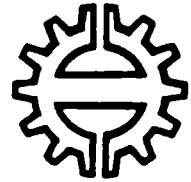


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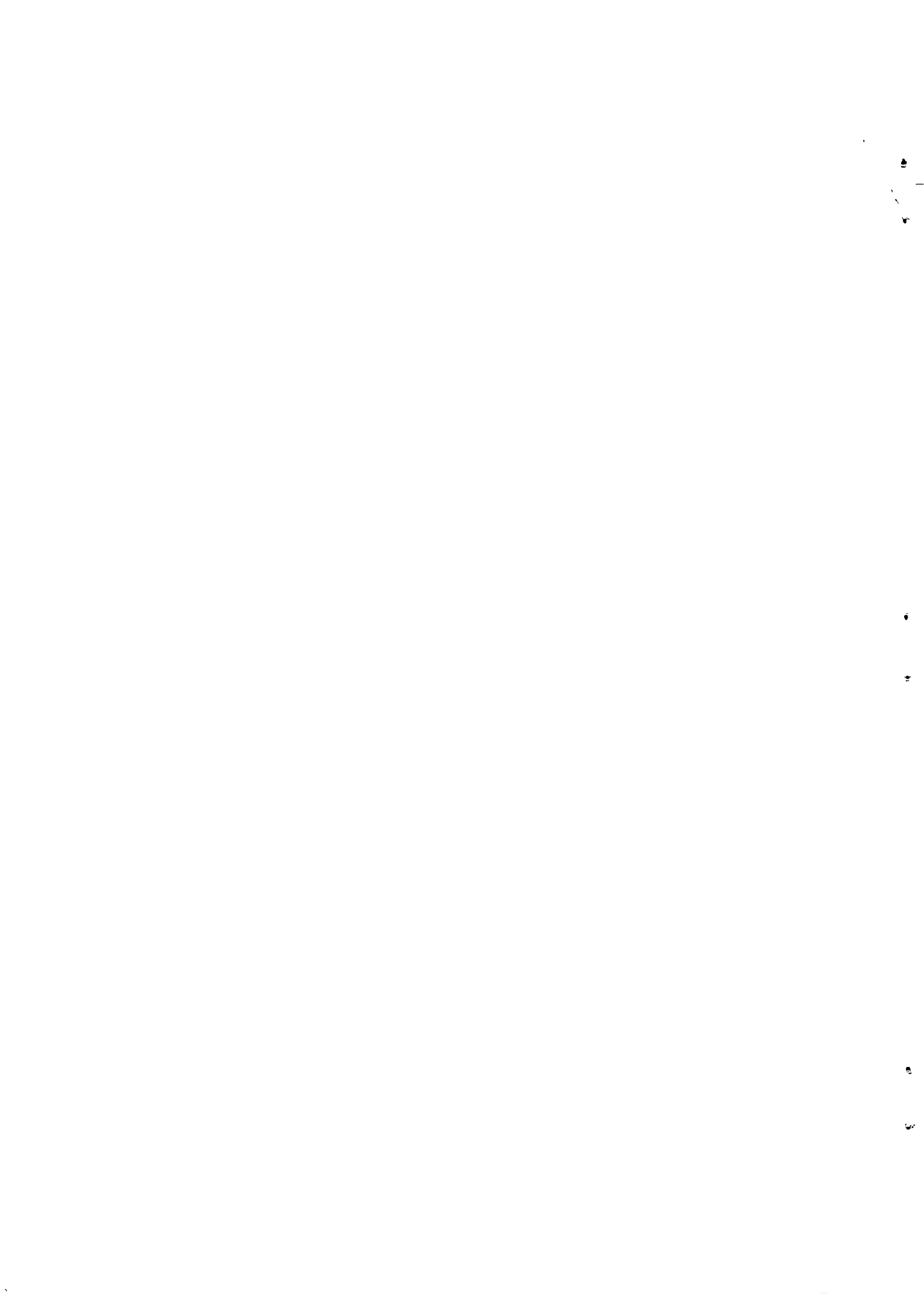
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LOW-INCOME AREA WATER SUPPLY AND SANITATION IN SELECTED AFRICAN CITIES

