study findings show that the existing water supply and sanitation systems have various limitations and are therefore inadequate considering the high population density of the study area. Various factors are responsible for this situation. These factors include soil characteristics, lack of support services, socio-economic factors and institutional prejudice among others. It is also evident that investment in housing does not seem to take into account crucial services such as sanitation and water supply systems as some of the built plots in the area of study lack these essential facilities.

Recommendations made in this study are geared towards reversing the present situation (of inadequacy of essential services) to one where every resident of the area can have easy access to these services. It is therefore recommended that water supply and sanitation systems should be adequate and appropriate

in order to achieve health goals and a sanitary environment. However, on their own, water and waste management systems cannot achieve health goals; they require support services such as lighting, access roads and public health education among others.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

FIGURES

TABLES

LIST OF PLATES

CHAPTER ONE

INTRODUCTION

1.1 Overview

A recent report by the World Health Organisation (WHO) commission on health and the environment states that it is biological pathogens in the human environment plus the high proportion of people who lack access to clean water and other essential sanitation facilities which represent far more serious environmental problems than chemical contamination both in urban and rural areas (WHO, 1992). That notwithstanding, most governments and urban authorities have been unable to ensure that all urban dwellers have the basic infrastructure and services essential for health and decent living environment.

The importance of providing safe and adequate water supply and sanitation has received attention both locally and internationally. The United Nations Water conference held at Mar del Plata, Argentina, in 1977 recommended that the period 1981-1990 be designated International Drinking Water Supply and Sanitation Decade. The Decade was launched by the General Assembly in 1980 (Habitat, 1986). The General Assembly stated that during the Decade, member states (of which Kenya is) would assume a commitment to bring about a substantial improvement in the standards and levels of services in drinking water supply and sanitation by the year 1990.

A convenient supply of safe water and the sanitary disposal of human wastes are essential ingredients of a healthy productive

CHAPTER ONE

INTRODUCTION

1.1 Overview

A recent report by the World Health Organisation (WHO) commission on health and the environment states that it is biological pathogens in the human environment plus the high proportion of people who lack access to clean water and other essential sanitation facilities which represent far more serious environmental problems than chemical contamination both in urban and rural areas (WHO, 1992). That notwithstanding, most governments and urban authorities have been unable to ensure that all urban dwellers have the basic infrastructure and services essential for health and decent living environment.

The importance of providing safe and adequate water supply and sanitation has received attention both locally and internationally. The United Nations Water conference held at Mar del Plata, Argentina, in 1977 recommended that the period 1981-1990 be designated International Drinking Water Supply and Sanitation Decade. The Decade was launched by the General Assembly in 1980 (Habitat, 1986). The General Assembly stated that during the Decade, member states (of which Kenya is) would assume a commitment to bring about a substantial improvement in the standards and levels of services in drinking water supply and sanitation by the year 1990.

A convenient supply of safe water and the sanitary disposal of human wastes are essential ingredients of a healthy productive

life (Kalbermatten, 1980:1). Water that is not safe for human consumption can spread diseases. Similarly, poor and inadequate facilities for excreta disposal reduce the potential benefits of a safe water supply by transmitting pathogens from infected to healthy persons.

Moreover, it is the low income people who suffer most from the absence of safe water and sanitation because they lack not only the means to provide for such facilities, but also information on how to minimize the ill effects of the unsanitary conditions in which they live (ibid). However, one of the fundamental problems in increasing sanitation coverage in urban areas is the high cost of conventional sanitation services. Effective and affordable means of providing sanitation to these areas therefore, requires urgent consideration.

The Kenya Government's position on informal settlements is that squatters should be offered an alternative resettlement site before being evicted. Beyond that there seems to be no Government policies dealing with informal settlements (Kunguru and Mwiraria, 1991:10). However, this position is somewhat biased for it seems to maintain that it is only squatter settlements that are informal. But informal settlements are also found in legally occupied land where the land occupants are unable to put up durable houses and provide services. A case in point are most of Kenyan towns where one finds a mixture of both permanent and semi-permanent structures. Indeed, informal settlements could be described as typically consisting of semi-

permanent structures, built in an unplanned manner on legally or illegally occupied land (Kunguru and Kariuki, 1995:1).

An inventory of Nairobi's informal settlements identified the following major characteristics:

(i) structures/houses are constructed primarily of temporary materials and do not conform to minimum standards;

(ii) densities are high, typically 250 units per hectare compare to 25 per hectare in middle income areas;

(iii) physical layouts are relatively haphazard making it difficult to introduce access roads, pathways, drainage, water and sanitation services;

(iv) the majority of residents have low or very low incomes;

(v) urban services such as water and sanitation are either non-existent or minimal;

(vi) morbidity and mortality caused by diseases stemming from environmental conditions are significantly higher than in other areas of the city, owing to poor sanitation, lack of potable water, poor drainage, uncollected refuse and overcrowding (USAID/REDSO/ESA,1993:5). It is, however, important to note that these characteristics apply to most other informal settlements in other Kenyan towns.

1.1.1 Statement of the Problem

The provision of basic infrastructure services that is water supply, sanitation, drainage and solid-waste disposal is

essential for safeguarding health, protecting the environment and promoting the efficient operation of human settlements. Although the need to provide basic services is well recognized, a number of factors seem to thwart action to change present conditions. Such factors range from inappropriate technologies, weak institutional arrangements to inadequate financial-resource mobilization.

The problem of unsafe water supply and poor sanitation is of concern in most developing countries, especially in the low-income urban settlements. Human activities and the people themselves generate a lot of waste which if not well disposed of can lead to health hazards and environmental degradation. As global urbanization continues to grow, so will the low-income urban settlements as these house majority of the low-income earners.

The intolerable and worsening living environments of the low-income urban dwellers coupled with their implications in terms of human suffering, deteriorating health and reduced life expectancy are a major concern. Therefore, the improvement of the living environment of these people should be a priority of most governments, especially those of developing countries.

The 1981 to 1990 period was adopted by the General Assembly of the United Nations as the International Drinking water supply and Sanitation Decade. The goal of the decade was that by the end of 1990, all people should have adequate safe water supply and satisfactory means of excreta and sullage disposal(Mara,

1982).

Provision of a sanitary excreta disposal system is listed by the World Health Organization (WHO) expert committee on environmental sanitation (1954) among the basic steps that should be taken toward ensuring a safe environment in any community (IDRC,1980). It is now six years since the end of the decade and water supply and waste disposal problems still continue to be experienced in most urban settlements, especially the low income ones. But organized community life cannot exist without the twin services of water supply and sewage disposal. Thus water supply and sewage disposal services should be considered as a joint block.

The World Health Organization (WHO) in 1983 estimated that of the total population of 2,552 million in developing countries (excluding China), 52 per cent had access to some form of water supply and only 29 per cent had access to sanitation (HABITAT,1986:2). Although globally some encouraging progress has been registered since the start of the United Nations International Drinking Water Supply and Sanitation Decade, the increased number of persons served has not been sufficient to keep pace with population increases, and the overall number unserved have remained almost unchanged (WHO,1985).

A study carried out by German Environmental consultants in Eldoret found that about 58.7% of low-income urban settlement residents get water from shallow wells and only 35.5% especially in Langas use Municipal council water from water kiosks for

domestic purposes (German Environmental consultants Vol. 1, 1989:4, and Vol. 11, 1989:19). Another study carried out in Langas by Wanyonyi (1994) showed that 55% of the residents get their water from wells. A more recent study on safe water environment in Eldoret municipality in 1995, found that only a few people seem to be aware of underground contamination of water through seepage from pit-latrines to wells. But an analysis of water samples from the area during the study indicated that pit latrines (which form the major human waste disposal system in the area) may be a source of well water contamination through underground transport of pathogens (Maithya and Akong'a, 1995:12). The implication of this sanitation system on land availability for more latrines and the possible contamination of ground water sources cannot therefore be overstated.

However, these studies do not seem to have tackled the problem of inadequate water supply in the area nor have they proposed more appropriate sanitation systems for the area. It is in light of the findings of these studies that the researcher proposes to investigate the factors underlying inadequate safe water supply and poor sanitation in the area of study with a view to suggesting appropriate safe water supply and sanitation systems for the area.

1.1.2 Study Objectives

The following are the study objectives:

(1) To highlight the present water supply and waste management systems used in Langas area and identify their limitations.

(2) To examine the factors that have contributed to inadequate and unsafe water supply and poor sanitation in the area.

(3) To propose ways of developing adequate water supply and sanitary services in Langas, Eldoret.

1.1.3 Study Assumptions

(1) The present waste management systems used in the area are inadequate.

(2) The physical conditions of the area adversely affect sanitation and water supply systems in the area.

(3) The socio-economic status of the residents contributes to the present unsanitary conditions of the area.

1.1.4 Justification of the Study

Urban areas are growing very rapidly in nearly all developing countries. The low-income settlements which accommodate the greatest proportion of the urban population are growing even faster. Indeed estimates range from 6-12% annually in these countries, and Kenya is no exception. This fast growth of urban centres has resulted in an immeasurable number of urban

environmental problems such as mushrooming of informal settlements, poor drainage, lack of adequate safe water and poor sanitation among others (Obudho etal, 1991). Inadequate disposal of excreta is perhaps the single most important factor in the transmission of serious diseases causing both disability and death in these areas (Habitat, 1986).

Kenya's urban centres have been growing rapidly in the last two decades. For instance the urban population has been growing within the range of 6 to 8 per cent per annum (Obudho etal, 1991). This growth is manifest in high population growth rates that have resulted mainly from immigration into the urban centres. The high population growth rate has not been marched by an equal expansion of water and sanitary infrastractural services and facilities. Indeed, most urban low-income settlements lack appropriate and adequate waste disposal systems and adequate safe water supply systems and this has resulted in an unsanitary environment which is a health hazard to the residents.

Various studies have recently been conducted in Langas for example, Nyaoro (1992), Wanyonyi (1994), and the Safe Water Environment study of 1995. These studies do not however seem to have tackled the problem of inadequacy of safe water and poor sanitation systems in the area. It is in light of this that the researcher will suggest appropriate safe water and sanitation systems in the area. Therefore, the current study is going to contribute towards offering possible solutions to the identified problems in the area of study.

1.1.5 Scope of the Study

This study was carried out in a low-income urban settlement (Langas) within Eldoret municipality. The study aims at exploring the factors that could be responsible for inadequate safe water supply and poor sanitation in the area. These two problems are evidenced by the fact that about 55% of the residents get their water from unprotected shallow wells (Wanyonyi,1994). In addition, there seems to be general poor management of wastes in the area manifested in careless disposal of human waste in open areas close to houses. Thus the study was to explore and suggest solutions to these problems.

1.2 Study Methodology

1.2.1 Reconnaissance Survey

A reconnaissance survey was undertaken first for the researcher to familiarise herself with the study area. During this survey, the researcher identified key-informants and made appointments with them where necessary.

1.2.2 Data Collection Methods

The study was carried out in Langas, a peri-urban area of Eldoret Municipality where the need for improved water and sanitary facilities is apparently great. The area has a projected population of 51,793 people. The area of study measures 24 sq.km. Data were collected from both secondary and primary sources. Secondary sources include relevant published

and unpublished literature such as text books, policy documents and/or seminar/conference papers. Primary data was obtained through interviews which were either oral or written. Observation and photography were used to supplement the other data sources. Two sets of questionnaires were used namely;

a) Household questionnaire which was administered to the sampled households.

b) Institutional questionnaire which was administered to Eldoret municipal council personnel.

1.2.3 Sampling Techniques

Since it was not possible to study the whole population of the study area given time and financial constraints, a study sample was drawn from the population. Simple random sampling technique was used to draw the study sample. The area of study is sub-divided into a total of 1850 plots. The study sample was drawn from the entire area on the basis of the (area characteristics) water and sanitation facilities therein. The individual plots house numerous households.

Sixty plots were randomly sampled for the study. Then from each of the 60 plots, a household was randomly selected making a total of 60 households. Then from each household, one adult member was randomly selected for interviewing.

1.2.4 Data Collection

In order to meet the objectives of the study, data was

collected on the socio-economic status of the households. This included information on education level, monthly income, house ownership, type of building and size and housing related problems in the area.

Information on the various water supply and sanitation systems used in the area and their shortcomings was collected. In addition to this, data on preferred improvements in as far as water supply and sanitation systems in the area are concerned were recorded.

Besides the household data, technical data was obtained from Eldoret Municipal council personnel. This covered aspects such as the role that the council plays in the provision of infrastructural facilities in the study area. Whether the area of study is recognized by the council particularly sections/blocks 1-4 as these have been planned although development in the area has preceded planning. The amount of water consumed per day in the study area from the municipal water supply and the financial status of the council among other aspects.

1.2.5 Constraints to Data Collection

Linguistic problems in translation were encountered as some english words lack precise words in kiswahili. This was solved by use of concepts rather than precise names to define english words.

Some respondents were reluctant to give full information

about their financial status. This problem was overcome by use of range of incomes for example, Ksh 1000-2000 per month and by observation to establish what material possessions the respondents have and their quality. There was problem of insecurity and suspicion. This was caused by the fact that most of the area residents are engaged in illicit trades/activities such as brewing illicit liquor, and are generally suspicious of, and hostile to any stranger for they imagine that they are being spied on. This problem was overcome by using the village elders who accompanied and told the area residents that the researcher did not have any bad intentions.

In some cases, respondents were absent or were unwilling to respond. Where the would-be respondents were absent, another household was picked within the same plot. The same applied to cases where the respondents refused to respond to questions.

1.2.6 Data Analysis

Descriptive analysis has been used to summarise, describe and the data. Data presentation techniques such as tables, pie charts and bar graphs have been used to present the findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Urban areas in developing countries are growing at an overwhelming rate. The rapid growth of the urban population and the increased concentration of the poor in urban areas of developing countries places strains on urban services. In almost all large urban centres in developing countries, low-income households have service coverage that is far below the average. This problem is aggravated by the rapid growth of slum and squatter settlements in third world urban settlements (Habitat, 1987:11). It is estimated that by the year 2000, 50% of the developing world's population will leave in urban areas (Kunguru and Mwiraria, 1991:3). Despite continued focus on rural development, urbanization has proceeded in Africa. However, the pace of development has not kept up with rapid urban growth. Thus shortages of low-cost housing persist and informal settlements continue to absorb the majority of the low-income urban population. For instance in Nairobi alone, the number of people in such settlements is estimated at over one million (NACHU,1990).

Kenya is urbanizing by more than 8 per cent per year, giving it one of the highest rates in the world (Sumka, 1991:26). But the pressures of rapid growth and increasing concentrations of low-income population are being felt throughout the country as evidenced by the mushrooming of numerous informal settlements in

most Kenyan urban centres. According to Kunguru and Mwiraria (1991:3), population growth rates in informal urban settlements in Kenya are as high as 12 per cent per annum, whereas the overall urban growth rate is 6 per cent per annum and declining. Informal settlements accommodate about 40-60 per cent of the urban population (Ibid.) but that notwithstanding, they lack adequate infrastructural facilities.

Kalbermatten (1980) contends that a convenient supply of safe water and the sanitary disposal of human wastes are essential ingredients of a health productive life. However, according to data collected by the World Health Organization (WHO) in 1977, only about one third of the population in developing countries had adequate sanitation services. The same message is emphasized by Akong'a and Maithya (1995) when they assert that the problem of availability of water in desirable quantities and quality has become a major one especially in peri-urban areas in technologically less developed countries like Kenya. In Kenya for example, 30 to 40 per cent of urban residents are found in slums where there are no adequate services such as the provision of piped water, street lighting, drainage, garbage collection and public toilets among others (Ibid.). Also, there seems to be very little co-ordination of water supply development, sanitation and public hygiene (Nyaoro, 1992:11). In the same vein, Mairura, (1988) is in consonance with Kalbermatten that adequate safe water and sanitation systems are integral in human health and their absence or inadequacy can only jeopardize

people's health. Therefore, any human settlement should incorporate water and sanitation services as part and parcel of the total environment.

The Kenya government's policy on provision of water is to facilitate the development and distribution of water in sufficient quantity and quality to meet the growing needs of various consumers (Republic of Kenya,1994/96:89). Therefore, Kenya's planning target on water is to provide clean and portable water at a source less than five kilometres in both high potential and low potential areas by the year 2000. To realize this objective, the government has however introduced cost sharing owing to escalating costs of providing water. Thus community participation has become very crucial in helping achieve this goal. The government recognizes the fact that the adequacy of housing is determined not only by the shelter it provides but also by the entire system of supportive and facilitative infrastructure and services (Republic of Kenya, 1989/93:24). It is in light of this that the government continues to support provision of infrastructural facilities both in rural and urban areas.

One of the principal benefits of improved sanitation is improved health. Excreta contain a wide variety of human pathogens and the removal of these pathogens from the immediate environment which is achieved by proper sanitation can have a dramatic impact on community health (World Bank,1980). Behaviours and facilities associated with the safe disposal of

human excreta and use of water for hygiene are some of the important measures for controlling certain diseases. That notwithstanding, in most urban development programmes, water supplies are constantly upgraded but sanitation does not seem to receive the same attention (Arnold,1978). This situation seems to obtain in Langas as the Eldoret Municipal council has for example made efforts to supply the residents with tap water through water kiosks but not much attention has been paid to sanitation. This is indeed supported by a study that was carried out by the German Environmental consultants that revealed that there is a major problem in the disposal of human wastes (German Environmental consultants, Vol.I,1989:83).

Successful provision of sanitation facilities in developing countries is, however, constrained by lack of funds, lack of knowledge about non-conventional sanitation technologies, and weak institutions with few trained personnel. There is also a general negative attitude towards the provision of basic services in low-income urban settlements. However, a number of technologies for sanitation which are less costly than conventional sewerage, yet able to provide the same health benefits and be both socially and environmentally acceptable to the users have been identified (Habitat, 1986). It is also important that such technologies reflect the communities' preferences (Kalbermatten,1980:3).

2.2 Problem Issues that explain Poor Provision of Infrastructure Services in Low-Income Settlements

The Nairobi city Commission (1991) highlights various problem issues that explain poor provision of infrastructure services in low-income settlements, among them are:

2.2.1 Land

Access to land by low income people in urban areas is difficult due to the following:

i) High and growing demand for land pushing prices above levels affordable by low-income people

ii) Insufficient land allocated to low-income groups

iii) Cumbersome administrative procedures

iv) Lack of appropriate land tenure arrangement for informal settlements.