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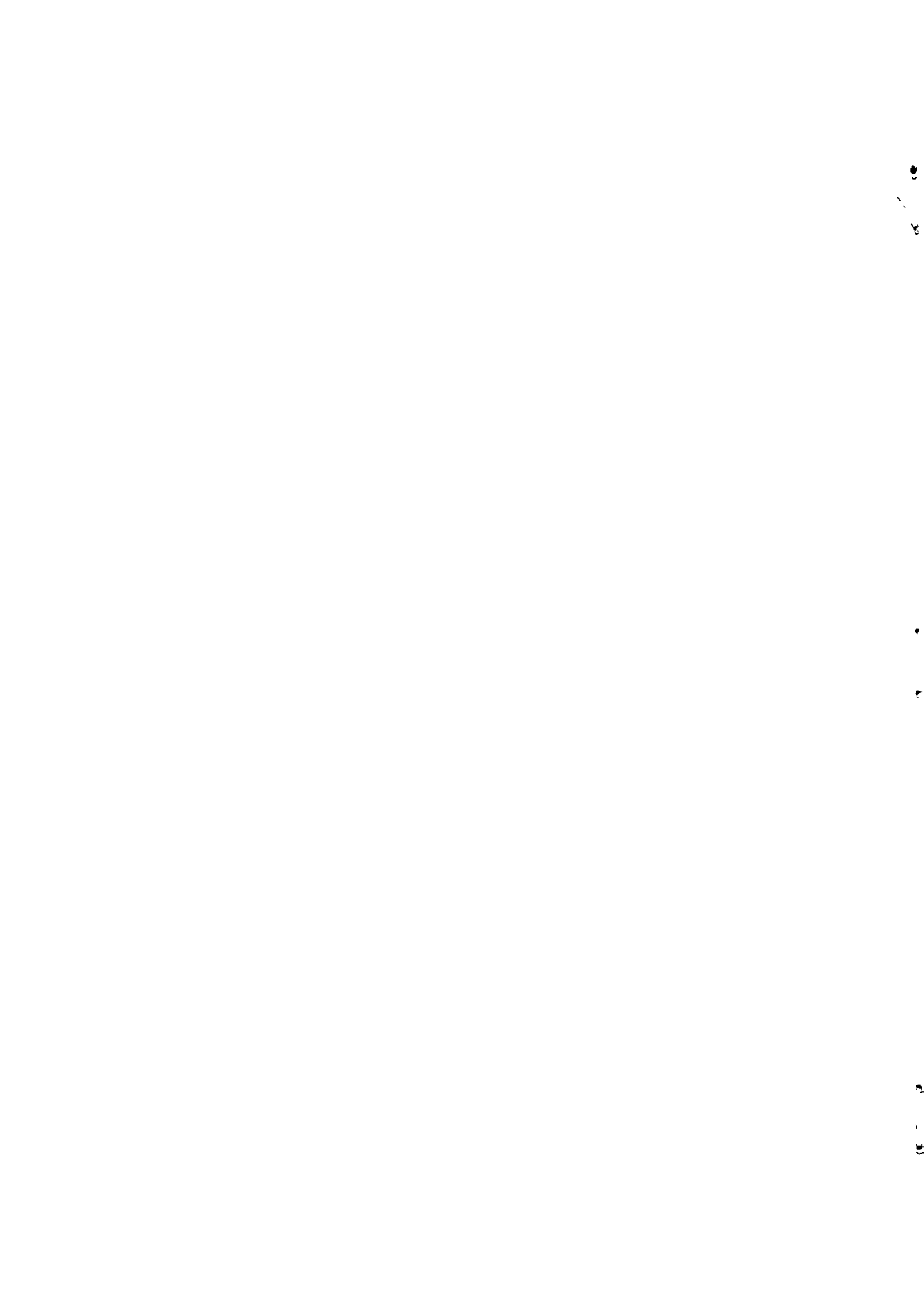
FOREWORD

**Part I: WATER SERVICES IN LOW-INCOME URBAN AREAS IN ADDIS
ABABA, ETHIOPIA**

**Part II: WATER AND SANITATION SERVICES IN LOW-INCOME AREAS OF
NAIROBI, KENYA**

**Part III: WATER AND SANITATION SERVICES IN LOW-INCOME AREAS IN
TANZANIA**

Part IV: URBAN WATER SUPPLY IN FRENCH-SPEAKING AFRICA



FOREWORD

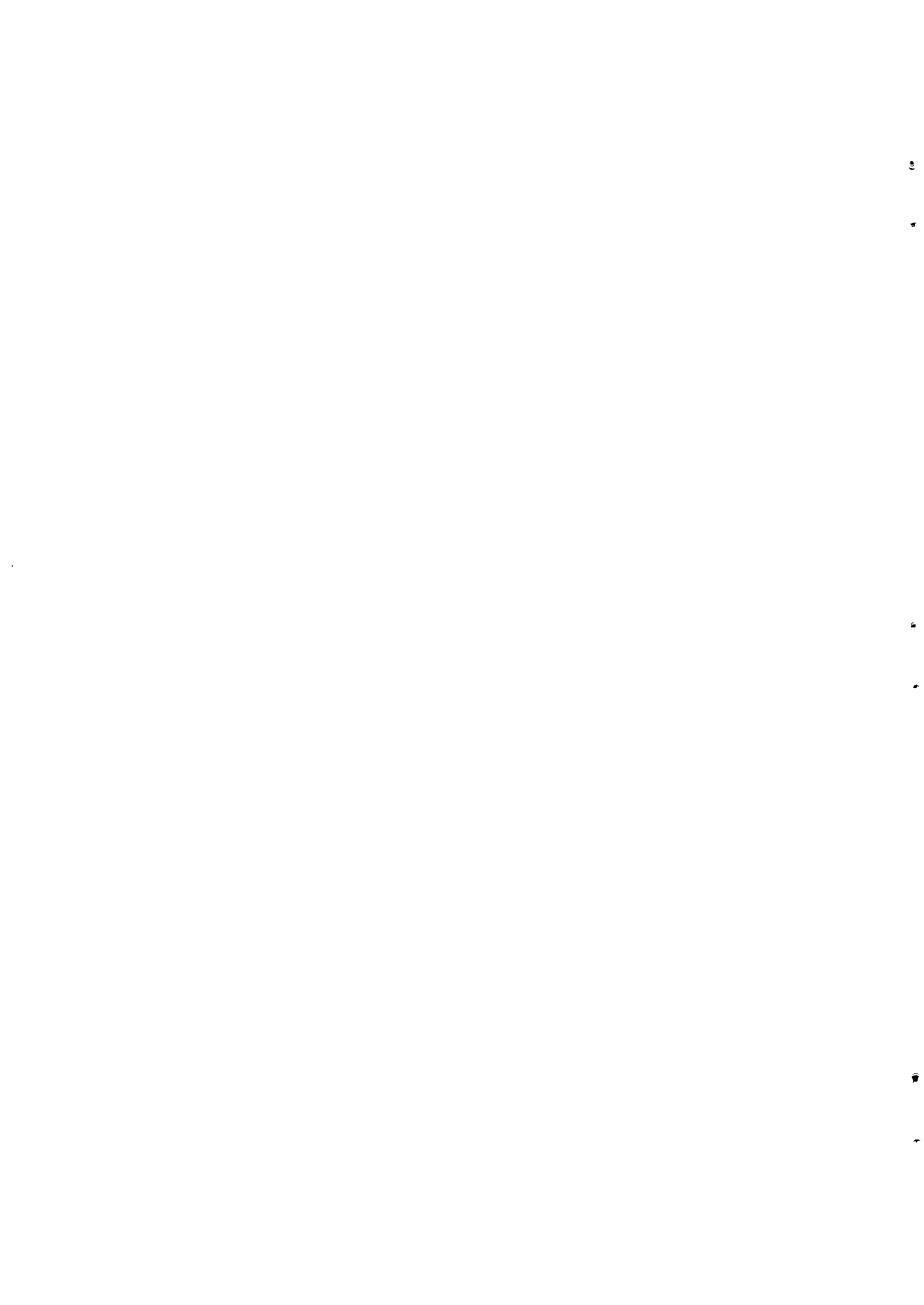
This report is part of the research programme "Institutional Development of Water Services" carried out by the Institute of Water and Environmental Engineering, Tampere University of Technology. The report describes water and sanitation services in low-income areas in East and West Africa:

- First part, compiled by Mr Metaferia, deals with the situation in Ethiopia.
- Second part, compiled by Dr Odira and Mr Nyangeri, deals with the situation in Kenya.
- Third part, compiled by Dr Mashauri, deals with the situation in Tanzania.
- Fourth part, compiled by Mr Morange, deals with the situation in Ivory Coast and in Senegal.

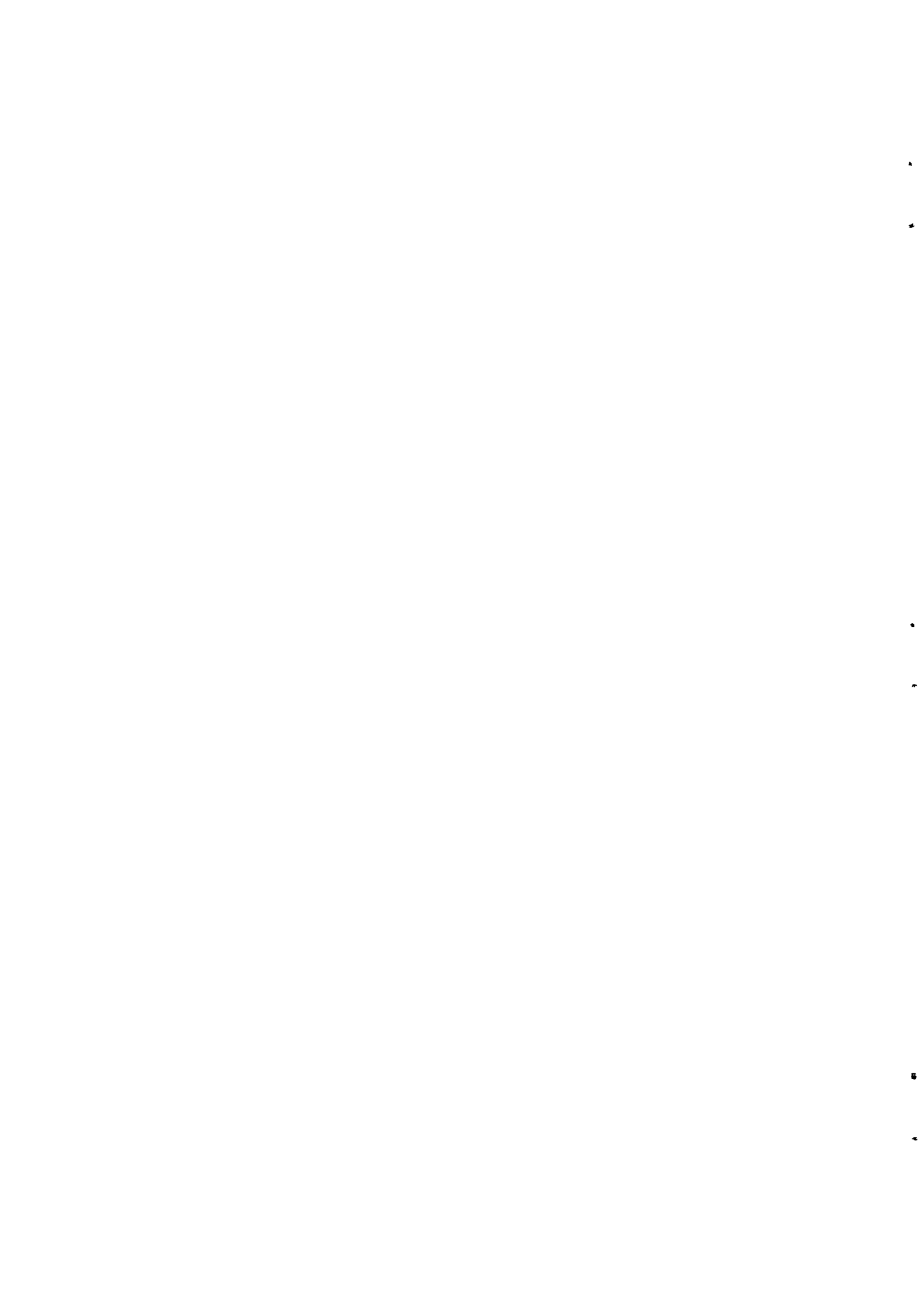
All these countries are suffering from in-adequate drinking water provision and poor sanitation practices. Especially urgent these problems have become in urban, densely populated areas. The progressive urbanization has multiplied the extent of the problems.