2.2.2 Policy

Lack of recognition of existing informal settlements by the Government and Local Authorities, and the fact that they are not covered by planning and development legislation prevents any substantial action to improve poor or inadequate living conditions. Besides, lack of secure land tenure prevents interventions by potential development agencies including local authorities, and tends to block the self-help potential of people in informal settlements.

2.2.3 Resources

Financial resources are limited among the low-income people for they do not have adequate cash and credit is unavailable due to lack of collateral. There is also lack of cohesion due to migratory tendencies that makes it difficult for the community to mobilize resources for community needs. In addition, the government and external support agencies are reluctant to allocate resources for activities which are considered "illegal".

2.2.4 Information

A lot of information with regard to population size, distribution by age and gender, household size, living conditions in informal settlements makes it difficult to plan for development and to estimate the required resources.

The foregoing problem issues pose a great challenge to planners in dealing with the low-income urban settlements. That notwithstanding, there is need for planners to extricate themselves from rigid development standards with a view to paving way for the recognition of informal settlements in urban areas for they provide affordable shelter to the low-income group of urban dwellers.

2.3 Kenyan Situation

Access to safe drinking water in Kenya depends partly on the availability and partly on the distribution of water resources. In Kenya, a person who lives in an area of medium to high

rainfall potential (water-rich areas) is considered to have access to safe water if he/she can obtain 20 litres of safe drinking water every day from a source which is within 1 km walking distance. In areas of low rainfall potential (water-poor areas), the distance increases to 4 km (GOK and UNICEF, 1992).

Kenyans living in planned high density areas have access to safe water in the greatest proportion (92% nationally), with the access levels dropping sharply for slum dwellers to 53% and rural dwellers 42%. In Kenya, drinking water is obtained from any of the following sources:

(i) surface water sources (rivers, lakes, ponds)

(ii) ground water sources (both unprotected and protected springs or wells)

(iii) roof catchment in medium to high rainfall areas

(iv) piped water supplies

Recent household welfare monitoring and evaluation surveys (1991-1992) indicate that the bulk of households sampled get their water from unsafe sources. Thus most households in Kenya are exposed to potentially contaminated water.

2.3.1 Water in Slum Areas

Obtaining safe drinking water is often very difficult for residents of Kenyan's urban slum areas. This is due to the fact that in most urban areas, adequate water systems either do not exist at all or are not extended to the unplanned settlements (GOK and UNICEF, 1992). Therefore, residents of these unplanned

settlements are forced to look for alternative, usually unsafe sources of water. Given this background, access to safe drinking water in areas of low-income and high population density is generally poor throughout the country; for instance in Mombasa, 63% of slum dwellers did not have access to any source of safe drinking water by 1992 (Ibid.). The following are the major sources of water in the unplanned urban settlements: public standpipes, house connections, vendors, rivers, wells and springs.

However, the proportion of the dwellers with house connections is very low in most urban areas; for example in Nairobi, there were only 22% while in Mombasa only 2% of the residents had house connections (CBS, 1990; AMREF, 1992).
Improving the provision of safe drinking water in Kenya's unplanned urban settlements is difficult due to the following;
i) the responsible local government councils lack adequate resources especially financial
ii) the central government does not have the resources needed to assume responsibility for what local authorities cannot do.
iii) even if the resources could be found to supply an unplanned settlement/slum today, new and equally impoverished slums will spring up further afield tomorrow (GOK and UNICEF, 1992).

That notwithstanding, the government has obligation to provide its people with basic needs such as water and its policy since the International Safe water Drinking Decade has been to ensure that every Kenyan has access to safe drinking water.

2.4 Sanitation

The most widespread form of water contamination in Kenya results from disease-bearing human wastes. These wastes pose great health risks for the people who are compelled to drink and wash in untreated water. This scenario is created by inadequate sanitation; for instance in 1990, only 35% of Kenya's population had access to a public sewer, septic tank, pour or flush latrine, ventilated improved pit latrine or simple pit latrine. The remaining 65% did not enjoy adequate sanitation (GOK and UNICEF, 1992).

2.4.1 Sanitation in Slum Areas/Unplanned Informal Urban Settlements

Unplanned settlements are found in virtually all urban centres in Kenya and are generally characterized by poor access to adequate means of excreta disposal. By 1990, 36% of slum population of Mombasa and 56% of the slum population of both Kisumu and Nairobi had no access to appropriate means of excreta disposal (CBS 1990).

2.5 Why Sanitation Systems are important!

One of the most important benefits of sanitation programmes is improvements in public health. Mara, (1982) notes that over fifty infections can be transferred from a diseased person to a healthy one by various direct or indirect routes involving excreta. In the same vein, Arnold, (1978) asserts that although

it is difficult to separate the effects of sanitation from benefits occurring for other reasons, improved sanitation certainly has a positive impact on people's health. It therefore becomes necessary to provide sanitation systems in order to control excreta-related diseases such as typhoid. However, sanitation systems in themselves are not sufficient for the control of excreta-related infections and their success in achieving this objective depends to a large extent on personal and domestic hygiene. Thus complementary inputs such as improved water supplies and sanitary education are essential for success (Esrey, 1990). Although it is difficult to quantify most of the benefits of a sanitation system, such as improved health and user convenience, there is no doubt that such benefits are enjoyed. Therefore, the primary objective of sanitation programmes in developing countries where excreta-related diseases are still responsible for high morbidity and mortality should be the improvement of public health.

2.6 Water Supply Service Levels

Water supply service levels often very strongly influence the choice of sanitation technology and the options for sullage disposal. According to Mara, (1982) there are basically three levels of water supply service in urban areas. These include public standpipes, yard taps and multiple tap in-house connections. Each of these water supply service levels permits certain levels of water consumption and the use of certain

sanitation technologies. The following table shows water supply service levels and associated options for excreta and sullage disposal in urban areas:

Table 2.1: **Water Supply Service Levels and Associated Options for Excreta and Sullage Disposal**

Water supply service level	Typical water consumption (lcd)	Options for excreta disposal	Options for sullage disposal
Standpipes	20-40	pit latrines, pour-flushtoilets,vault toilets	soakage pits
Yard taps	50-100	pit latrines, pour-flush toilets, vault toilets, sewered pour-flush toilets, septic tanks	soakage pits,stormwater drains, sewered pour-flush toilets, septic tanks
Multiple in-house connections	>100	sewered pour-flush toilets, septic tanks, conventional sewerage	

Source: Mara, (1982:16)

2.7 Wells

Besides the three basic water supply service levels, wells are used as a water source in some areas. Thus Mara, (1982) contends that some low-income urban communities obtain their water from public or private wells. In such areas, on-site excreta disposal presents a potential hazard of ground water contamination and disease transmission through excreted pathogens.

Although it is not possible to establish universally valid guidelines for horizontal and vertical separation of on-site disposal systems and wells, it is however clear that the greater the ground water abstraction, the more porous or fissured the soil, the greater the distance should be between a latrine and a well. The generally accepted practice has been to keep a minimum distance of 10 meters between on-site disposal systems and wells and increase this distance up to 30 meters in gravel and sand.

However, sometimes a latrine may penetrate the ground water which provides water by means of shallow wells. Mara, (1982) recommends the use of vault latrines in such a situation. Thus on-site sanitation systems should be used where the water supply is already piped or the water table is extremely low and soil porosity very low.

2.8 Factors that Influence Choice of Sanitation Technology:

2.8.1 Water Supply Service Levels

The amount of water used in an area reflects to a large extent the level of service of the water supply and the options that can be used for its disposal (Arnold, 1978). According to Kalbermatten, (1980) standpipes supply 20 to 25 litres per capita daily. A yard tap increases water consumption to 50 litres per capita daily, while a tap inside the house raises water use from 50 to 100 litres per capita daily and this is about the limit for on-site disposal of sullage. The amount of water consumed

influences the amount of waste water generated, and therefore the choice of disposal technology as shown in Table 2.1.

2.8.2 Soil Conditions

Most sanitation technologies are influenced by soil conditions since they are contained below ground level. Soil stability is very crucial for pit latrines and pour-flush toilets among others (Kalbermatten,1980). Where soils are unstable, stabilization measures must be incorporated in the sanitation technology; for instance pits must be lined to their bases. An important characteristic of the soil is its permeability. Soil permeability is important for on-site technologies such as latrines, pour-flush toilets and septic tanks soakaways. Where soils are impermeable, these technologies are technically infeasible.

Where the ground water table is within one meter of the ground surface, pit latrines and pour-flush toilets may not be applicable. This is because the pit is likely to be unstable unless supported to its base. Besides, pit excavation and lining are likely to be hazardous and difficult as these technologies require large pits.

The nature of rocks underlying the ground surface influences the choice of sanitation technology. Where there is very hard rock near the ground surface, most sanitation technologies become difficult to construct besides being more expensive.

2.8.3 Population Density

Population density has a direct influence on the choice of appropriate sanitation technology for an area. In high density population urban areas, pit latrines and septic tanks with soakaways are infeasible (Kalbermatten, 1980: Habitat, 1986: Arnold, 1978). This is because the latrines are likely to fill up within a short period of time thus calling for digging of other pits in an area where land for such use is likely to be inadequate given the high population density. Similarly, septic tanks with soakaways would be infeasible for there would not be adequate space for soakaways; and waste water from the septic tanks is likely to soak probably into walls of buildings given the high housing density of such areas. Thus in high population density urban areas, conventional sewerage, sewered pour-flush systems and vault toilets are the only feasible sanitation technologies.

Kalbermatten, (1980) asserts that for 250 to 300 persons per hectare population density, on-site systems become infeasible. The main issue is the availability of sufficient space on the plots to provide alternating pit sites. Absolute minimum lifetime for pit latrines is 5 years, but 10 years is preferred. Given high population density, such systems are not likely to have even the absolute minimum lifetime.

2.8.4 Costs

One very crucial aspect in the provision of sanitation

technologies is their affordability. The chosen technologies should be affordable. The decision of which technology is to be selected should be based on economic rather than financial costs as the former represent the real resource cost to the national economy (World Bank, 1980). Normally, the technology with the lowest economic cost should be preferred.

Besides the above factors, there are other considerations that have to be taken into account when selecting a sanitation technology. Such factors include the type of anal cleansing material likely to be used by the beneficiaries. The material used may adversely affect the functioning of the system. For example pour-flush and cistern-flush toilets cannot easily cope with anal cleansing materials that do not dissolve easily, such as maize cobs, stones, leaves and hard paper among others due to the clogging of the water seal.Use of water for anal cleansing presents problems to Double Vault Composting toilets as this makes them become too wet for efficient composting.

2.9 Past Interventions

Various interventions have been carried out in the study area in many ways. The first intervention was undertaken under the third urban project of Kenya.

2.9.1 Background to the Third Urban Project

The rate of urban growth in Kenya has been high and this has not been matched by an equal rate of urban planning, housing

production and infrastructure development. According to Syagga (1988), annual urban growth rates range between 5 percent and 10 percent. Urban population growth rate has also increased tremendously over the years; for instance in 1948, urban population accounted for 5.1 percent of the total population and in 1962, urban population accounted for 7.8 percent of the total population, while in 1979, 15.1 percent of the total population was urban. This rose in 1989 to 18.1 percent.

Previously, the bulk of Kenya's urban population was concentrated in her two largest towns of Nairobi and Mombasa. However, recent trends show that the proportion of urban population to be found in Nairobi and Mombasa has declined while the corresponding proportion for secondary and small towns has increased (Ibid.). This is proved by the fact that in 1969, Nairobi accounted for 45.8 percent of the country's total urban population while by 1979, this proportion had dropped to 35.8 percent (Ibid.).

This trend has no doubt called for the improvement of secondary towns' ability to provide the necessary urban infrastructure. It was against this background that the third urban project was conceived to address the issue.

Kenya's urban investment policy has followed a basic needs strategy with an emphasis on water supply, low-cost shelter, primary education and basic health care. Thus the conceptual framework of the third urban project for Kenya was closely aligned to the country's urban investment policy as a way of

implementing the policy.

The third urban project aimed at improving shelter and urban services for the urban poor in Kenya's secondary towns. The project was financed by the World Bank. The World Bank defined the urban poor in Kenya according to an absolute poverty criterion with the poverty cut-off set at Kshs 2,300 (US dollars 183) per capita per year (World Bank Staff Report, 1983 cited in Syagga, 1988). According to Syagga, (1988) by the start (1983) of the project, only 25 percent of the households in the project towns had income beyond the absolute poverty level.

2.9.2 The Third Urban Project

The third urban project began in 1983 as part of a programme of support for Kenya's urban investment policy (Syagga etal, 1989; World Bank, 1992). As pointed out earlier, Kenya's urban investment policy has been concerned with investments in infrastructural services namely water supply, education, health and shelter. The third urban project covered five towns of Kenya namely; Nakuru, Thika, Nyeri, Kitale and Eldoret. The project ended in 1990.

2.9.3 Components of the Project

According to World Bank (1992), the following were the components of the project:

(a) Servicing of urban land for residential and small enterprise development in the five towns.

(b) Construction loans for residential and small enterprise development.

(c) Community facilities such as markets, workshops, education and health facilities.

(d) Financial project management and maintenance support and policy studies.

The project had urban development proposals for the five towns that it covered. The primary emphasis in each town was servicing of land and provision of shelter and related community facilities for the low-income groups. However, the implementation of the physical component of the project was the responsibility of the respective Local Authorities (World Bank, 1992).

2.9.4 Servicing of Urban Land

Servicing of land was done through the following modes of participation:

(1) Site and Service Development

This was done on plots earmarked for this sort of development. In Eldoret, it was done in Kipkarren and Old Uganda Road areas.

(2) Servicing of Vacant Private Land

The project involved the respective local authorities in servicing private land to stimulate urban development. The costs

of the services so provided were to be recovered from the landowners. The chosen sites would be given full servicing that is, water, sewerage connection, drainage of surface water, access roads and refuse facilities or they would get partial servicing embracing a few of the services together with surveying and demarcation of the land. Langas, (area of the current study) of Eldoret municipality is one of the sites that benefited from partial servicing. Partial servicing in the area included water supply through water kiosks, a loop road joining the area to Eldoret-Kisumu road, survey and plot demarcation, and lighting especially along the main street (loop road).

(3) Private Sector Joint Venture

This component was to take care of the middle income groups as the first two components were intended for the low-income groups. This involved inducing the private formal sector through a joint venture scheme in Eldoret to serve as a possible model for replication elsewhere (Syagga, etal.,1989; World Bank, 1992). An agreement to this effect was made between Rural Housing Estates Ltd (a private developer) and the Eldoret Municipal council to service land and construct 831 medium cost houses. Land required for service lines and construction of community facilities was to be given to the council by the developer.

It was the responsibility of the private developer to construct the houses using commercial financing and repay the council for the cost of the infrastructure provided by the

council, after selling the houses.

(4) Settlement Upgrading

This involved upgrading of existing settlements through provision of full or partial infrastructure, surveying and plot demarcation. The following sites were covered by this component; Langas and Kamukunji in Eldoret, Tuwani Farm in Kitale, Bondeni in Nakuru, Majengo in Nyeri and Kiandutu in Thika.

(5) Construction Loans

Besides lack of infrastructure services, housing development is hampered by lack of finances for construction. Thus in addition to availing construction loans to site and service development areas, other loans would be availed in some non-Bank financed projects. This component did not however cover Eldoret. It covered sites in Nakuru, Thika and Nyeri. The loans so given were to cover the cost of two rooms with kitchen and wet core where water-borne sanitation was available, or two rooms only where plots are served by water kiosks. The beneficiaries were then to use their own resources to put up additional rooms as was the case in Dandora and Second urban projects (Syagga, etal., 1989).

(6) Community Facilities

Community facilities that were provided include markets, lorry parks, workshops, schools and health facilities. These

accounted for 8 percent of the total project cost.

(7) Management and Urban Policy Studies

This component was aimed at strengthening the financial and project management base of the local authorities. This accounted for 15 percent of the total project cost through acquisition of necessary equipment and software, staff training, maintenance of equipment and carrying out policy studies on low-income housing and urban transportation among others.

2.10 Interventions the Study Area Received Under the Third Urban Project

The third urban project carried out the following interventions in Langas that were aimed at upgrading the area.

1) Provision of a tarmacked loop road in the settlement
2) Water supply / extension of the municipal water supply to the area through water kiosks
3) Storm water drainage along the tarmacked road
4) A municipal primary school
5) Surveying and demarcation of plots in the area
6) Lighting along the main street

However, it is important to note that these interventions were not adequately done. A major shortcoming of the project (that has been cited by one of the implementing officers- a master Macharia of the Department of Urban Development, Ministry of Local Government, and who actually was at Langas during the

project) was that sector coverage was too wide and therefore the sectors could not be covered in depth. For instance the water supply that was extended to the area was through a few sparsely scattered water kiosks in the area (see figure 6) for the spatial distribution of water kiosks in a section of the study area.

Only ten water kiosks were constructed and made operational during the period of the project. Given the high population density of the area, these ten water kiosks were inadequate. Besides, most of the households are far from the water kiosks and in most cases, a distance that exceeds 300 meters has to be covered to the kiosks. Thus an earlier study in the area found that there is a threshold distance of about 200 meters (Mangat, 1989). Therefore, most households use water kiosks in those cases where the distance to the kiosk is less than or about 200 meters.

The other problem of the water kiosks is caused by the land tenure system. The kiosks are located in privately owned land and this leaves the decision whether to operate or not to the discretion of the landlords. As a result, some of the kiosks in the area are no longer operational. Plate 2.1 depicts one of such kiosks that has not been operational for about a year because the owner of the plot on which it is located decided not to operate it.