Although the basic nature of the problems is the same, each country has its own priorities and constrains in solving the problems. Poor institutional frameworks, poorly operated infrastructure, weaknesses in management, lack of finance, and socio-cultural differences are just a few of the challenges to be met in providing water and sanitation services for urban low-income areas. Thus, a multidiscipline approach should be applied in solving the problems.

Several slum upgrading programmes have been accomplished. The report shows that the programmes have been successful and the living conditions of the poor have improved. To ensure the long-term sustainability in water supply and sanitation, policies and strategies, and technologies have to be developed on the local basis.



**Part I: WATER SERVICES IN LOW-INCOME URBAN AREAS IN ADDIS
ABABA, ETHIOPIA**



WATER SERVICE IN LOW-INCOME URBAN AREAS IN ADDIS ABABA, ETHIOPIA

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Amha Yesus Metaferia: Water Service in Low-Income Urban Areas in Addis Ababa, Ethiopia

ABSTRACT

From the 600 million urban dwellers living in the developing countries about 20–50 % live in the low-income areas commonly referred as slums or squatters. The conditions in which these underprivileged people live are not well-known. This paper attempts to review these conditions with respect to water services in the low-income areas of Addis Ababa, Ethiopia.

As water service depends quite much on the institutional and financial arrangements and the urbanization process in the town the first three chapters of this paper look into:

- background information about Ethiopia
- existing institutional and financial arrangement for the urban and water sector
- urbanization process in Addis Ababa.

Chapter 4 deals with a case study of a typical low-income area in Addis Ababa. Chapter 5 describes the experience of low-income area upgrading undertaken in Addis Ababa with particular reference to the Teklehaimanot Area Upgrading. Chapters 6 and 7 give recommendations and conclusions derived from the review.

This review indicates that the water service in the low-income urban areas is inadequate and in some cases the situation is much worse than a rural water service standard. This is a result of the combined effect of the existing poor conditions (housing, access, settlement pattern), lack of appropriate policy on land and housing ownership and appropriate service tariff structure. On the other hand the review shows that the upgrading programmes in Addis Ababa are in general successful and have resulted in improved living condition of the poor in the project area. To tackle the problem in total an organization responsible for planning, programming and coordinating the upgrading of low-income areas should be established.

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ETHIOPIA

1 INTRODUCTION

Ethiopia has a total land area of 1 251 282 km², comprising a central highland mass surrounded by lowlands. It is the seventh largest country in Africa. The country extends from latitude 3° N to 18° N and longitude 33° E to 48° E with approximately equal east-west, and north-south dimensions. Its northern boundary is the Red Sea with a coastline of 1 220 km, to the west is the Sudan, to the South Kenya, and to the East Somalia and Djibouti. Figure 1 shows the geographical location and map of Ethiopia. The relief of the country is largely a high plateau with an elevation ranging from 100 m below sea level in the Dallol depression to mountain peaks of over 4 000 m above sea level.



Figure 1. Map of Ethiopia.

The population of Ethiopia is estimated to be about 50 million in 1990, of which about 88 % live in rural areas. The age distribution of the population is predominantly young. 47 % of the population is under 15 years of age and 69 % under 30 years of age. The total population is estimated to grow at 2.9 % and the urban population at an average of 4 % per annum. In population size Ethiopia ranks as the third populous country in Africa and the twenty second populous country in the world (CSO 1987).

In 1989 the country was divided into 29 administrative regions. The seat of the government is in Addis Ababa, located in the geographical centre of the country.