TION OF WATER KIOSKS

N

LEGEND

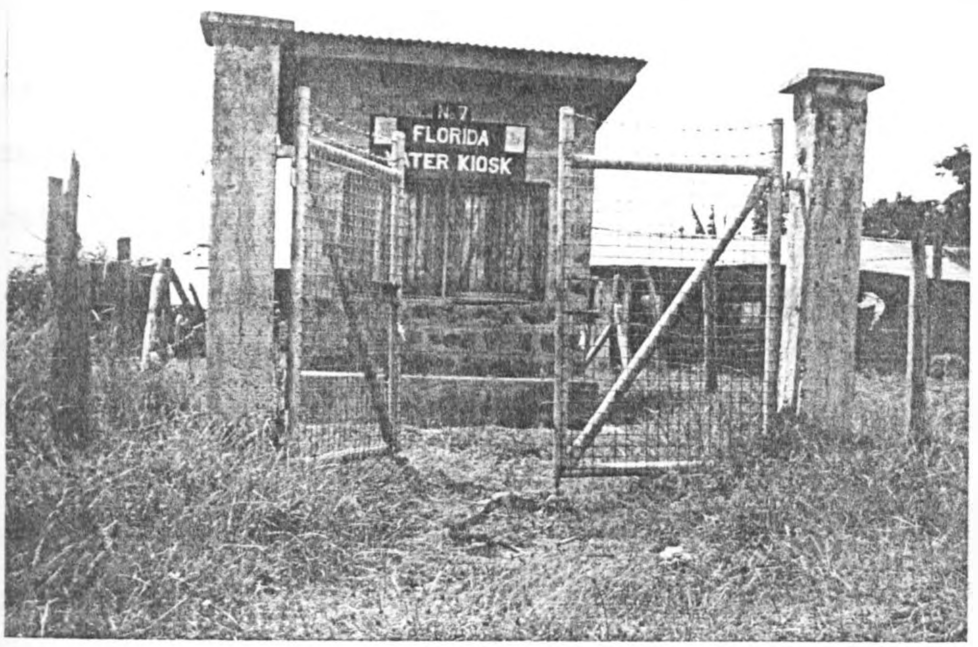
- 25 mm pipe
- 38 mm pipe
- 50 mm pipe
- 200mm pipe
- 250mm pipe
- TYPE WATER MAIN DIRECTION
- BLOCK BOUNDARY
- MUNICIPALITY BOUNDARY
- WATER KIOSK

MINISTRY OF LOCAL GOVERNMENT
URBAN DEVELOPMENT DEPARTMENT ON BEHALF OF MUNICIPAL COUNCIL OF ELDORET.

LANGAS WATER RETICULATION SYSTEM

SCALE 1:2000 DATE JUNE 1988 DWG No. 10A5/01/32

plate 2.1 A Non-operational Water Kiosk



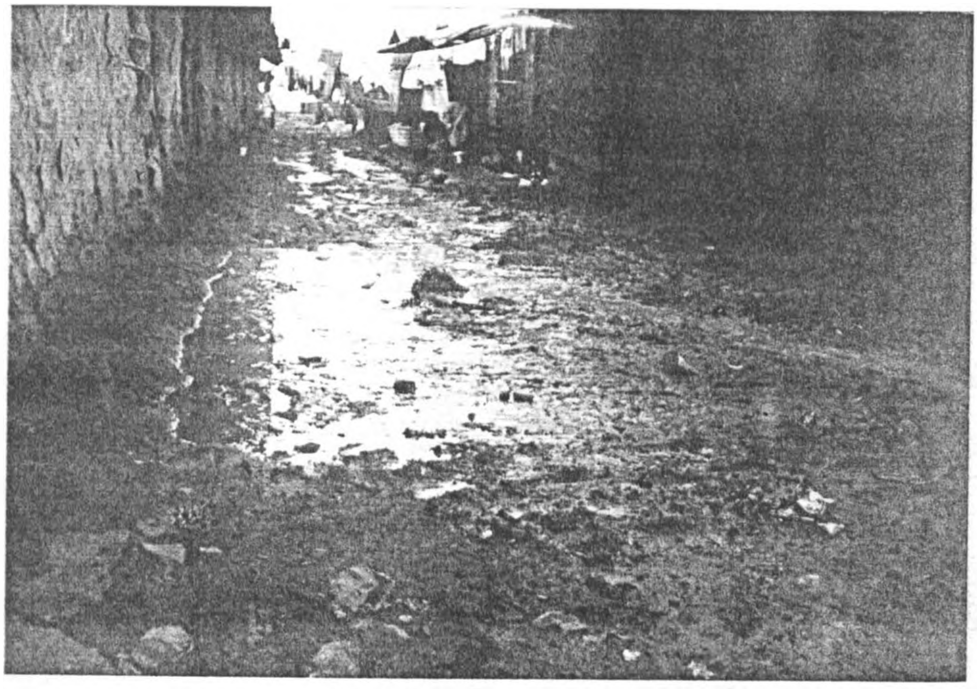
Source: Field Survey, 1996

Thus although during the third urban project landlords willingly donated land for the water kiosks on condition that they were going to operate them, some of the landlords have not lived up to their promise. The problem of the operation of the kiosks is compounded by the fact that the Eldoret Municipal Council does not and cannot operate the kiosks owing to difficulties in revenue collection from such kiosks. Therefore, land for utilities should have been set aside during planning of the area and locate the kiosks on it while leaving their operation open to anybody interested rather than tying their operation to the plot owners who may not always have somebody to operate the kiosks.

The other problem that has contributed to low usage of the water kiosks by the area residents is the high water tariff imposed by the kiosk operators. The current tariff of Kshs. 2-3 per 20 litres of water by far exceeds the officially recommended rate of 50 cents. It is no wonder then, that majority of the residents of the area continue to use contaminated well water for drinking and other domestic purposes, considering the myriad of factors that militate against the use of the water kiosks in the area.

The storm water intervention that was done covered a very small portion of the area, mainly along the loop road. Otherwise, most of the plots are poorly drained and during the rains, the environment becomes very unsightly with a lot of undrained storm water mixed with sullage. See Plate 2.2.

Plate 2.2 Shows a Poorly Drained Compound



Source: Field Survey, 1996

Surveying and demarcation of plots in the area was carried out during the third urban project. However, owing to bureaucratic delays and lack of follow-up by the municipal council, the issuance of title deeds by the Commissioner of Lands was not effected prior to the project closing date (World Bank, 1992). As a matter of fact, landowners of Langas have not yet been issued with their title deeds. The lack of title deeds still limits the landowners' access to credit facilities especially those that require collaterals, and which may be used to improve the settlement. Therefore, there is need to supplement the third urban project efforts in the area in order to realize full upgrading. Supplementary efforts could address some of the problems that were not covered in the area under the third urban project such as sanitation particularly the problem of human waste disposal.

The Eldoret Municipal council has, however, made attempts to supplement the efforts of the third urban project in extension of water mains by providing four water kiosks. This makes a total of 14 water kiosks in the area. However, the council has made the same mistakes that were made during the third urban project and has thus constructed the additional water kiosks in private land; may be the council should have bought the land so that it could have some control over the kiosks.

Besides interventions by the third urban project, other interventions in the area have been by way of research, most of which has been done after the third urban project. The most

recent of the studies is the "Safe Water Environment Study" of 1993-1995 which found that most of the wells have been contaminated by the pit latrines used in the area. Thus laboratory tests of water samples taken from some wells showed that well water is highly contaminated (Akong'a and Maithya, 1995). That notwithstanding, the wells continue to be used as a source of water for domestic purposes. From the foregoing, it is clear that more interventions are still necessary in this area.

CHAPTER THREE

BACKGROUND INFORMATION OF THE STUDY AREA

3.1 Physical Background

3.1.1 Location

Eldoret town is located in the high-agricultural potential highlands of Uasin Gishu district in Rift valley province. It lies at an average altitude of 2085 metres above sea level. The town is traversed by approximately latitude 0.31′ and longitude 3516′ longitude East. It is located about 312 km North West of Nairobi on the main Kenya/Uganda road. From Kisumu, it is 170 km. The municipality is traversed by the main international Road (Mombasa-Lagos Trans Africa Highway and rail routes from Mombasa and Nairobi to Uganda. The town is the centre of communications for Uasin Gishu District as it forms the focal point of roads from Kapsabet, Kipkabus, Moiben, Soy and Turbo. Figure 1 shows the location of the town in the national context while figure 2 shows the location of study area within Eldoret Municipality.

FIG. I LOCATION OF ELDORET IN KENYA

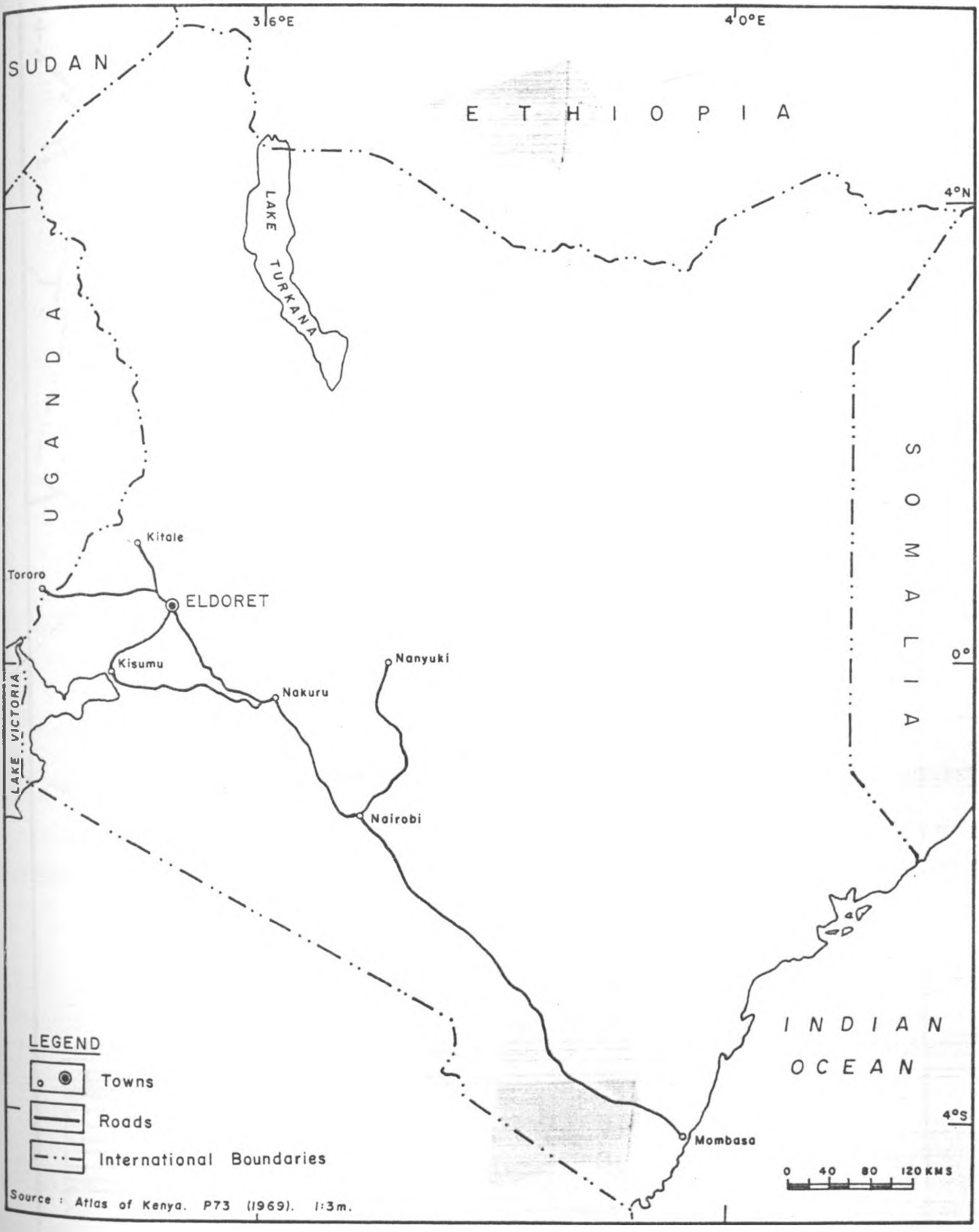
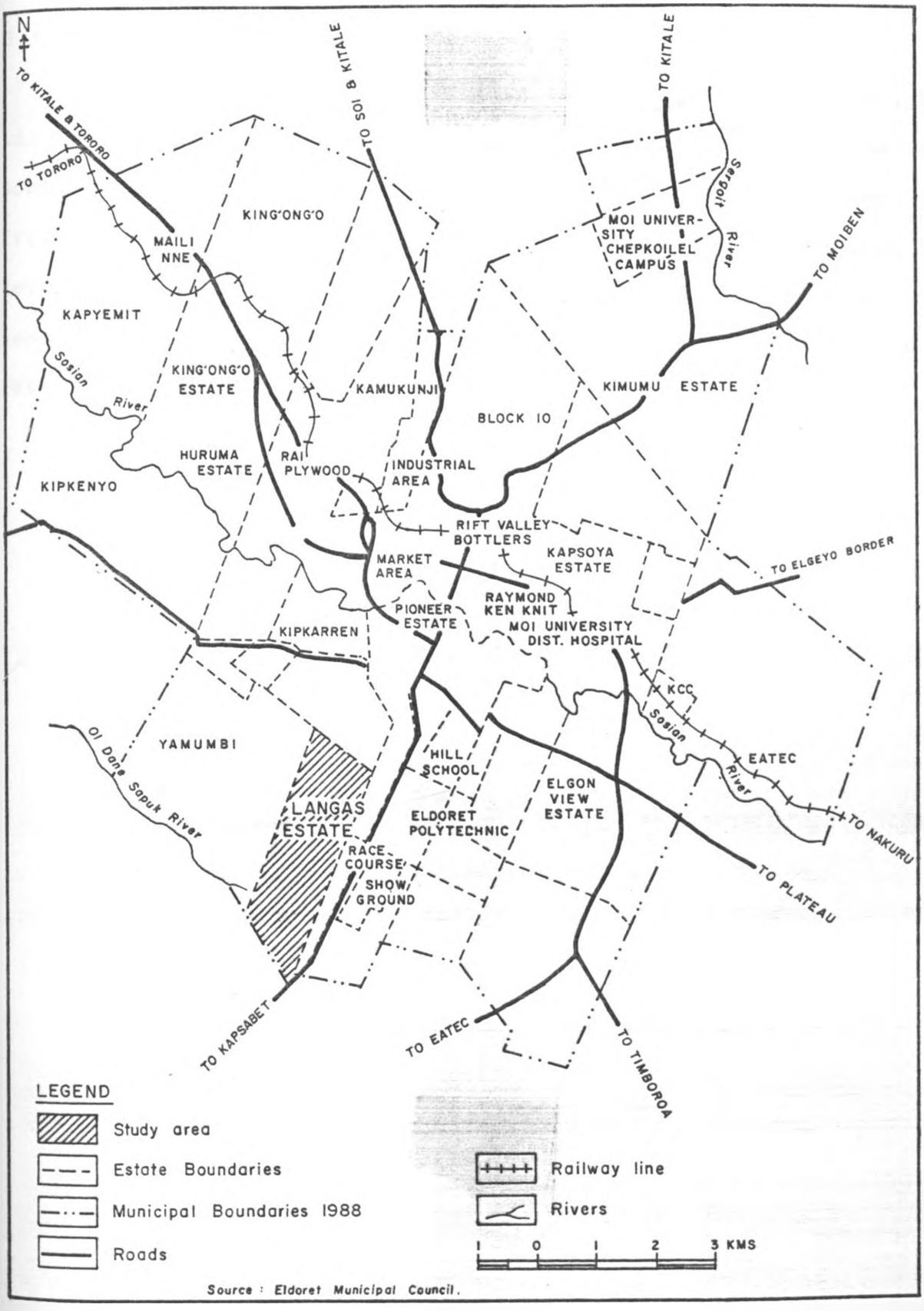


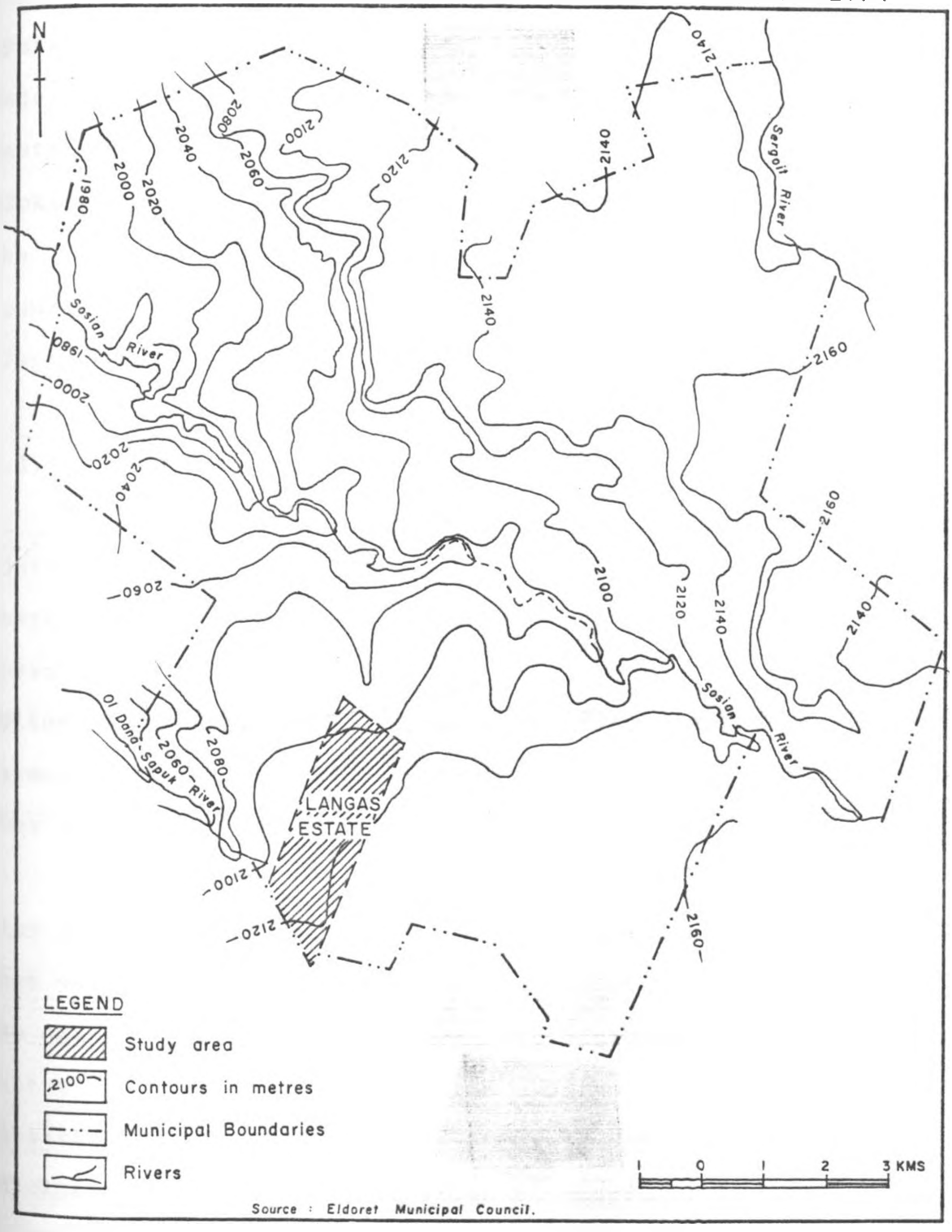
FIG. 2 LOCATION OF LANGAS WITHIN ELDORET MUNICIPALITY



3.1.2 Physical Features

The Eldoret municipality lies on a highland plateau. The land rises from the river Sosian valley both Northwards and Southwards from about 1800 metres in the extreme north-west and from below 2120 metres in the extreme South-East towards and beyond 2200 metres. The plateau that extends south of the Sosian valley is less uniform. This comprises the fast growing settlement of Langas and other estates (refer to Figure 3).

FIG. 3 A TOPOGRAPHICAL MAP OF ELDORET MUNICIPALITY



3.1.3 Geology

Eldoret municipality is dominated by tertiary volcanic rock. Structurally, the area is an upstanding block of basement rock system surrounded to the East, South and West by minor faults. Major thrusts formed during dynamic metamorphism cross the western part of the area, particularly at Turbo and in the Kipkarren valley. Several north treading faults occur between the Kikarren and Sosian valleys, with the largest faults occurring along the North and Eastern boundary of the area (Germany Environmental Consultans, 1989).

3.1.4 Soils

Top soils consist of silt with a locally variable clay content and fine sand. Their colour is predominantly red though there are some that are brown and others grey. A major characteristic of the soils is poor drainage, resembling black cotton soils. Their thickness ranges from 0.3 to 0.6 m and their permeability is low a factor that contributes to poor drainage in some part of the area (Ibid.).

The area being within the Uasin Gishu plateau has rich silty clay soils that have been weathered from the phonolite lava flows that were experienced in the area during volcanism. These soils are good for agriculture. On the plateaus wells penetrate 15 metres of weathered phonolite without having reached the unweathered phonolite layer. But in the sloping areas, the thickness of weathered phonolite is reduced to a few metres due

to erosion. Practically all shaft wells in the area draw their water from the weathered phonolite layer. The depth to water level depends upon the morphology and the thickness of the weathered phonolite layer. On the plateaus, water levels are at about 10m, while in the sloping areas, it is 3-8m (Patel Mangat & partners, 1989). Permeability in the weathered phonolite depends upon the locally variable degree of jointing and also on the degree of joint sealing, by mineral precipitation, but is always low and many wells dry up during the dry season. Pit-latrines standing in weathered phonolite of reduced thickness and without murrum cover cannot absorb enough fluid and often overflow.

Besides the above types of soil, there is murrum. 1-3 m thick layer of reddish murrum lies below the top soil. Murrum is an advanced weathering product of the phonolite and can be described as a mass of compact lateritic gravel with a matrix of clay-silt filling the interstices between the coarse grains. The grains are irregular in shape, contain iron oxides and are hard enough to be used for construction purposes. The murrum forms stable walls as in wells, pits and does not require stabilization measures. Most of the wells and pit latrines penetrate the murrum layer. Ground water tables are always found well below the murrum base and this raises the possibility of ground water contamination where on-site sanitation systems are in use.

There is also unweathered phonolite in the area. The phonolite thickness is estimated at some 100-150m. The phonolites are fine grey hard rocks with scattered coarser

crystals of felspar. These rocks are unaffected by tectonics. Water infiltration and ground water movements take place along joints exclusively, whereas the rock itself is practically impervious. The unweathered phonolites are poor aquifers and ground water infiltration is apparently reduced by a clogging of joints by clay from weathered products at the top of these rocks.

3.1.5 Hydrogeology

Poor permeability and storage capacity of the soils and rocks in Eldoret municipality set close limits on ground water exploration. The predominance of pit latrines is considered to have contaminated shallow ground water in the densely populated peri-urban areas of the municipality. In some localities, pits cannot be excavated as deep as required because of solid unweathered phonolite sometimes already struck in shallow depths. Furthermore, the population density in these areas is very high and individual plots are so small and covered by buildings that it is not possible to abandon filled up pits and dig new ones. Thus the pit latrines require regular emptying.

3.1.6 Drainage

Generally, the ground surface shows a downward gradient towards the Northwest. Thus rivers draining the area form a sub-parallel drainage system towards West-North-West. The slope of the river bed is at an angle slightly greater than the dip of

the volcanic rocks. The main river that drains the municipality is Sosiani. This river runs through the middle of the municipality for several kilometres (see Figure 3).

3.1.7 Rainfall and Temperature

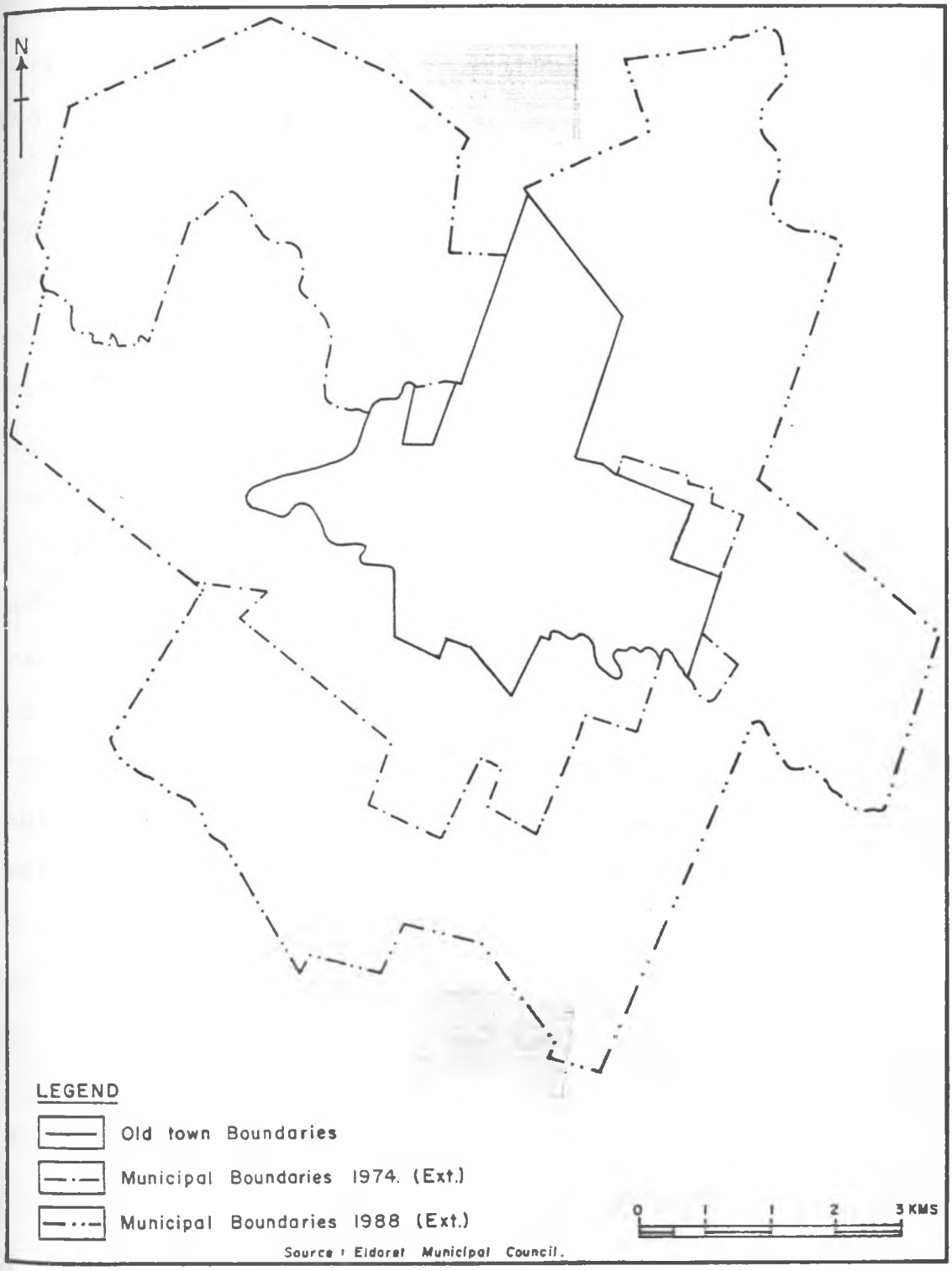
Eldoret municipality is located in a high potential area as stated earlier and therefore receives high rainfall. During the period 1975 to 1982, a total annual average rainfall of 1147.9mm was recorded at Eldoret. However, this rainfall amount fell to 792.3 between 1980 and 1989. The highest amount of rainfall is received in the months of June and August. Lowest rainfall amount is recorded in the months of December and January. The municipality experiences an average daily mean maximum temperature of 24°c (Ibid.).

3.2 Socio-Economic Background

3.2.1 Historical Development of the Municipality

The Eldoret town developed from an isolated post office serving mostly a European farming community into a major dynamic regional administrative, commercial, educational and industrial centre. It was established in 1908. In 1912, Eldoret was officially gazetted as a township occupying an area of about 11.2 sq.km (Habitat, 1991). Development in the region and the growth of Eldoret town was slow until the completion of the Kenya-Uganda railway in 1924 passing through the town. The railway together with permanent settlement in Uasin Gishu district were

FIG. 4 ELDORET MUNICIPALITY BOUNDARY EXTENSIONS



3.2.2 Population

The Eldoret municipality has been growing rapidly in the last few decades. Population figures for the town for various periods attest to this. For instance in 1962, the municipality had a population of 19,605 residents compared to 24,900 in 1965. By 1979, the population had increased to 50,503. During the 1989 population census, the town had 111,882 people and was ranked the fifth most populated town after Nairobi, Mombasa, Kisumu and Nakuru. The town's population is estimated to be growing at an average rate of 8 per cent per annum and this is one of the highest in the country. The 1994 population estimates show the town's population to be between 150,000-200,000 people. The population growth rate of Eldoret is attributed to natural growth, net in migration, boundary extensions (which basically transform rural population into urban population) and rapid industrial growth.

Table 3.1: Population Trend Figures, 1948 to 1989

Year	Population
1948	3,193
1962	19,605
1969	18,196
1979	50,500
1989	111,882

Source: Population Censuses of 1948,1962,1969,1979,1989.

Habitat, (1991) attributes the rapid growth of industries in Eldoret and therefore its growth to the following factors:

a) A relatively well established transport system;

b) Availability of relatively adequate water and electricity supplies;

c) In the recent past, there has been adequate and serviceable government land for industrial development;

d) Availability of a variety of raw materials from the town's hinterland;

e) A growing diversified market for industrial products

f) Existence of other supportive services and facilities such as commercial banks, the central bank and general post office among others; and

g) Through the Kenya Government's policy of support for selected growth and service centres, the town was earmarked to develop as a regional industrial centre in the western region of Kenya.

Besides the above, the town has in the recent past enjoyed political goodwill, a factor that has attracted a high development impetus. For instance the town has become an important educational centre and currently has a national university, a national polytechnic and a number of colleges and schools. The third international airport of the country is currently under construction in the area. This will no doubt stimulate more growth of the town for among other things, it will serve horticultural farmers by facilitating their direct access to

to European markets besides promotion of tourism in the area.

The town has enjoyed sound management at the council level. The council has over the years operated without deficits. Thus compared to other Kenyan local authorities, Eldoret municipal council depicts a sound management standing as portrayed by Table 3.2.

Table 3.2 : Eldoret Municipal Council's Budgetary Allocations

Year	Revenue	Expenditure	Balance
1990/91	56149432	42446599	13702833
1991/92	123539297.60	97984472.20	25554825.40
1992/93	208372454.75	182161523.85	26210930.90
1993/94	177330173.00	163566618.00	13763560
1994/95	263149135.00	230303416.00	32845719.00

Source: Eldoret Municipal Council, 1996

From the table, it is evident that the council has had a financially sound account for the last five financial years.
All these factors combined have led to rapid growth of the town.

This fast population growth rate has far reaching implications on the existing infrastructural facilities as their coverage is not expanding as fast. For instance peri-urban areas of the municipality continue to experience problems of inadequate water supply and sanitation systems.

Langas, the area of study had a population of 27,982 people according to 1989 Population Census Report. The total number of households was 8,986 and a population density of 1,166 persons per square kilometre. Current projected population at growth rate of 8% (Eldoret town's growth rate) shows the area has an estimated population of 51,793 people.

3.2.3 Economic Base

Agriculture, agro-based industries and farm-implement servicing firms have been the main backbone for the growth of the municipality since its inception. However, the town has attracted other key industries and institutions. These include Kenya Co-operatives Creameries, cereal grinding industry (Unga Ltd), the East Africa Tanning Extract Company, financial institutions, Ken-Knit, Raymond woollen mills, Rai Plywood, Kenya Industrial Estates, Rivatex, Highland Paper Mills and Rift valley Bottlers among others. These sectors offer employment to the town's fast growing population. For instance in 1988, the manufacturing sector accounted for about 51 per cent of total employment in the town (Habitat, 1991).

3.3 Water Resources for the Municipality

3.3.1 Surface Water Resources

There are three main rivers in the area which include:

1) Sosiani river which flows through the town
2) Sergoit river located 16 km North East of the town

3) Ol Dane sapuk river located South West of the town (see Figure 3)

However, Sosiani river and its tributaries are situated nearest to the town and water for the municipality has been abstracted by gravity from the intakes constructed on the rivers. Intakes are situated on Sosiani river and Ellegirini river (a tributary of Sosiani river).

3.3.2 Water Supply Systems

A significant proportion of water supply in the municipality is provided by the municipal council of Eldoret. The intakes of Sosiani and its tributary have provided the town with water for several years. However, as pointed out earlier, the town has been growing fast leading to a high demand for water for commercial, residential and industrial uses. This has called for an expansion of the existing water supplies to match the growing demand. Information availed during the field survey indicated that the recent completion of the Moiben water supply project has provided the municipality with adequate water for all its water needs.

Although the current water supplies are providing adequate water for the municipality, this water has not been well distributed to reach all the consumers. In this respect, peri-urban areas of the town are the most hit for they have very little access to the municipal water owing to its mode of distribution. Therefore, 60% of the town's population is served

with house connections or yard taps while 40% is served by water kiosks and private shallow wells.

3.3.3 Ground Water Resources

Eldoret has no major ground water aquifers and the government's policy restricts ground water exploitation for environmental reasons (Eldoret municipal sanitary study, 1986). However, the available few ground water aquifers form a major water source to most of the peri-urban areas of the municipality namely Langas, Maili nne, Ya Mumbi and Kimumu among others. The depth to the water table depends on the local morphology and the thickness of the weathered phonolite layer. On the plateaus, wells penetrate 15 meters of weathered phonolite without having reached the unweathered phonolite layer. Water levels on the plateaus are frequently encountered at a depth of about 10 meters whereas on the sloping areas water levels are mostly higher 3-8 meters.

However, ground water sources in the area have been endangered by the use of pit latrines which constitute the major human waste disposal system especially in the peri-urban areas of the municipality.

3.4 Existing Sanitation Systems

Both off-site and on-site sanitation systems are used in the municipality. 40% of the town's population is served by sewer, 10% is on septic tanks with a flush toilet, while 50% of the

population uses pit latrines (Germany Environmental Consultants, 1989). The sewer system covers the town centre, main industries and the North western blocks of the municipality.

The treatment works are in Huruma. Virtually all residents with indoor water connection have either sewer connection of septic tank which facilitate safe disposal of all waste water from such areas. However, those residents with either yard taps or no water connection at all use pit latrines. These residents are mainly found in the peri-urban areas of the municipality and release their sullage on the ground surface in their yards. Langas is mainly served with pit latrines and a few septic tanks.

3.4.1 Pit Latrines and Septic Tanks

These serve 50% of the town's population mainly in the peri-urban areas. Pit latrines are feasible in areas with sufficient soil permeability preferably areas with red soils and murrum but not the rocky areas of phonolites. Septic tanks serve a population of about 10% and are located in the low density/high income areas (Ibid.).