Ethiopia's principal natural resource is its rich endowment of agricultural land. About 10 % of the total arable land area is currently under crops. Agriculture is based on small-holder subsistence production which makes extensive use of the land hence production of food crops is by and large in the hands of individual peasants, with state farms and co-operatives playing a rather limited role.

Major cash crops are coffee, oil seeds, cotton, sisal, tobacco, fruits, pepper and sugarcane. In the size of its livestock resources the country is first in Africa and tenth in the world. The country's Red Sea coast, the rift valley lakes, streams and rivers potential is estimated to be 871 096 tons of fish catch.

Forest resources and wild-life seriously depleted in the past covers only 3.5 % of the total land area. Hydroelectric potential is estimated to be 56 billion kWh of which only about 1.2 billion is tapped currently.

2 INSTITUTIONAL FRAMEWORK

A number of institutions, organizations and authorities are involved in the urban and water sector. Even though the country at present is going under reorganization the text below tries to explain the situation in 1990.

2.1 Urban sector administration

2.1.1 Ministry of Urban Development and Housing

Ministry of Urban Development and Housing (MUDH) is responsible for formulating urban development plans and for increasing housing availability and administration of government rental houses. This is carried out through a number of departments, including Physical Planning, Housing Research, Cooperative Housing and Agencies such as the Rental Housing Administration.

In addition under MUDH comes the National Urban Planning Institute (NUPI) and the Urban Development Project Office (UDPO). NUPI is responsible for formulating master plans and developing regional urban development plans. It was recently formed from a planning group that was created to carry out Master Plan Study for Addis Ababa Town. UDPO was formed to supervise the implementation of site and service part of the Urban Development Project I funded by International Development Association (IDA) and the Ethiopian Government.

2.1.2 Urban Dwellers Association

Urban Dwellers Association (UDA) is the local administrative and political organization in an urban area. The Kebeles are the grass root urban communities with a designated geographical division and limited administrative authority. The Central Association (municipality) represents the highest level of the organization, the intermediate level being the Kefetegna or Awraja (Kefetegna are being replaced by Awraja). The three levels are interrelated to each other by superimposition of elected committees (Appendix 1). The Central Associations with the given legitimate and urban management power, and in coordination with the Ministry of Urban Development and Housing, assures the planning, housing and economical and social development interventions of the urban area (city).

At present MUDH recognizes some 325 urban centres of which 213 have central associations (municipalities) the remaining being at Kebele UDA level. The powers and duties of a typical municipality include:

- preparation of urban land rent, urban house tax and service charges and submission to MUDH for approval
- preparation, submission to MUDH and when approved implementation of the urban centre's Master Plan
- operation and maintenance of streets, squares, marketplaces, cemeteries, transport services, social service programs, theatres and cinema, fire fighting, ambulance and sanitary services

- collection of rents on lands and houses within the city rented up to ETB 100 per month
- collection of charges rents taxes and fees due to municipalities
- operation of revenue-generating activities including abattoirs, quarries and pharmacies through autonomous agencies.

2.1.3 Addis Ababa Administrative Region

The 1945 Imperial Decree established Addis Ababa as the only chartered city in Ethiopia. As a chartered city it reports directly to the Council of Ministers through MUDH. In the 1988 Government reorganization the Addis Ababa Administrative Region (AAAR) has been formed to include the city of Addis Ababa and neighbouring towns. The AAAR is divided into 18 zones, of which 12 are in Addis Ababa City comprising 284 Kebeles. Until the details are worked out the Municipality of Addis Ababa assumes responsibilities for all 18 zones through existing City Departments, Agencies and Project Implementation Office (PIO). PIO is the regions office responsible for the implementation of the World Bank funded upgrading projects.

With respect to water services the Municipality is responsible for:

- collection and disposal of solid waste
- provision of sanitation in public areas, market places, etc.
- provision of access roads and storm drains.

The current organization chart of the Addis Ababa Administrative Region is shown in Appendix 2.

2.2 Water sector administration

2.2.1 Water Resource Commission

The Water Resource Commission is an autonomous Government organization which was created by official proclamation, no 217 of November 7, 1981. The Commission is responsible for the protection and development of the nation inland water resources.

2.2.2 Water Resource Development Authority

The objectives of this authority as set in the proclamation no 218 of 1981 are "to conduct studies regarding the utilization, administration regulation of the nation's inland waters and to supervise in details the implementation of water resource policy and plans issued by Government".

2.2.3 Ethiopian Water Works Construction Authority

This authority is established by proclamation no 190 of 1980 as an autonomous public authority specifically for the construction of waterworks and particularly for domestic water supply and irrigation schemes.

2.2.4 Water Supply and Sewerage Authority

The objectives of Water Supply and Sewerage Authority (WSSA) as set in the proclamation no 219 of 1981 are to provide water supply and services throughout Ethiopia except Addis Ababa.

Presently 182 urban water supply systems are under WSSA. The remaining are being supervised by the municipalities and urban dwellers associations. WSSA plans to take over step by step additional water service units. The number of rural water service units which WSSA is providing maintenance and operating assistance has not been determined but is estimated to be over 5 000.