3.4.2 Solid Waste Systems

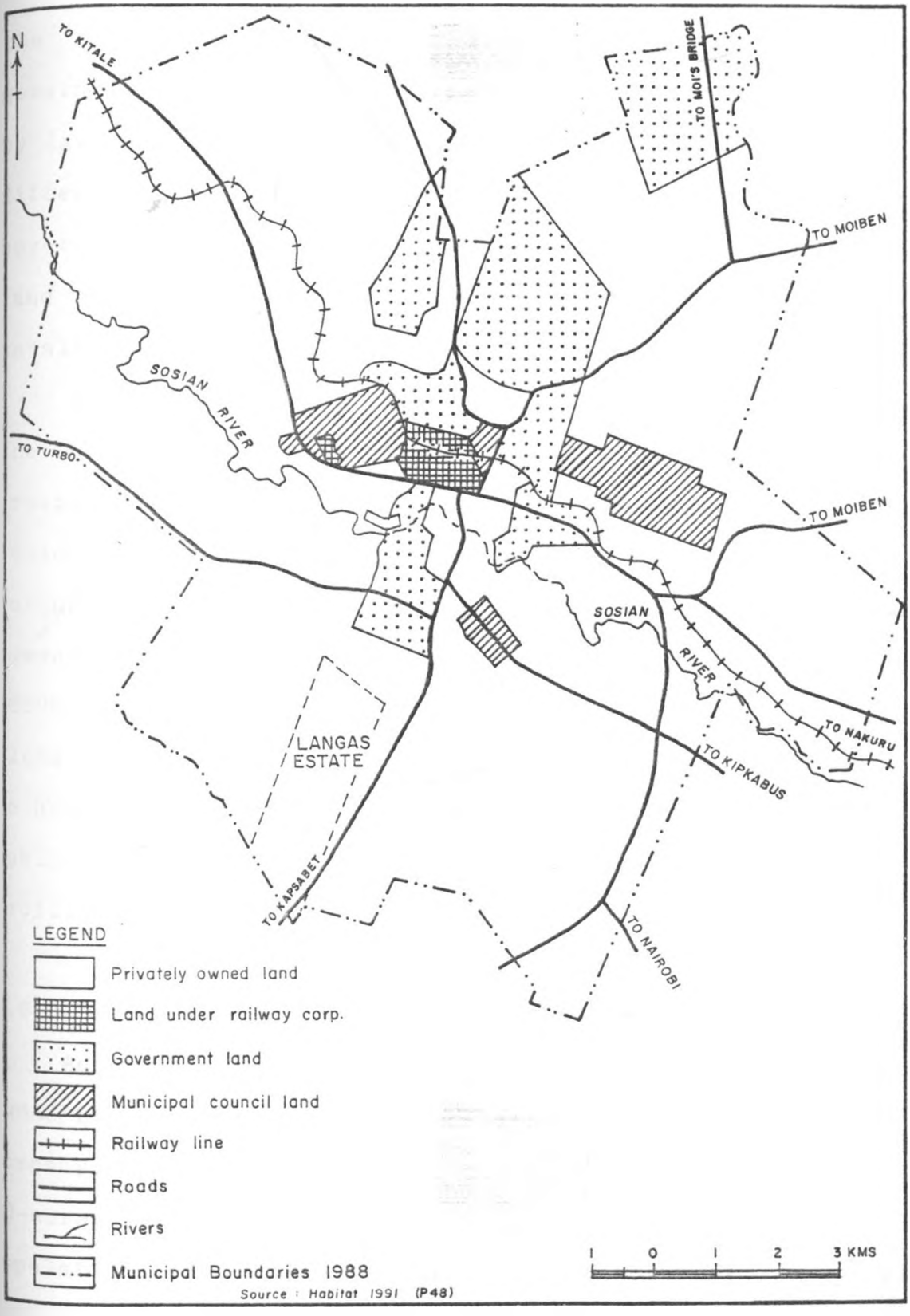
The removal and disposal of domestic waste within the municipality is the responsibility of the Eldoret municipal council. However, industries have to manage their own waste. Solid waste is collected by municipal employees and transported directly to the disposal site by collection vehicles. But solid

waste collection is only done in those areas which are also served by the municipal water supply. About 60% of the town's population is served by the solid waste collection service while the remaining 40% is unserved.

3.5 Land Tenure Systems in the Municipality

There are four major land tenure systems in Eldoret. These include; the municipal council land, land under railway corporation, Government land, and privately owned land. Figure 5 depicts the various land tenure systems in the area.

FIG. 5 ELDORET MUNICIPALITY LAND-TENURE SYSTEMS



From the figure, it is evident that most of the land within the municipality is privately-owned. While the disposal of government land is done by the Commissioner of Lands as required by law, the situation with regard to privately-owned land is very different as land transfers are conducted on a willing-buyer/willing seller basis. Land transfers of privately-owned land in Eldoret started in the early 1960s and have had considerable impact on the efficient urban management of the town.

After independence, large tracts of land were purchased from the former white settlers by land-buying companies, self-help groups, cooperatives and private individuals. The land was sub-divided and shared among the group members. The initial buyers further sub-divided the pieces of land into smaller plots as demand for land increased with the growing population. In the 1980s, the small plots were further sub-divided into yet smaller plots averaging 1/8 of an acre to 1 acre. It is however important to note that most of these sub-division did not leave land for public-purposes such as access roads, schools, and health facilities among others.

3.6 The Study Area

According to Habitat, (1991) Langas estate was formerly owned by a white settler and later acquired by a land buying company. The initial members of the company were given each some 10-acre plots by the management committee. Over time, the population of the area rose and demand for individually-owned

residential plots grew. To meet this demand, the initial plot owners sub-divided the land into various small plots. Today, most of the plots in the area measure 1/8 of an acre. Most of these sub-divisions were done informally as negotiations were done verbally. These illegal sub-divisions have resulted to among other things inaccessible plots, boundary disputes and clashes between plot owners over rights of way. Illegal subdivisions have been followed by illegal residential and commercial developments which in turn have led to inadequacy of basic services such as water, power and access roads in the uncontrolled settlement.

From the foregoing background, it is not suprising that there is no adequate land for provision of public services. Indeed, some of the public services such as the water kiosks are located on privately owned land. However, lack of land for public facilities should not deter the provision of the same in the area because during the third urban project, the landowners agreed to resolve this problem using the harambee approach (Habitat, 1991:69). Thus the plot owners would contribute money for compensating the landowners whose land has been earmarked for public facilities. The same approach can be used to provide land for other public services, particularly water kiosks.

CHAPTER FOUR

STUDY FINDINGS

4.1 Overview

Langas plot owners have made attempts to provide services in the area especially within individual plots. Such services include water supply which is provided mainly through shallow wells, and waste management systems namely pit latrines and garbage pits for solid-waste disposal. However, these facilities are inadequate and inappropriate due to various factors as shall be shown in the analysis.

4.2 Socio-economic Characteristics

4.2.1 Average Household Size

Average household size in the area is 5 persons per household. This has implications on population density per plot and the use ratio of sanitation and water supply systems therein. Most of the plots in the area measure one eighth (1/8) of an acre and on average house 15 to 20 households in single rooms. Thus from the average household size, each plot has an average 75-100 persons sharing one pit latrine and a well. The implication of this high use ratio is inconvenience to the users besides the lifespan of the latrines being considerably reduced to less than two years for they fill up within a very short time .

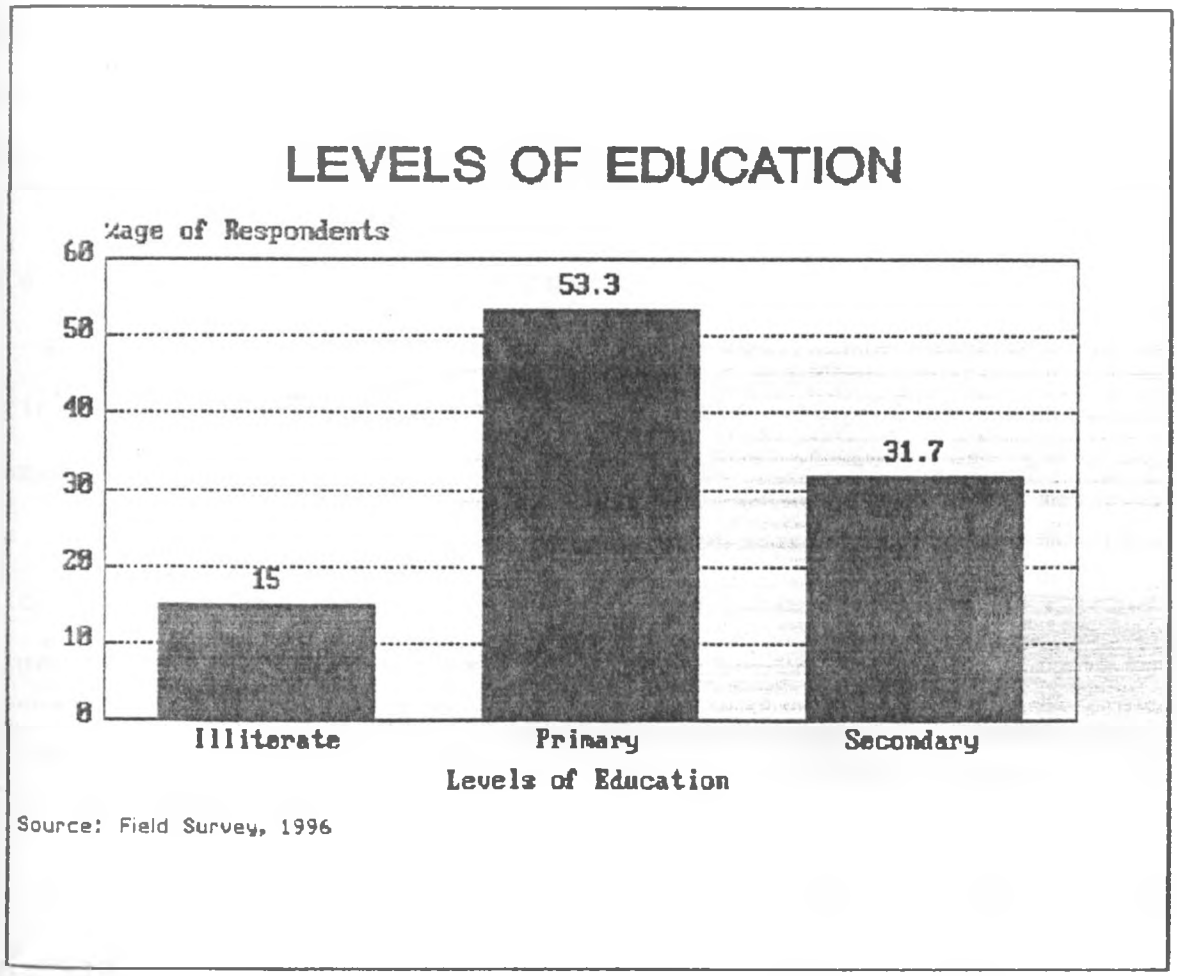
4.2.2 Respondent's Sex

71.7% of the respondents interviewed were women while only

28.3% were men. This scenario resulted from the fact that most of the women are housewives and were found within their residence. There is a high proportion of single women-headed households in the area. Therefore, most of the information was elicited from female respondents and this provided first-hand information of the subject under investigation particularly water supply and sanitation facilities as it is women who are concerned about these two at the household level.

4.2.3 Education Level

Many of the area residents have primary level of education.



This is shown by the fact that 53.7% of the respondents have this level of education. Figure 4.1 depicts the various levels of education. Education allows people to adopt hygiene behaviours as they are made aware of the biomedical links between behaviour and health. Therefore, where majority of the people are either illiterate or have very low level education, this is likely to be lacking. Health impact studies show the importance for health of positive changes in hygiene behaviour which the new facilities make possible or easier. However, without such changes, water and sanitation are not likely to offer health benefits. A recent overview of lessons learned from ten years of water and sanitation experience in developing countries supports these views (Esrey, 1990).

4.2.4 Household Monthly Income

46.6% of the households interviewed have monthly incomes ranging from 1000-3000 Kshs. 41.7% of the households have monthly incomes of over 3000 Kshs while 11.7% have incomes below 1000 Kshs. It is evident from the percentages that over 50% of the residents are low income earners. Income level has a direct influence on people's lifestyle in that it determines where to live. Table 4.1 sums the information of household incomes.

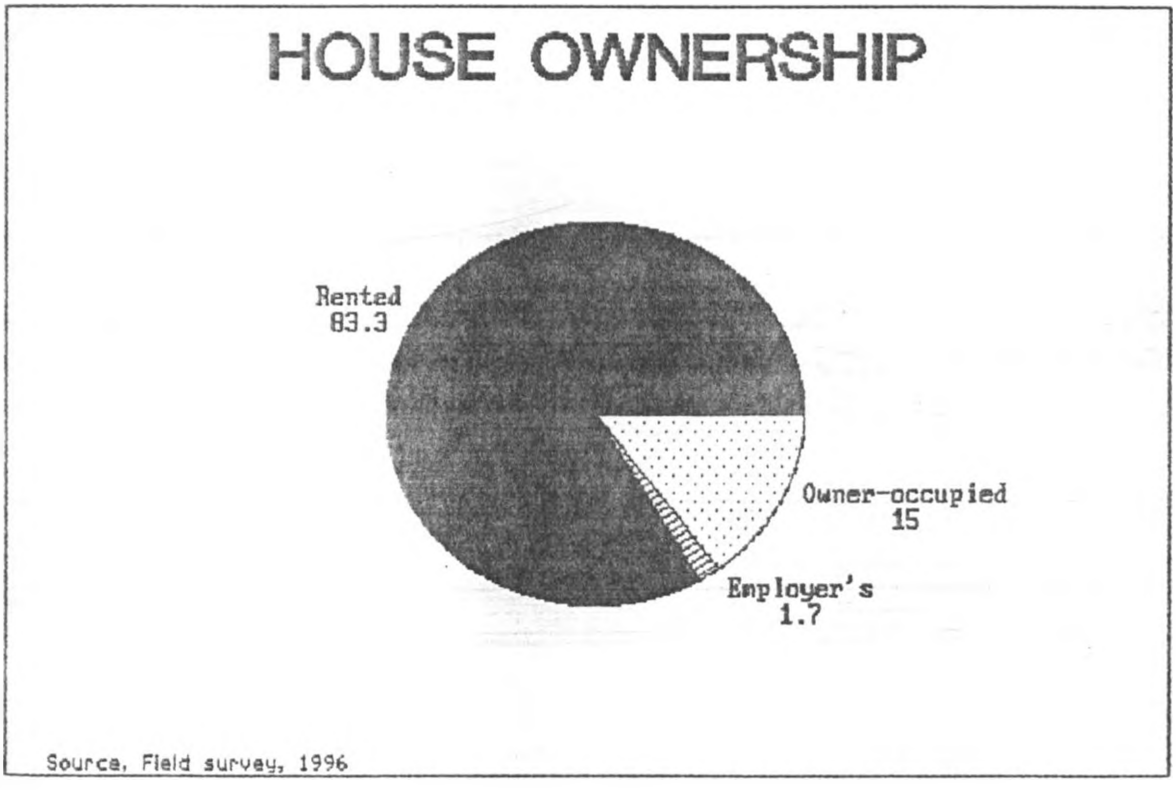
Table 4.1: Household monthly incomes

Range of Income	Percentage of Respondents
1001-2000	23.3
2001-3000	23.3
3001>	41.7

Source: Field Survey, 1996

4.2.5 House Ownership

A significant proportion of the area residents do not own houses in the area. This is portrayed by the fact that 83.3% of the interviewed households live in rented houses. Only 15% of



the respondents live in their own houses. This sets limitation to improvement of the houses and provision of services because although the occupants may recognize the need for improvement of houses and water and sanitation services, the owners may not recognize the same, or may be incapable. Figure 4.2 depicts frequencies on house ownership in the area.

4.2.6 Rent Paid

About 66% of those interviewed pay a house rent of between 100-200 Kshs while 22% pay between 201-300 Kshs and only 12% of the respondents pay rents of over 300 Kshs. These percentages show that most of the residents of the area are low income earners as income level influences the choice of housing. Table 4.2 summarizes this information.

Table 4.2 Ranges of rent paid

Rent paid	percentage of respondents
100-200	66
201-300	22
300>	12

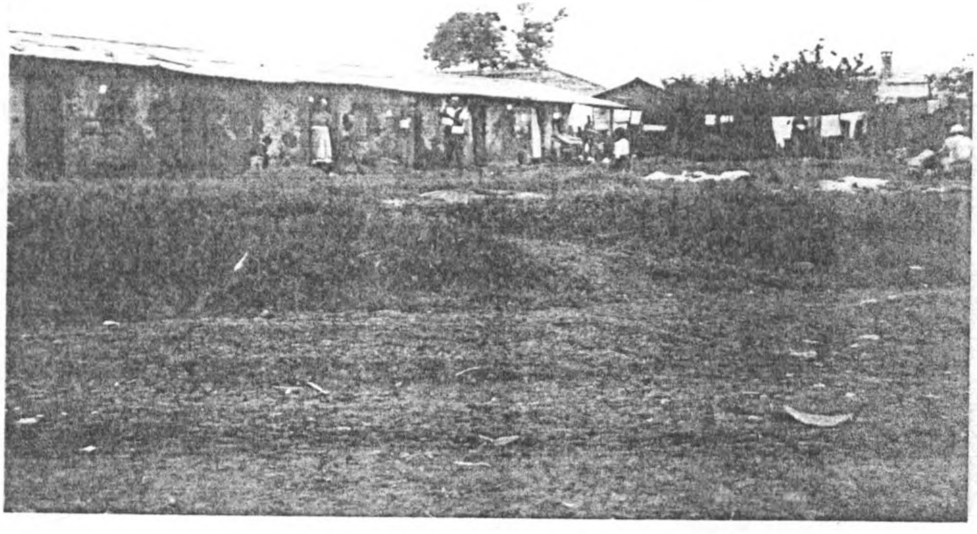
Source: Field Survey, 1996

4.2.7 House Type and Size

Most of the houses in the study area measure about 7 by 8

feet and have mud walls, earth/cowdung floor and corrugated iron sheet roofs (semi-permanent). 83.3% of the households interviewed live in such houses. Hygiene behaviour and the prevention of diseases are influenced by socio-economic and evironmental factors such as proper housing and education. No doubt families with better housing find it easier to maintain personal and domestic hygiene than do people with poor housing especially when poor housing is combined with crowding (Boot and Cairncross, 1993). The poorly constructed houses in the area guarantee habitation by disease vectors especially on the walls. A common vector in the area is the flea which after entering the human body (particularly on the toes) become jiggers. The fleas tend to hide on the mud walls and in the dust of the earth floor. 61.7% of the households live in single roomed houses and this shows that most of the area residents live in single rooms. Given the average household size of 5 persons, a single room is most inadequate for housing and overcrowding is a common feature. 21.7% of interviewed households live in one-bedroomed houses and only 16.7% live in houses with more than one bedroom. Plate 4.1 the type of houses in the settlement.

Plate 4.1: Typical houses in the area



Source: Field Survey, 1996

4.2.8 Housing Related Problems

Various housing related problems were cited by the respondents; these include poor waste management, poor drainage and overcrowding. Poor waste management was ranked first and 63.3% of the respondents cited it. This was followed by poor drainage which was indicated by 58.3% of the respondents. The problem of overcrowding was third cited by 46.7% of the respondents. This problem is experienced at two levels; at the household level due to the small sizes of the rooms and at the plot level owing to the density of development.