Although urban sanitation and waste water is under the responsibility of WSSA except few minor incidences it has not been involved in urban sanitation and waste water to date, because the lack of organizational setup and professional staff.

2.2.5 Addis Ababa Water Supply and Sewerage Authority

The Addis Ababa Water Supply and Sewerage Authority (AAWSA) was established in 1964, as an autonomous body to provide water supply and sewerage services within the city of Addis Ababa only. Recently its responsibility has been expanded to cover the entire Addis Ababa Administrative Region. At present it is providing potable water for the total population and is operating vacuum tankers for emptying domestic septic tanks and pit latrines. A sewerage system covering a limited part of the city centre is provided. Appendix 3 shows the organization chart of AAWSA.

2.2.6 Ministry of Health

The Ministry of Health (MOH) has national responsibility for overseeing and maintaining the health of the population. Water supply and sanitation are the major components of the MOH Primary Health Programme. The ministry through its environmental health department and the Addis Ababa Administrative Region Health Service Office promotes water points and ventilated improved pit latrines in the city.

2.3 Financial sources and arrangements

2.3.1 Municipal finance

The key sources of revenue for municipalities are trade license fees, urban land rent, property tax and various service and license fees. In addition recently some municipalities derive additional income from commercial rents and from taxes on economic activities unique to the towns.

The city of Addis Ababa has not increased its trade license fees schedule since 1952 and has not increased building and land taxes since 1979. Its annual revenue has been stagnant for many years (ETB 15.58 = USD 7.0 per capita) (World Bank 1990). In addition since the current financial system in the country is undeveloped and contains typical features of a socialist financial system the involvement of the private sector in the urban development is minimal.

Except shares of customs taxes and minor assistance in kind, the municipalities receive no regular subsidies from the Government. In general the municipalities are required to be financially self-sufficient with expenditures contained within revenues. In the past due to lack of fund and awareness the allocation of fund for upgrading of low-income areas is virtually absent. However, since the start of the Teklehaimanot Upgrading Project a positive indication has been seen.

2.3.2 Housing and Saving Bank

The Housing and Saving Bank (HSB) was established in 1975 as the only bank with a mandate for mortgage lending. It is a Government-owned savings and loan association under the supervision of the National Bank of Ethiopia. HSB's loans are provided primarily to housing cooperatives, private people and state enterprises for construction and purchase of single family dwellings and commercial buildings.

In terms of value of loans the majority of HSB's lending has been given to the state owned enterprises for nonresidential buildings. Recently due to change in interest rate policy and in housing policy more loans have been approved for new housing construction.

2.3.3 Addis Ababa Water and Sewerage Authority finance

According the proclamation of the establishment of the organization, AAWSA should be self-sufficient financially. However, since the water tariff has been ETB 0.50 since 1948 and there are no sewerage usage fees, and the fees for emptying sewage from pit latrines and septic tanks is only ETB 25–30 per trip the financial situation has been negative for many years (Table 1) (World Bank 1990). As a result it has not been able to settle its debts (for both Ministry of Finance and Foreign Loans) and the Government has to use foreign loans.

AAWSA charges ETB 200 – 300 from consumers wishing to be connected to the water supply system and ETB 1 500 – 3 000 for customers wishing to be connected to the sewage collection system.

AWSA has prepared several tariff studies over the years and requested the Government for tariff adjustments. These requests have, however, not been acted upon.

Table 1. Summary of financial situation of AAWSA 1986/87 – 1988/89 (World Bank 1990).

	1987 ETB 1 000	1988 ETB 1 000	1989 ETB 1 000
Operating revenue	11 405	16 337	16 076
Operating expense			
Before depreciation	12 400	12 904	13 350
Operating income			
Before depreciation	(995)	3 433	2 726
Depreciation	3 949	4 344	4 561
Operating income			
Before interest	(4 944)	(911)	(1 835)
Interest	3 223	5 305	3 482
Net income (loss)	(8 167)	(6 216)	(5 317)

3 URBANIZATION IN ADDIS ABABA

3.1 General introduction

Addis Ababa, which is the capital city of the country and seat of several international organizations, was merely the last in a series of garrison towns designed to house and feed Ethiopia's armies near the shifting battle fields when it was established by Emperor Menelik II in 1881. Its central location, climate, natural resources, and the political stability uphold it to remain as the capital city.

The gradual development of industry, commercial educational and health services and the centralized political and administrative functions promote the rapid economic growth and urbanization.

Today, Addis Ababa with 1.8 million people (CSO 1987) representing 3.5 % of the population of the country and about 29 % of the urban dwellers, is the fifth largest city in Africa.

The city of Addis Ababa is located on a huge plateau near the geographic centre of Ethiopia approximately 10° north of the equator. The present area of the city is approximately 218 km² and elevation within the city limits vary from 2 800 m in the northern section to 2 200 m in the southern part of the city. Hills, valleys, rivers and dry streams make a major portion of the city's topography which combined with the weather significantly influences water services and solid waste management.