4.3 Water Supply and Sanitation Systems

4.3.1 Water Supply Systems

Analysis of field data shows that there are four types of water supply service levels in the area namely;

i) individual tap

ii) communal tap

iii) water kiosks

iv) wells

91.7% of the respondents indicated that they draw their water from the wells. 50% of the respondents use the water kiosks. It should however be noted that those who fetch water from the kiosks use it for drinking only while water for the other domestic purposes is got from the wells. 11.7% of the respondents use communal taps and only 1.7% use individual taps. Although yard taps have been introduced in a few plots, little or no effort has

been made to take care of the waste water resulting from the use of the water. Such plots have shallow unlined earth drains that lack outlets and this makes drainage of sullage of such plots difficult. Plate 4.2 depicts this problem.

Plate 4.2: Poorly constructed drains

Source: Field Survey, 1996

It was however indicated by the respondents that their water source, (especially those using wells and the water kiosks) varies depending on its use, the time of day, water charges and season. Thus 83.3% of the respondents reported that they vary their water source from the water kiosks to the wells due to high water charges imposed by the kiosk operators. Although the officially recommended water tariff by the Eldoret Municipal council is 50 cents (per 20 litres), the water kiosk operators usually charge between Kshs. 2.50 and Kshs 3.00. This high cost of the kiosk water has discouraged many residents from using it.

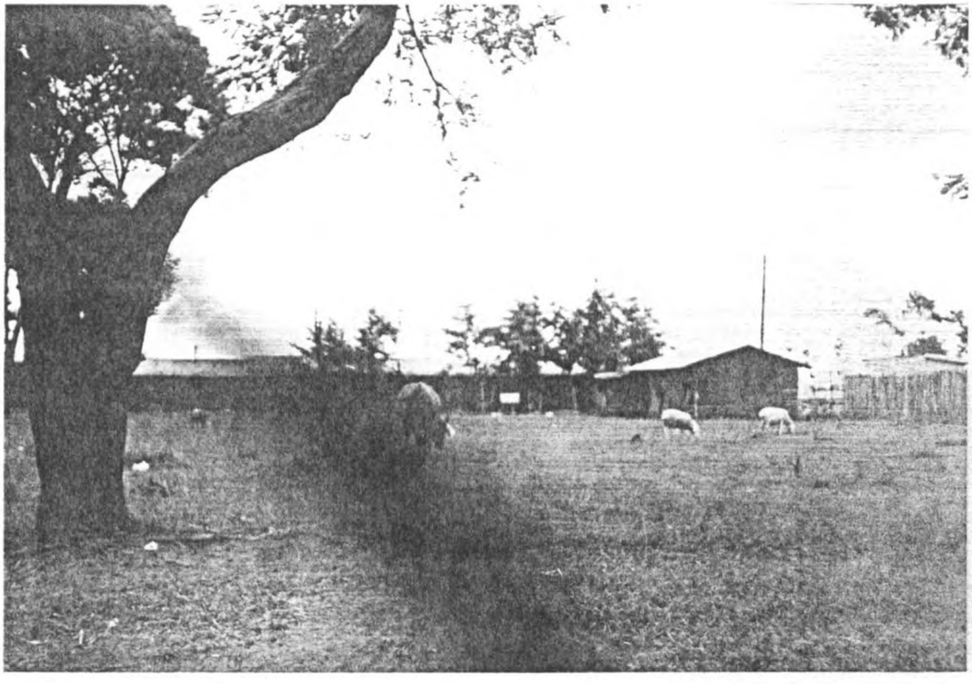
4.3.2 Transportation of Water

Majority of the area residents transport their water from the source to their houses by porterage. 88.3% of respondents interviewed indicated so. The mode of transporting water has negative implication on the use of water kiosks in the area as they are sparsely located so that most of the households have to cover a distance of over 300 meters to the water kiosks. This long distance deters most of the residents from fetching water from the water kiosks, taking into account that they have to carry the water themselves. There is therefore need to increase the number of the water kiosks and locate them within a threshold distance of 200 meters from the houses. This is likely to promote the use of the municipal water instead of the untreated well water.

4.3.3 Uses of Water

Water in the area is used for three major purposes namely; domestic, livestock and garden irrigation. 11.7% of the respondents indicated that they use it on livestock while 20% reported that they use it to irrigate their gardens. This shows that besides the domestic uses of water, there are other two uses that have to be served with water from the wells, which during the dry season is even inadequate for the people as indicated by 21.7% of the respondents. Besides competing for the already inadequate water, livestock plays a role in contamination of the wells that are unprotected by either dropping their wastes in them or their wastes being washed into the wells by surface runoff during the rains. Plate 4.3 shows some of the livestock types found in the area.

Plate 4.3: Some Livestock Types Kept in the Area



Source: Field survey, 1996

4.3.4 Water-Related Problems

There are various water related problems in the area. These include; lack of treatment of well water, salinity, high water charges, inadequacy and unreliability of the water. The following table highlights these problems.

Table 4.3: Water-Related Problems

Problem	% of Respondents
Lack of treatment	73.3
Inadequate and unreliable	33.3
Expensive	15
Salinity	11.7

Source: Field Survey, 1996

From the table, it is clear that lack of treatment of well water is the most serious water related problem, yet 91.7% of the respondents indicated that they use well water. 73.3% of the respondents reported this problem and this reflects the magnitude of the problem. Untreated well water has far reaching implications on the health of the residents given that some of them use the water for drinking. Inadequacy and unreliability of the well water occurs especially during the dry season when the water table falls considerably thus reducing the quantity of well water. Some of the wells may dry completely.

4.3.5 Preferred Improvement

Majority (60%) of the respondents interviewed proposed

provision of piped water to all the plots as the long term solution to the stated water related problems in the area. Indeed, 98.3% of the respondents indicated willingness to pay for improved water supply.

4.3.6 Water Storage Problems

Owing to the low water service level in the area, the residents have to store water in their small rooms. About 97% of the respondents indicated that they store water in their houses. However, they experience a number of problems in storing the water. These include inadequate storage facilities and inadequate space besides possible pollution during storage. Thus 91.7% of the respondents cited lack of adequate storage facilities, as their major problem while 78.3% of the respondents indicated lack of adequate space as a big problem. Given that majority of the residents live in single rooms and the average household size is five persons per household, the problem of inadequate space is real.

4.3.7 Uses of Well Water

Well water in the area is mainly used for drinking , cooking and washing. 91.7% of the respondents reported that they use the water for cooking and washing, while 33.3% of the respondents indicated that they use it for drinking. It is however important to note that most of the wells in the area are unprotected, a factor that exposes the wells to contamination. Thus 87.7% of the

respondents reported that they use unprotected wells. Plate 4.4 depicts one of such unprotected wells.

Plate 4.4: An Unprotected Well

Source: Field Survey, 1996

4.4 Solid Waste

The following methods are used in solid waste management

i) Garbage bins

ii) Garbage pits

iii) Open ground

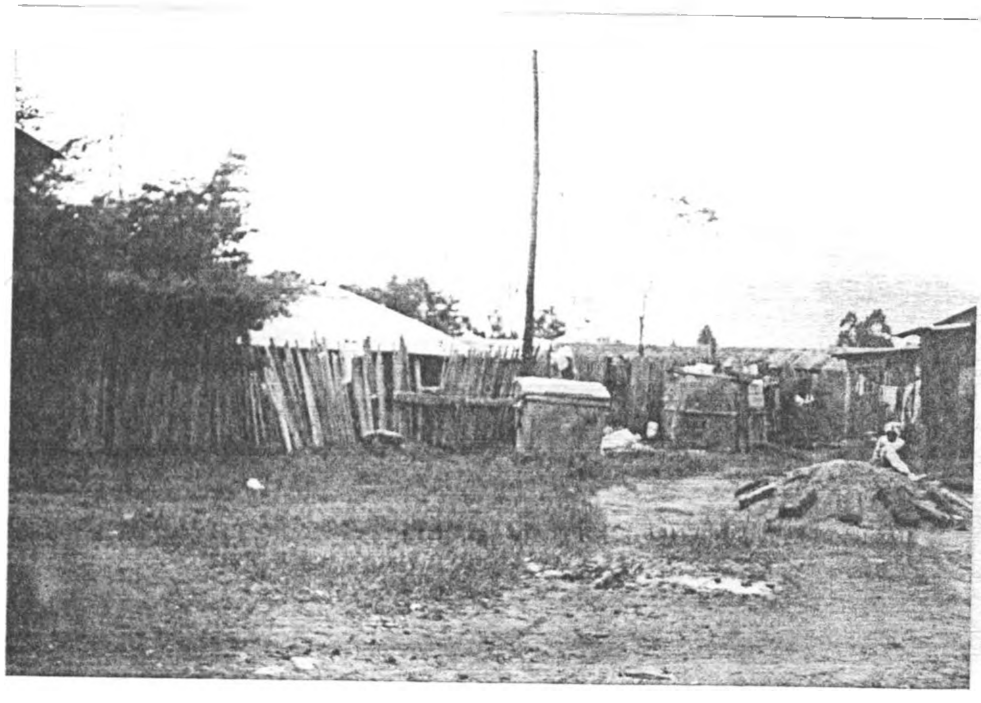
About 62% of the respondents interviewed indicated that they use pits to dispose of their solid waste. About 32% of the respondents reported that they throw or leave their waste in the open ground. Only 1.7% of the respondents use garbage bins. These percentages show that most of the area residents use pits for disposal of their solid waste. Where the pits are used, they are not emptied or replaced promptly once they fill and a lot of garbage litters the sites as some of it is blown away by wind. Plate 4.5 depicts a plot where a garbage pit is used and is poorly managed.

Plate 4.5: A Poorly Managed Garbage Pit

Source: Field Survey, 1996

The use of pits and open ground for solid waste disposal is not sustainable in the area given plot sizes which range from 1/8 to 1/4 acre. Besides, the pits form rich breeding grounds for flies and mosquitoes. Majority (92.9%) of the respondents cited flies and mosquitoes as a critical problem in the area. The respondents suggested provision of garbage bins as the long term solution to the problem of solid waste disposal in the area. Plots where garbage bins are in use are relatively cleaner compared to those that do not have. Plate 4.6 shows a plot that has a garbage bin.

Plate 4.6: A Compound Served With a Garbage Bin



Source: Field Survey, 1996

4.5 Sullage Disposal

The area of study does not have any developed sullage disposal system. About 98% of the respondents indicated that they dispose of their sullage just outside their houses and that the waste water remains close to their houses. This coupled with storm water during the rainy season makes most of the plots very unsightly as most of the water stagnates just outside the houses. This scenario ties with Arnold's, (1978:13) observation that water supply and sanitation programmes in most developing countries have usually been developed separately and that lack of co-ordination of the two systems leads to poor environmental conditions where water supply has been provided without drainage. Such a situation no doubt puts the health of the beneficiaries at risk. Plate 4.7 highlights this problem.

Plate 4.7: Poor Sullage Drainage

Source: Field Survey, 1996

Washing of clothes, utensils and bathing of children is done close to the wells as indicated by about 71% of the respondents interviewed. Given that most of the wells are unprotected, then this is one way through which the wells are contaminated. Plate 4.8 depicts this scenario.

Plate 4.8: Cleaning is Done Close to the Well

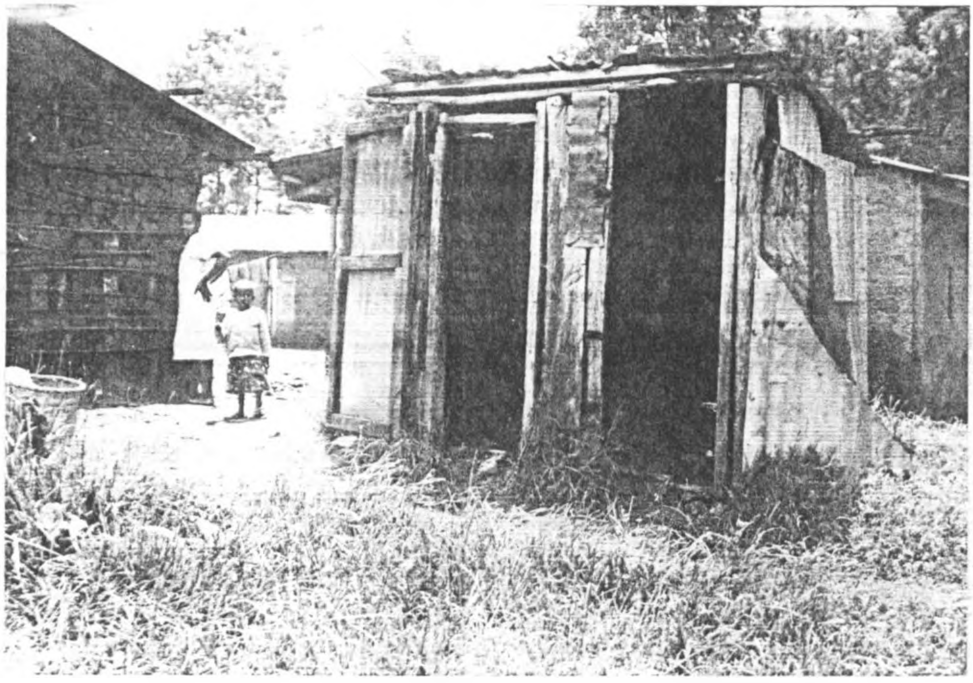
Source: Field Survey, 1996

4.6 Human Waste Disposal

Human waste disposal in the area is mainly by on-site sanitation systems. There are pit latrines and septic tanks with a flush toilet. About 93% of the respondents reported that they use pit latrines. This shows that majority of the residents in the area use pit latrines. 5% of the respondents indicated that they dispose their human waste on open ground for lack of a facility. Only 1.7% of the respondents use septic tanks with a flush toilet.

However, majority of the respondents expressed dissatisfaction with the pit latrines as 66.1% of them indicated a preference for water-borne disposal systems. Most of the residents of the area use communal pit latrines as indicated by 98.3% of the respondents while only 1.7% reported that they use private ones. The respondents reported that the communal latrines are riddled with a host of problems. Thus 65% of the respondents indicated that the latrines are very dirty and unsafe while 63.3% of the respondents reported that the latrines are too few; for instance a plot with about 15-20 households could have a 2 or 3-door pit latrine so that the use ratio is very high, given the average household size of 5 persons. Besides, the toilets are poorly used and managed, a factor that deters their use. Plate 4.9 depicts one such pit latrines.

Plate 4.9: A Poorly Used and Managed Pit Latrine



Source: Field Survey, 1996

However, the respondents expressed preferences for different types of toilets; 66.1% of the respondents showed a preference for a flush toilet, 27.1% preferred an ordinary pit latrine while only 6.8% indicated preference for improved pit latrines. Taking into account the advantages of an improved pit latrine over the ordinary one, it is only logical to conclude on the basis of these findings that a great proportion of the residents is not aware of the merits of the improved pit latrine and this could explain why improved pit latrines are very few in the area.

In addition, 95% of the respondents cited darkness and insecurity as the major problems in using the latrines at night since they are located outside the houses and there is no lighting. In view of this, 93.3% of the respondents suggested the provision of electricity in the plots as the solution to the problem. It was also reported that children are not comfortable to use the communal latrines as most of them are unsafe and filthy. Therefore, 74.1% of the respondents indicated that children do not use the latrines, yet there are no alternatives for them. Thus most of the children defecate in the open within the plots. Again the implications of this are far reaching. A study by Alam etal., (1989) indicates that the absence of child's faeces on the compound results in a reduction in the incidence rate of diarrhoea. Therefore, it is not unlikely that most of the children's faeces finds its way to the unprotected wells when it rains, through surface runoff.

The area of study is a high population density one and during

the 1989 population census, it had a population density of 1166 persons per sq.km. Given the high population density, the pit latrine system of human waste disposal is not and cannot be sustainable as the latrines fill up within a short period of time.

Besides, the pit latrines tend to overflow too soon because it is not possible to dig very deep latrines as the water table is high. Also, landlords sometimes take too long to have overflowing or filled latrines emptied.

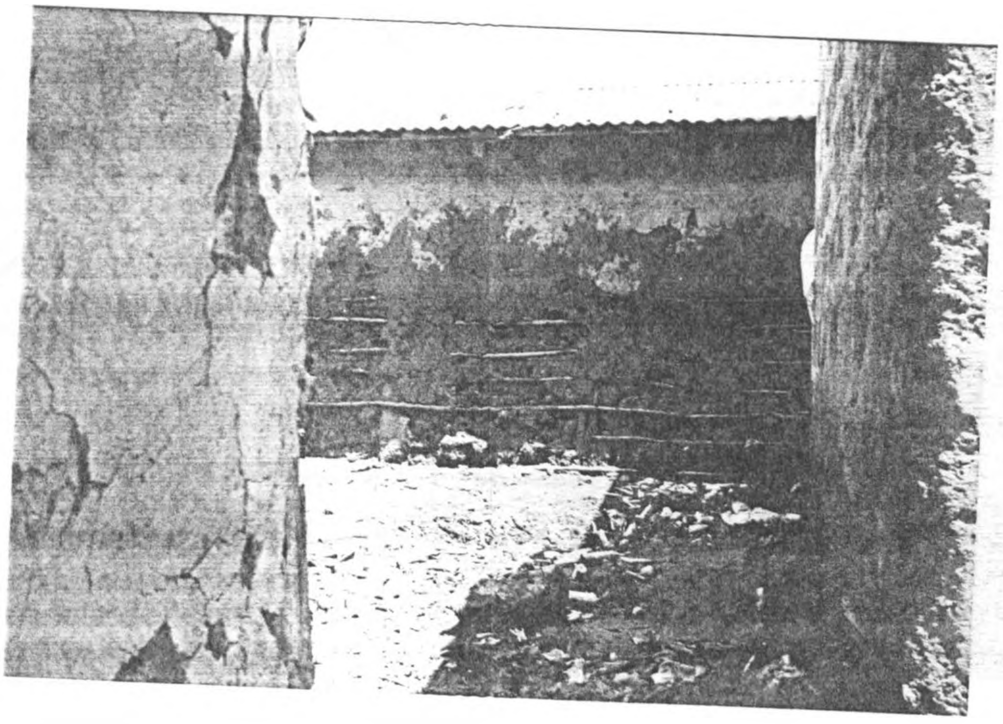
Also, the use of wells as the major water source for domestic uses in the area should ideally disqualify the use of on-site sanitation systems to avoid the possibility of ground water contamination by the latrines. However, both pit latrines and wells are used in the same plot, yet the plots measure between 1/8-1/4 acre and this leaves a very short separation distance between the two facilities. According to general guidelines, a minimum separation distance of 10 meters should be left between a latrine and a well with the distance increasing to 30 meters if water abstraction is high; but this has not been observed in some cases owing to the small plot sizes and high density development.