The mean temperature is about 15°C: daily maximum temperature being 25°C and minimum temperature being 5°C. Higher and lower temperatures are occasionally recorded. Rains fall during two periods of the year. Heavy tropical thunderstorms are experienced from mid-June to September and account for 80 % of the annual rainfall. From mid February through April small rains occur. The remaining months of the year are virtually free of rain.

The first phase land use pattern of Addis Ababa was inherited and evolved from strictly feudal land use pattern, where the important chiefs of Emperor Menelik I (his ranking civil and military officials of the court) were allotted large tracts of land around the Royal Palace and built their abodes. The chiefs in their turn gave places of their land to their immediate subordinates to build their huts around their residences. This coupled with the unique geographical setting had developed the city till recently into a conglomerate of dense cores linked by narrow bridges and winding roads with spaces of vacant land and eucalyptus woods between them. The historical settlement pattern and the physical landscape conditions has made Addis Ababa a distinctive city in many respects (Figure 2):

- Rich and poor have traditionally lived in an integrated land use pattern and hence, segregation by income, social status and tribe or race, so common in colonial founded cities did not occur in Addis Ababa.
- Because landowners were omnipresent and exercised close control over their territory, squatter communities in the usual sense of illegal landholding and self-build homes never developed in Addis Ababa.
- As a result of the combined impact of the dominance of land-ownership by so few, and the object poverty of so many, nearly 70 % of the households are

tenants. As most families were denied access to land, credit and political influence, the feudal pattern of landownership appears to have effectively disfranchised the low-income vast majority of urban dwellers who remained severely impoverished.

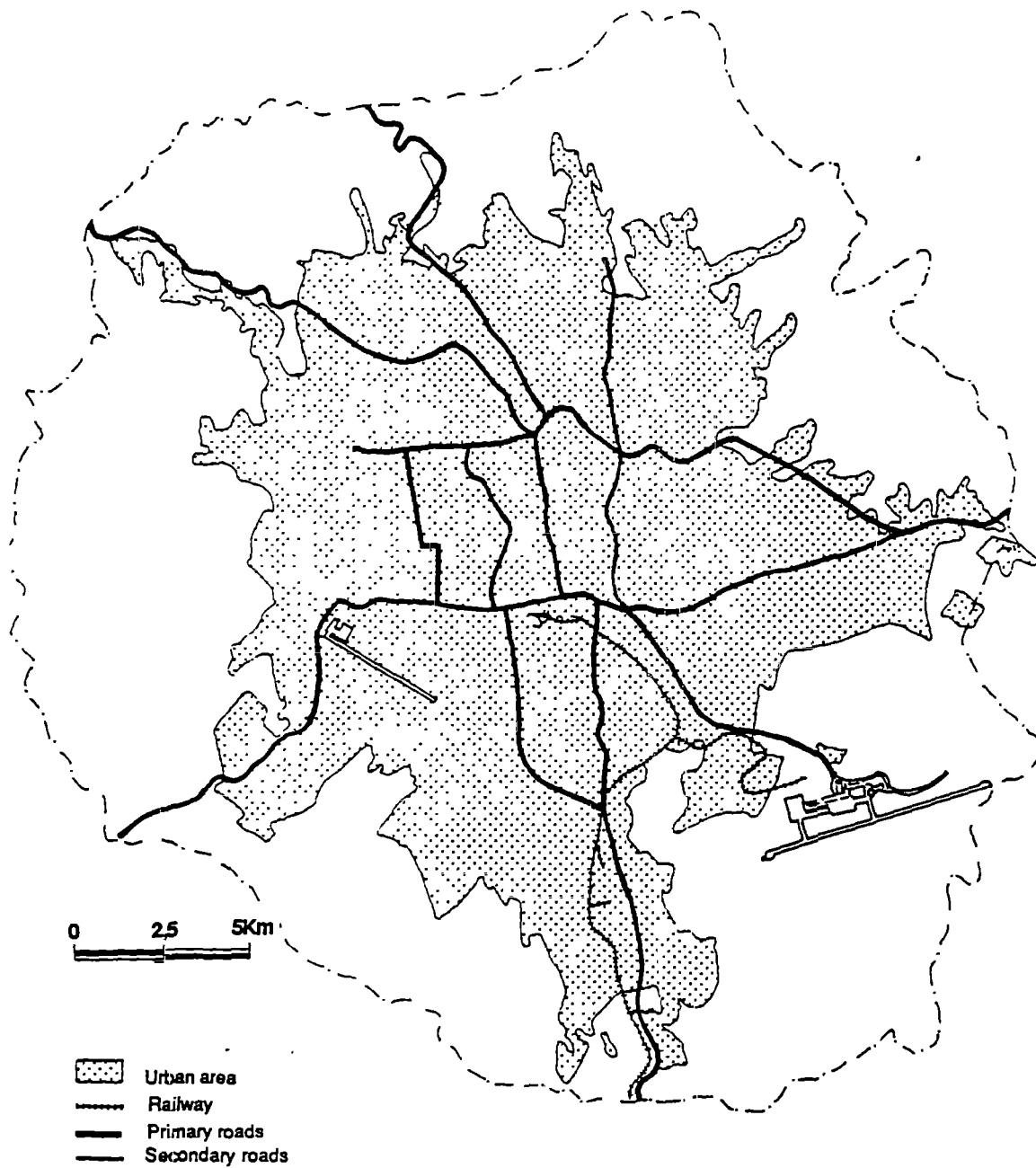


Figure 2. Addis Ababa urban area.