4.7 Support Infrastructure Services

Data analysis depicts that water supply and sanitation services cannot be efficient on their own; they need to be accompanied by support infrastructural services namely lighting, roads, drainage and community health education among others. Thus most of the (93.3%) respondents expressed the need for lighting within the

plots. Lack of lighting at night limits accessibility to water and sanitation facilities. In the circumstances most people are unable to resist the temptation of defecating in the open just behind the houses. Other equally important support services are access roads. A source at the Eldoret municipal council indicated that lack of accessibility to some parts of the area inhibits emptying of filled latrines by the municipal exhauster vehicles. Plate 4.10 depicts this situation.

Plate 4.10: Inaccessibility of Some Latrines



Source: Field Survey, 1996

4.8 The Role of Eldoret Municipal Council in Provision of Services in the Area of Study

The Eldoret municipal council (EMC), provides the following services in Langas:

i) Access roads

ii) Street lighting especially along the main street

iii) Conservancy and cleansing services

iv) Water supply through water kiosks

However, these services have not been provided adequately. Provision of access roads has experienced two major problems. First, the uncontrolled developments in the area preceded planning so that even after planning, some areas where access roads ought to be, already have developments on them. Secondly, the land tenure system in the area has posed other problems. Land is privately owned and acquiring land for the access roads and other community facilities has not been easy.

Conservancy and cleaning services are limited to the few plots that have garbage bins. Thus majority of the residents remain unserved and the responsibility of removing wastes from the plots remains their landlord's. This has had the effect of most of the residents using poor waste management systems in the area as indicated earlier in the analysis.

The EMC has so far been able to provide 14 water kiosks in the area in two phases. The first phase was accomplished during the third urban project during which 10 water kiosks were constructed and made operational. The second phase was done

during the Eldoret second water supply project during which 4 more water kiosks were constructed and completed by 1995. However, as pointed out earlier, these water kiosks are sparsely distributed and majority of the residents remain too far from them. Besides, the fact that the water kiosks are located on privately owned land and their operation is tied to the plot owners on whose land they are, minimizes their benefits to the beneficiaries as noted earlier.

The EMC has not provided any human waste disposal systems in the area. Again this responsibility has been left to the plot owners to develop their own systems. The shortcomings of such systems do not need overemphasis in light of the foregoing discussion.

Given the high costs that must be met in the provision of infrastructure, the EMC strongly feels that the plot owners should cost-share. While this is a noble idea and one which would transform the area if implemented, there are factors that militate against it, although the plot owners have been noted previously for their co-operation in community participation. Plot owners had not yet been issued with title deeds at the time of this survey (1996) although they were supposed to have been issued title deeds during the third urban project (1983-1989). In the absence of title deeds, many of the plot owners lack collaterals for obtaining credit. Secondly, lack of awareness among some of the landlords of the importance of improved infrastructural services is likely to make most of them reluctant to improve the

same on their plots. For instance some of the plot owners interviewed during the survey indicated that there was nothing wrong with the well water for they have used it for over 10 years without any serious health problems. However, the municipal council medical officer of health indicated that his department was aware of the fact that the well water has been contaminated by the pit latrines (as confirmed by an earlier study "safe water environment" of 1993-1995) and indeed the area experiences typhoid every year and this has always been traced to the ground water sources. That notwithstanding, the council has not done enough to ensure that the contaminated wells are either treated or not used altogether.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary of Study Findings

From the analysis the following is evident:

a) That the existing water supply and sanitation systems have various limitations. For example, the well water is contaminated, some of the water kiosks are not operational, and for the ones that are operational, water charges are too high. In addition, pit latrines have a short lifetime owing to high use ratio.

b) That both socio-economic and physical factors have to some extent contributed to the current poor state of the said systems.

c) That the current water supply and sanitation systems are not adequate considering the high population density of the area.

d) That there is need to develop appropriate water and sanitation systems in the area, taking into account the local conditions.

These findings have implications on the provision of water supply and waste management systems in low-income urban settlements. Considering that these areas are characterized by high population densities, on-site sanitation systems should not be provided as a long-term solution to waste management. On-site sanitation systems such as pit latrines and garbage pits require land for alternating which is not likely to be available in high density areas. Also, where ground water is being used for water

supply, pit latrines should not be recommended unless the water table is extremely low, and soil characteristics are not likely to contribute to contamination of ground water. Therefore, if pit latrines must be used, then water supply must be piped, or if shallow wells must be used, then human waste should be disposed of through a water-borne sanitation system.

5.2 Recommendations

However, the future of Langas lies in the hands of the authorities and the landowners. These two will ultimately determine whether the area will be upgraded to a formal low income settlement or be redeveloped as a middle income residential area. The informal settlement of Langas is likely to remain for a considerable period of time and given the continuing high population growth rate, rural-urban migration and poverty, low income informal settlements are likely to remain a facet of urban life for the foreseeable future. Various steps can and should therefore, be taken to improve the situation (even if in the short-term).

In this respect, the government should recognize that low-income households have the financial capability to pay for services and therefore provide increased service coverage and extend credit to allow them to improve their situation particularly infrastructural services. This is supported by the fact that 98.3% of the households interviewed registered willingness and capability to pay for improved water supply. Their

capability to pay for improved water supply is portrayed by the fact that due to its poor distribution, those who use kiosk water pay more per cubic metre than middle and high income households although they consume considerably smaller amount of water per capita. The official tariff for water purchased at a kiosk is 50 cents per 20 litre container. However, as indicated in chapter 4, charges range from Kshs 2-3. For comparison , a consumer with a house connection would pay about 50 cents for same amount of water.

Willingness and capability to pay for services depends partly on household income. Although most residents of Langas fall into the low-income category, many are employed in the formal sector and therefore have a reliable source of income. Others are engaged in small-scale businesses such as selling of second- hand clothes, foodstuffs and liquor.

The government should encourage experiments in promising appropriate technology to improve conditions in low income areas and adapt these to suit changing local needs.

There is need for the government to recognize that regardless of tenure, a long-term planning perspective is necessary to ensure sustainability of development efforts in informal settlements.

5.2.1 Sanitation Technologies

There exists a variety of sanitation technologies that can be used in developing countries. However, in these countries where the effect of excreta-related diseases is still high, the primary

objective of sanitation programmes must be the improvement of public health (Mara, 1982). Otherwise, refinements to increase user convenience are of secondary importance and can be made at a later date when the community can afford them. This primary health objective can be fully achieved by sanitation technologies which are much simpler and cheaper than conventional sewerage (Ibid.). Mara, (1982) defines the most appropriate technology as that which provides the most socially and environmentally acceptable level of service at the least economic cost.

Selection of sanitation technologies is greatly influenced by among others site conditions, population (its density and growth patterns), existing water supply service levels, socio-cultural factors, and affordability. Given the physical conditions, population density and the existing water supply service levels in Langas, some sanitation technologies are technically infeasible for the area; for example water-borne sanitation systems can only be used if water is connected in the building. Thus the improvement of sanitation technology is closely related to the service level of the water supply. For the purpose of the area of study, both short-term and long-term sanitation interventions have been explored.

5.2.3 Short-Term Interventions

Short-term interventions will include those technologies that can be adopted to serve the area under investigation for a period

of about ten years or less, taking into consideration the area's local conditions.

Providing adequate excreta-disposal facilities in human settlements has the objective of safeguarding community health and the promotion of a safe environment. There is a range of appropriate on-site sanitation technologies which can provide the same health benefits as conventional water-borne sewerage at a fraction of its cost (Habitat, 1992). It is important to note that a majority of the on-site sanitation technologies which cost only a tenth to a third as much as conventional sewerage, also require low levels of water use for their operation; and are therefore ideal for settlements that have low water service levels for example where standpipes, water kiosks and wells are in use. Water-borne sanitation systems such as cistern-flush toilets require a large amount of water in the order of 50-100 litres per capita a day (Ibid.,:9).These high water requirements imply that they cannot be achieved with low level water supply service common in low-income settlements.

However, soil conditions and housing densities may preclude reliance on on-site disposal technologies, their low cost notwithstanding. It is in light of the local conditions of the study area that on-site disposal technologies will be suggested as short-term intervention of the human waste disposal problem in Langas area.

The area of study has physical characteristics that militate against the use of on-site disposal technologies as a long-term

solution in the area. As pointed out earlier in the text, much of the soils have characteristics of black cotton soils, with poor drainage. This coupled with the high water-table in some parts of the area makes the use of pit latrines problematic as these two factors reduce infiltration of the soils considerably. Therefore, given that the pit latrines cannot be excavated to great depth owing to the high water table, only shallow pits can be excavated. Taking into account the high user ratio of latrines in the area of over 70 persons per latrine, then such shallow pits fill up within a very short period of time; for instance some respondents indicated that their latrines get filled up in less than two months of emptying. Besides, some parts of the area get flooded during the rains so that most of the latrines get filled with surface runoff, a factor that creates a lot of inconvenience to the users and contributes to water pollution.

However, with a few modifications, the pit latrines could serve as a short-term solution to the human waste disposal problem in the area of study. Latrines are basically chambers excavated in the earth with the capacity to store human waste and infiltrate liquid. They comprise three main components namely, a pit, a squatting plate and a superstructure. If properly designed, used and maintained, they present no health risk. There are various types of pit latrines among them the ordinary pit latrine, ventilated improved pit-latrine (VIP) and the ventilated improved double-pit latrine (VIDP) among others.

The ordinary pit latrine is the simplest in design. It

simply consists of the superstructure, squatting plate and the pit. The squatting plate may be concrete or earth. This type of latrine has the disadvantage of mosquito and fly-breeding, besides the unpleasant odour from the pit. It is this type of latrine that is most commonly used in Langas its disadvantages notwithstanding. Besides, most of the latrines in the area of study are poorly constructed so that they do not offer any privacy or safety to the users. For example the superstructure may be poorly constructed, lacking a door for closing the entrance during use, and the squatting plate may be earth or made of wooden poles placed across the pit. Such structures are very unsafe and there is need to construct the improved pit latrines for they do not have most of the cited problems of the ordinary pit latrine.

The ventilated improved pit latrine is an improved version of the ordinary pit latrine and has two openings in a base concrete slab. One of the openings is used for ventilation through which an external vent pipe is installed, while the other one is the channel through which human waste is deposited into the pit. The vent pipe is painted black and located on the sunny side of the latrine superstructure. Solar energy heats up the air in the vent pipe to create an updraft with a corresponding downdraft through the squatting plate. Any odours emanating from the pit contents are expelled via the vent pipe, leaving the superstructure odour free. The vent pipe is covered by a gauze screen so that any flies that may be in the pit are prevented from escaping and they eventually fall back to die in the pit (World Bank, 1980). The

pit walls should be cemented to curb infiltration of waste water from the latrine to ground water sources. Such a pit latrine can conveniently be emptied as the need to do so arises. Therefore, since the VIP latrines offer greater user convenience, Langas plot owners should move away from the construction of ordinary pit latrines to the more advantageous VIP latrines.

At the time of this survey, there were very few VIP latrines in the area of study. Increased use of this type of latrines in the area could be achieved by educating the community on the advantages of the improved latrines. It was evident during the survey that most of the area residents do not know the difference between the two types of latrines. The VIP latrine offers the same health benefits as a flush-toilet provided the squatting plate is kept clean.

Besides the VIP latrine, there is the ventilated improved double-pit latrine (VIDP). This is similar to the VIP latrine except that the former has two pits. Each of the pits has an average capacity of 2-3 years. The pits are used alternately and operated under the same principle as the VIP, but with a cycle of equal periods of use and storage (Mara, 1982; Habitat, 1984). The VIDP latrines have similar advantages as those of the VIP ones but have a longer lifetime since once one pit gets filled, the other is used while the filled one is emptied to await re-use. Since the VIDP latrines have a higher capacity than the other discussed types of latrine, it would serve the area of study better taking into account the high use ratio. There is therefore need to

introduce and encourage this type of latrines in the area of study.

It should however, be noted that the latrines can be emptied and reused depending on whether their location is accessible by the exhauster vehicles. In the area of study, inaccessibility of most of the plots hampers emptying of the latrines. However, appropriate technology can be a short-term solution to this problem. For instance a special latrine emptying vehicle designed by Manus Coffey Associates for emptying latrines could be introduced in Langas. This vehicle has its advantages in that it can service pits with dense wastes which cannot be serviced by conventional equipment. Besides, it can reach areas inaccessible to conventional exhauster vehicles. This type of vehicle has been used by Kenya Water for Health Organization (KWAHO) in Kibera successfully (Kuguru and Mwiraria, 1991). However, due to poor planning and layout of houses in the settlement, many latrines would still remain inaccessible to the emptying vehicle. In this case, the solution would be to lengthen the hose pipe so that it could reach those latrines that are situated far from the nearest access road or footpath. The area community leaders and local development committee could also encourage the landlords to provide access to all latrines. Although appropriate technology can have a dramatic impact, it needs to be continuously adapted to suit changing local needs. For instance with continued use of the latrine emptying vehicle, the basic latrine design could be adapted to increase the durability of the latrine. In this

respect, areas within Langas where the soils are unstable and the water table is high, shallow latrines of about four metres deep with reinforced walls would be more appropriate. Wall reinforcement could be done using cement. Construction of emptiable latrines with suitable reinforcement that facilitates emptying would eliminate the need for frequently rebuilding new latrines in an area where land is limited.

Technology can dramatically improve conditions but in order to have a lasting impact, it must be affordable, appropriate and sustainable to local needs. Given the various types of pit latrines, the VIP latrines have been accepted as superior in terms of hygiene and reduced odour. The VIDP latrine is even much better for it has an extra advantage of a longer lifespan. The cost of VIPs was estimated at Kshs. 8,000 by 1991 (Kunguru and Mwiraria, 1991) and given an upward trend of prices due to inflation, its current cost is estimated at Kshs. 10,000 while that of VIDPs is slightly higher. Taking into consideration the past co-operation of Langas landlords during the third urban project, they can still take advantage of such co-operation and build the VIDPs as a short-term intervention to the current human waste disposal problem.

5.3 Long-Term Solutions

Given the high use ratio of the pit latrines in Langas area, they cannot be a long-term solution to the human waste disposal problem. This is because, assuming that the latrines will be

upgraded to the VIP or VIDP latrines and that they can be emptied once they fill, this may not be feasible after a period of about ten years in the area of study taking into account the high population growth rate. High population growth means greater use of the latrines and therefore filling within even a shorter period. This will call for more frequent emptying of the latrines and therefore higher costs for the service.

Emptying the latrines is costly as it cost about Kshs 400/= to suck about 500 litres of liquid waste at the time of this survey, yet in some compounds latrines fill within a period of less than six weeks. This cost coupled with the problem of inaccessibility of some of the plots calls for a long-term solution to the human waste disposal problem in the study area. Where emptying of latrines is not possible, another pit latrine is dug after the earlier one is filled. Taking into account the high density development in the area and the small plot sizes, there is no adequate land for the pit latrines and there is need for water-borne sanitation disposal system. A water-borne sanitation disposal system could be made feasible by first raising the water supply service level from the present low service level for the majority to either yard taps or in-house connection so that water for the facility would be easily accessible.

5.4 Water Supply Improvement

Providing a water-supply system for a community involves tapping the most suitable source of water, ensuring that the water

will be fit for domestic consumption and supplying it in adequate quantities (Habitat, 1984). Given the two major sources of water in the area of study namely; wells and water kiosks, and considering the quality and quantity of the water from these sources as indicated in chapter 4, it is in line with conventional wisdom to recommend increased use of the treated municipal water and a move away from the well water. This can be achieved by ensuring that the treated water is within the reach of the area residents, both physically and economically. In this respect, various efforts can be made to improve the water supply in the area, by different actors.

Given the foregoing analysis and the resources at the council's disposal, the EMC could improve the area in terms of infrastructure provision in various ways. Water supply could be improved by the council increasing the number of water kiosks to the extent that none of the area resident is beyond 200-300 meters from a water kiosk. This would encourage the residents to use the water as the walking distance would be considerably reduced. Taking into account the cost of a water kiosk of Kshs 60,000 as per 1989, and the council's sound financial account, such improvement can easily be realized. Indeed, water and sewerage department earns the council most of its revenue particularly from the water supply. The following table shows the council's water department's revenue and expenditure figures for the last five years.

Table 5.1: Eldoret Municipal Council's Financial Resources

YEAR	REVENUE	EXPENDITURE
1994/95	43452201.35	22055220.35
1993/94	26050767.50	25860266.95
1992/93	21637824.95	19265366.50
1991/92	20635050.65	15006041.00
1990/91	12286458.00	17927337.60

Source: Eldoret Municipal Council, 1996

From table 5.1, it is evident that from 1991/92 to 1994/95 financial year, the EMC's water department has been having a sound financial account and has operated without any deficits. There has therefore been substantial balance which could be reinvested in provision of water particularly extension of the municipal water to peri-urban areas that are considerably underserved. Taking into account the cost of a water kiosk of Kshs. 60,000 and the high balance on the water account, the council would be able to construct several water kiosks each financial year in the peri-urban areas thus easing the water problem. Therefore, there is need for the municipal council to give priority to construction of more water kiosks in the area of study with a view to taking the service closer to the beneficiaries.

The council's department of public health should undertake a serious public health education campaign in the area with a view

to educating the area residents on the importance of safe water supply, and the dangers of the contaminated well water that most of them use. If more water kiosks are provided within a short walking distance preferably of 200-300 metres, then most of the area residents are likely to stop using the well water especially after they are told about its dangers. Boiling of well water before its use for drinking should also be encouraged.

However, provision of extra water kiosks and public health education may not ensure change from the use of well water to the municipal treated water unless the council ensures smooth operation of the water kiosks. This could be achieved by the council acquiring the land where the water kiosks are located and where the additional ones are to be constructed. This way, the council would exercise control over the operation of the water kiosks and therefore ensure that they are run by competent people. Also, the council should supervise and ensure that the kiosk operators do not overcharge as this has been the practice that discourages many residents from using the kiosk water. Stiff penalties should be enforced on any offenders with regard to overcharging for water.

Acquisition of the land on which the water kiosks are, should not be a problem because Langas plot owners are on record as having shown a good harambee spirit through which they contributed money to compensate those people whose land was earmarked for public facilities such as schools, during the third urban project. The same approach can still be used to acquire land for the water

kiosks. Also, operation of the water kiosks could be streamlined by greater involvement of the community in the operation of the kiosks; for instance women groups could take over the operation of water kiosks once the council has acquired the land in which they are located. Women are likely to improve the situation as they are more present. Besides, women are more seriously affected by the lack of adequate services such as water since they are responsible for collecting water for their households. In this respect, most of them are willing to participate in community efforts to alleviate water problems.

Operation of the water kiosks can be an attractive starting point for women's income generating activities. In fact, some women groups in the area are involved in the sale of foodstuffs and given the opportunity, they would probably operate the kiosks to diversify their income-generating activities. The government could promote the participation of women groups by advancing them credit to supplement their resources. Introduction of community managed water kiosks would in addition to increasing access to water, help to introduce competition through lower prices. This would also allow the area residents purchase more water. This kind of participation of women groups has successfully worked in Kibera (Kunguru and Mwiraria, 1991). The women's participation in Kibera has no doubt enabled more residents to have access to water. These efforts can be replicated in Langas.

Besides the introduction of more water kiosks by the EMC, the plot owners should be encouraged to introduce yard taps within

their plots as this would take the service much nearer to the beneficiaries while at the same time increasing the user convenience. A few plot owners have already provided yard taps on their plots and in such plots, the residents have stopped using the well water for drinking purposes. Majority of those interviewed indicated their wish to have yard taps and willingness to pay for the improved water supply.

However, it should be noted that introduction of the yard taps will certainly raise water consumption as the taps give a higher service level than the wells and /or water kiosks. Therefore, it will be necessary to device an appropriate system of disposing the sullage resulting from the higher water consumption. The few plots that have yard taps are already experiencing sullage disposal problem as there are no fully developed drains through which this waste water can be disposed of. As indicated in chapter 4, the few plots that have yard taps have poorly constructed quasi-drains that lack outlets and this leads to accumulation of sullage within the plot thus posing a health hazard to the residents. There is therefore, need to develop a well lined drainage system for draining sullage in the entire area. Such a system should comprise the main drains running parallel to the access roads and branch drains to serve each individual plot.

5.6 Solid Waste Disposal

The need for the adequate collection and disposal of solid

waste in urban settlements is based on aesthetic and health considerations. Solid waste dumps provide a habitat favourable to disease carriers, such as rodents and flies besides the unpleasant odours that result from biological decomposition of the waste. Although most solid wastes normally contain only low concentrations of disease-causing organisms, in low-income areas, faeces is commonly dumped with refuse thus making such wastes of greater danger to health than those in areas with sanitation coverage (Habitat, 1992).

The area of study does not have a well developed and sustainable system of solid waste disposal as portrayed in the study. Garbage pits are the most commonly used method of solid waste disposal and as pointed out earlier, this method cannot be sustainable in the long-run considering the small plot sizes. Furthermore the garbage pits have their own limitations which have already been highlighted. In view of this and the respondents' preference, there is need to introduce garbage bins in every plot to ensure proper solid waste disposal.

5.7 Support Infrastructural Services

As pointed out in chapter 4, support infrastructural services such as lighting and access roads are lacking in some plots. Indeed, lighting is limited to the main access road traversing the area of study.

It is on the basis of this that the study recommends that besides the improvement of water supply and sanitation systems,

support infrastructural services are necessary. This is in consonance with what another study in the Kinango-Kitui informal settlements found out (Mairura, 1988).

5.8 Conclusion

Unplanned settlements play and will continue to play a significant role in providing housing for many low-income households in Kenyan urban areas. Lack of low-income housing in urban areas has stimulated the development of unplanned settlements. A study on development of informal housing in Kenya, case studies of Kisumu and Nakuru towns found that informal sector housing developers have taken advantage of this situation and are providing housing for many low-income households at much faster and reasonable prices (Syagga and Malombe, 1995). This is the more reason why local authorities should provide such settlements with basic infrastructural services.

It seems that only the national or local levels of government can provide the urban poor with access to a wide range of infrastructure and services. This is because the private sector usually considers these services unprofitable besides the high capital outlay required by some of the services especially the network-based ones. However, with the increased cost of providing services, it has become difficult for most governments and local authorities of developing countries to meet the ever expanding demand for these services in the urban areas due to rapid urbanization. However, there are a number of policy options that

may help the situation.

One policy option that could probably work in the area of study would be self-help provision of infrastructure services by the neighbourhood or mutual benefit organizations with input or assistance by the area local authority. Langas plot owners were noted for their cooperation in community participation during the third urban project through which they were able to provide land for community facilities such as schools. The same initiative can be used to extend water from the water kiosks to the individual plots. The EMC could organize the landowners around this objective.

Women have a special role to play in the area of study because they are more present, are or can easily be organised and are more receptive to community development initiatives. This is reflected in the study findings as 71.7% of the respondents were women. Also, 98.3% of the respondents indicated their willingness in community participation to improve the living conditions of the area. For instance if women groups could take over the operation of the water kiosks once the EMC has acquired the land in which they are located, they are likely to improve the current situation for women are more easily organized.

The central government could create a special fund for urban infrastructure and service development that can be used to finance costly capital infrastructure investments. Similar special funds have been created before in the country and the current National Youth Fund is a case in point. This fund has so far received a

lot of generous contributions from people of all walks of life. If a similar special fund were established to take care of infrastructure development in the low-income settlements, it would most likely receive similar support provided it has the blessings of the central government.

Non-Governmental Organizations (NGOs) could help improve the situation in the area of study in the short-term. At the time of this survey, two NGOs were operating in the area namely; the World Vision of Kenya and the Maranatha mission. These two are involved in development of education in the area either through running schools or sponsorship of children. Such NGOs could be approached to diversify their coverage so that they also assist in funding more water kiosks, that could then be operated by women groups thus breaking monopolies of the private operators.

NGOs could play an important role because they are not geared toward profit making and are often able to obtain funds from various sources with which to experiment on new tools and techniques. In addition, they are flexible and therefore able to use various approaches to serve the community's needs.

If services for high-density urban settlements are to be improved over the long term, the financial capacity of local Authorities in developing countries to deliver services and construct and maintain infrastructure effectively and efficiently must be greatly expanded. This should be accompanied by a change of negative attitude towards the low-income urban settlements by the local authorities and central governments. Otherwise, most

local authorities do not seem to give priority to the infrastructural problems affecting these settlements even when such are not squatter settlements.

In summary, increasing the access of infrastructure and services to the urban poor is likely to remain one of the biggest challenges in developing countries given the high rate of urbanization in these countries. For governments in developing countries to meet the growing needs of the urban poor for services, there is need for them to explore a wide range of options for service delivery, financing and land acquisition. There is need for the government to play a much stronger role in providing services that are not profitable for the private sector and that affect public safety, health and welfare.

Areas for Further Research

There is need for in-depth research in order to establish the right separation distance between pit latrines and shallow wells as general guidelines seem to give a range of distance (10-30 meters) and most people / developers tend to choose 10m in order to economize on space, even in cases where such a distance should not be applicable.

REFERENCES

Akong'a, J. and Maithya, H.M. (1995): **Safe Water Environment in Eldoret Municipality: the social dimension.** Paper presented at a conference on Safe Water Environments in Eldoret, August 1995.

Alarm etal., (1989): **Mother's personal and domestic hygiene and diarrhoea incidence in young children in rural Bangladesh.** In international journal of Epidemiology, vol. 18, no.1.

Arnold, P. (1978) (ed.): **Sanitation in Developing countries.** John Wiley and Sons Ltd., Chichester.

Boot, M.T. and Cairncross, S. (eds) (1993): **Actions speak: The study of hygiene behaviour in water and sanitation projects.** IRC International Water and Sanitation Centre and London school of Hygiene and Tropical medicine.

Duncan, M. (1982): **Appropriate technology for water supply and sanitation.** World Bank, vol. 1b.

Esrey, S.A. etal. (1990): **Health benefits from improvements in water supply and sanitation: survey and analysis of the literature on selected diseases (WASH technical report; no. 66).** Arlington, U.S.A., Water and Sanitation for health project.

Germany Environmental Consultants (1989):
-Eldoret Municipal council sanitation study- Vol.1 Report Annex A
-Eldoret Municipal council sanitation study- Vol.11 Annex B. Study on socio-economy and Public Health Pre-Feasibility Report.

Habitat, (1991): **The management of secondary cities in Sub-Saharan Africa.**

Habitat, (1987): **Shelter, Infrastructure and Services for the poor in developing countries: Some policy options.**

Habitat, (1992): **Delivery of basic infrastructure to low-income settlements: Issues and options.**

Habitat, (1987): **Shelter, infrastructure and services for the poor in developing countries: some policy options.**

Habitat, (1984): **A review of technologies for the provision of basic infrastructure in low-income settlements.**

Habitat (1986): **The Design of shallow sewer systems.**

HABITAT (1986): **Delivery of Basic Infrastructure to low-income settlements: Issues and Options.**

HABITAT (1990): People, Settlements, Environment and development.

Jorge, E.H. et al. (1994): Environmental problems in Third World cities. Earthscan publication Ltd. London.

Kalbermatten, J.M. (1980): Appropriate technology for water supply and sanitation: technical and economic options.

Kunguru, J. and Mwiraria, M. (1991): NGO Support to informal settlements: A Case study of Kibera, Nairobi.

Kunguru, J. and Karinki, M. (1995): Congestion and Human Responses to getting rid of waste. A review of community based environmental sanitation improvements as analyzed in case studies of two informal settlements; Kibera (1992) and Maina village (1993).

Mairura, E.O. (1988): "Development of water and sanitation infrastructure in unplanned low-income urban settlements of Kitui, Kanuku and Kinyago, Nairobi". M.A. Thesis, University of Nairobi.

Nairobi City Commission Public Health Department, (1991): Improving Environmental sanitation in informal settlements.

National Cooperative Housing Union (NACHU), (1990): A survey of informal settlements in Nairobi.

Nyaoro, W. (1992): "Water supply and consumption in Eldoret". M.Phil. Thesis, Moi university.

Obudho, R.A. etal, (1991): "Urban Environmental problems". In 17th WEDC Conference on infrastructure, environment, water and people. Water, Engineering and Development centre, England.

Republic of Kenya (1989): Population census Report.

Republic of Kenya (1979): Population census Report

Republic of Kenya (1969): Population census Report

Republic of Kenya (1962): Population census Report

Republic of Kenya (1948): Population census Report.

Republic of Kenya, National Development plan 1989-1993.

Republic of Kenya, National Development plan 1994-1996

Sumka,H. (1991): Improving Environmental Sanitation needs in informal settlements - a paper presented in an Environmental sanitation workshop held in Naivasha.

Wanyonyi, R. N. (1994): "The urban poor and the environment in Eldoret, Kenya. M.Phil. Thesis, Moi university.

World Bank, (1992): Project completion Report, Secondary towns project, Kenya.

World Bank,(1980): Appropriate technology for water supply and sanitation.

World Bank, (1980): Appropriate technology for water supply and sanitation- A planner's guide.

APPENDIX

HOUSEHOLD QUESTIONNAIRE

1 (a) Questionnaire Number . . . . . .

(b) Date of Survey . . . . . .

HOUSEHOLD DETAILS

2. Number of people living in the household . . . . . .

3. Household details including the respondent:

Sex	Age (Yrs)	Length of stay in Langas	Education Level	relation to the head	Income Ksh/ month

HOUSING

4. Who owns the house?

a) Occupier

b) Employer

c) Rented

If rented, what is the rent paid for the house per month in Kshs?

. . . . . .

5. Of what building materials is the house made?

Wall	Roof	Floor
Block Brick Timber Mud Wood	Tiles Iron sheets Asbestos Grass	Earth Tiles Cement Wood

6. SIZE OF THE HOUSE

Rooms	Number
Bedroom Living room Bathroom Toilet Guest wing	

7. What are the major housing problems here?

a) High rental charges

b) Poor drainage

c) Security

d) Overcrowding

e) Inadequate supply

f) Waste collection

g) Others . . . . . .

WATER SUPPLY

8. Where do you get your water from?

a) Individual tap

b) Communal tap

c) Water kiosk

d) Rain water

e) Wells

f) River/Stream

9. Does the source of water vary depending on:

a) The use of water

b) Time of day

c) Water charges

d) Season

10. How do you transport the water from the source to your home?

    a) Motor vehicle

    b) Mkokoteni

    c) Wheelbarrows

    d) Others (specify). . . .

11. What are the major uses of water?

    a) Domestic

    b) Livestock

    c) Irrigation

12. How many 20 litre jerricans of water do you use in a day?

13. Do you pay for water?

    a) Yes

    b) No

On what rates do you pay for the water per month in Kshs?

Piped/per month	20 litre container	Flat rate per month

14. How much money do you spend on water per day?

15. What water related problems do you experience?

    a) Salinity

    b) Inadequate supply

    c) Untreated water

    d) Expensive

    e) Unreliability

16. How can this problem be solved?

17. Do you store any water in the house?

Yes/No

18. Do you experience any problem is storing water?

If so, is it,

a) inadequate storage facilities

b) Possible pollution while stored

c) Inadequate space in the house.

d) Others (specify).....

19. When do you clean the storage vessel?

20. For what purposes do you use well water?

a) Drinking

b) Cooking

c) Washing & Cleaning

d) Irrigation

e) Livestock

21. Is the well protected i.e, lined and covered?

a) Yes b) No

22. If unprotected, what danger does the well water pose to the users?

23. Are you willing to pay more for an improved water supply?

Yes/No

24. What type of improvement would you prefer?

a) Individual tap

b) Increased communal tap

c) Lower water changes

d) More wells

SANITATION

25. How do you dispose of waste water?

    a) Throw it on the ground outside the house

    b) Throw it in a drain

    c) Throw it in a sewerage system

    d) Pour it on the house floor especially is it is earth.

26. Does waste water remain close to your house? No/Yes

27. Where do you do your washing and bathing?

28. What methods do you use to dispose of your solid waste?

    a) Throw it on the ground

    b) Throw it into a garbage pit

    c) Throw it into a garbage bin

    d) Others (specify) . . . . . .

29. What happens to the waste when it finally fills up?

30. What problems do you experience with the above methods?

31. How can these problems be solved?

32. What system do you use to dispose of human waste?

    a) Pit-latrine

    b) Bucket right-soil collection

    c) Leave it on open ground

    d) Sewerage system

    e) Septic tank with flush toilet.

33. Which system do you prefer?

34. Do you use a private or a communal toilet?

35. Where is the toilet located?

a) Inside the house

b) Outside

36. What problems do you experience as you use the toilets?

a) Dirty

b) Unsafe

c) Too few

d) Others (specify) . . . .

37. Are you charged for the use of the toilet?

Yes/No

If so, how much?

38. Which type of toilet do you prefer?

39. What problems do you encounter in using the toilet at night? How can they be solved?

40. Do children find it comfortable to use the present toilets? Yes/No.

41. Who owns the toilets?

42. How long do the toilets take to fill up?

43. What happens when they fill up?

44. How often are they cleaned and who does it?

45. What communal activities are carried out in this area?

46. Would you be willing to join others in improving health conditions in this area or should everyone work as an individual to improve the unsanitary environment?

QUESTIONNAIRE FOR THE LOCAL AUTHORITY

1. What is the legal standing on unplanned settlements like some of those in Langas?.
2. If they are illegal, what makes the so?.
3. Do you recognize land ownership or construction of houses by Langas residents?
4. What infrastructure services do you provide in Langas?
5. Who qualifies for these services?
6. Who finances investment in on-site/trunk services?
7. List major water suppliers in the municipality.
8. Who distributes the water?
9. What are the yields of the various wells and boreholes in Langas?
10. How much water from the municipal water supply is consumed in Langas per day or month?
11. Who is responsible for waste water disposal?
12. What is the design capacity of the water plant?
13. What is the actual quantity of water produced?
14. Please give figures of operation and maintenance allocation for the last 5 years and their breakdown.

e.g. <u>operation costs</u>	<u>maintenance costs</u>
personnel costs.....	servicing.....
power.....	spare parts .....
chemicals.....	

15. How much did it cost to develop each of the following?
    - water supply
    - sewerage
    - pit- latrine
    - septic tanks
    - communal water points
    - individual connection
    - night soil
    - roads
16. Have you experienced any water pollution problem in Langas?
17. What would you say about the implication of on-site human waste disposal systems amidst ground water sources such as wells in Langas?
18. Which types of sanitation services do you offer in Langas?
    e.g. sewerage/septic tanks/cess pools/pit latrines/night soil(buckets)/soakaways
19. What determines the type of service provided?
    - residential area
    - residents' income
    - existing related services
    - density of development
20. What do you base cost recovery on?
    market rates / subsidy

21. How much do you charge for the following water and sanitation services?

water:-communal water points.....

-individual connection.....

sanitation:sewerage-communal.....-private.....

septic tank.....; cess pools.....

pit latrine.....; night soil.....

soakaways .....; solid waste.....

22. What do you use the revenue that accrues from these services for?

23. What happens to the revenue collected from these services?

24. What method is used to collect the revenue?

-using water bill

-separately for each service

-flat rates

25. Do you encounter any problem in revenue collection?. If so, what are they?.

26. Who maintains the communal facilities?

27. Who finances the maintenance of the facilities?

28. What maintenance is done?

29. What common maintenance problems do you encounter?

30. Do you have adequate staff for maintenance of these services?

31. Does the Eldoret municipal council have exhauster vehicles?

32. How much does an exhauster vehicle cost?

33. What is its operation and maintenance cost per month?

34. What are the capacities of the exhauster vehicles in M^3/litres?

35. What problems does unplanned settlement pose to exhauster vehicles?

36. How do you get to know about cases of maintenance and how are they solved?

37. Do communal water points and toilets pose any problems in terms of poor usage, wastage and none payment of revenue?

38. Which infrastructure service(s) do you provide as a priority to low-income housing areas?