The 1974 revolution has fundamentally recorded social and economic relationship in Ethiopia. Since 1975, three proclamations introduced by the revolutionary government have left serious impacts on urban areas. These proclamations are:

- Nationalization of urban land and rental houses; Proclamation no 47 of 1975.
- Restructuring of credit institutions proclamation no 60 of 1975.
- Changes in the structure and functions of local governments i.e. formations of Urban Dwellers Associations; Proclamations no 79 and 104 of 1976.

Despite several important measures and attempts including the creation or modification of institutional frameworks and the initiations of some urban development programmes (in housing basic infrastructure and facilities), urban problems have been worsening particularly in Addis Ababa.

Such worsening urban problems are:

- Growing lack of houses and inadequate quality is perpetuating and worsening the housing problems particularly affecting the low-income urban people.
- There is increasing deficiency of sanitation mainly because of the lack or inadequacy of basic infrastructure and facilities as well as overcrowding. The major part of the housing stock is dilapidated and obsolescent and suffers from severe inadequacy in the basic facilities including water supply, toilets and other solid and liquid disposal facilities, access, drainage, etc.
- Continuous growth of the urban population in the face of acute financial (both public and private) and other resource constraints, are widening the gap between demand and the ability to supply (or pay).
- There is an increasing inadequacy of the urban communal facilities which provide services that cannot be individualized, including roads and drainage, waste removal facilities and points, shopping centres, communal centres, health centres, etc.
- Together with and reinforced by the above urban constraints, there is a drastic deterioration of the living (physical and social) environment, with the prevalence and predominance of the associated problems of urban unemployment, poverty, disease and delinquency.

3.2 Population

The 1984 population and housing census showed that the city of Addis Ababa had about 14 million inhabitants. At present the population is estimated to be about 1.8 million. The Addis Ababa Master Plan Project Office has projected that the population of Addis Ababa and its expansion area will reach 3.3 million in the year 2006 (Table 2).

Table 2. Projected population of Addis Ababa and the future expansion area (Group Huit 1988).

Year	Addis Ababa 10 ³	Akaki 10 ³	Kotebe 10 ³	Peasant ass. area 10 ³	Total 10 ³
1984	1 424	54	12	20	1 510
1986	1 509	58	13	22	1 602
1990	1 832	76	16	26	1 950
1996	2 204	107	19	31	2 361
2001	2 593	137	23	37	2 790
2006	3 021	176	28	44	3 269
Average growth rate (%)	3.5	5.5	3.8	3.7	3.6

3.3 Housing condition

3.3.1 Housing stock

The total housing stock was estimated to be 268 500 in 1988. The total annual housing output since 1984 including those built by government, co-operatives and private was estimated to be 3 300. About 30 % of housing stock are owner-occupied and 70 % are rented from Kebeles and the Rental Housing Administration, both of which took over ownership of "Extra Houses" (rented) from private household after the 1974 revolution (World Bank 1990).

The majority of dwelling houses in Addis Ababa are "Chika" Houses (mud and straw on a timber framework with corrugated iron roofing). Due to the failures of the Kebeles to carry out constant maintenance the condition of the houses and attached service is very deplorable.

The survey of Kebele rented houses in 1988 revealed that 32 % of the houses are in a very bad condition, and the costs of rehabilitation would be greater than constructing the new one. For this reason it would be more economical to demolish them and replace with new houses. Furthermore, 51 % of the houses are in a fair state and need urgent maintenance, and 12 % need only minor protective measures. Housing built of durable materials constitutes only 5 % of needs no innervation.

The 1988 Group Huit Study shows that the average housing area per person is 5 m², and the average number of people per room is 3.3. However for 84 % of the Kebele housing stock the number of people per room is 5.3 and for 54 % of the housing stock the average house area per person is 3 m² (Table 3).

Table 3. Conditions of Kebele rented houses (Group Huit 1988).

Condition	Houses Number	%
Very good	7 150	5
Good	167 440	12
Fair	72 060	51
Total	140 250	100

3.3.2 Future housing needs

Assuming that the major problems in housing in Addis Ababa will be tackled in 10 years i.e. the number of existing households 1.09 per house will be decohabited, the 44 000 houses considered to be in poor condition will be replaced, the average annual increase of 80 000 people will be housed and 22 000 new houses will have to be constructed annually (Table 4).

Table 4. Annual needs in new housing (Group Huit 1984).

Item	Number of houses
Needs due to increase of population	15 000
Needs due to decohabitation	2 340
Needs due to replacement of old housing	4 200
Total	21 540

However, nowadays the annual new housing output is estimated to be 3 300. The accumulated unfulfilled housing need to date is calculated to be about 109 400 dwellings.

3.4 Access

The area of Addis Ababa is about 216 km² with an average population density of 28400 per km². There are close to 195 km paved roads resulting an average of 900 m of paved roads per km², which is low by most urban standards. Most Kebeles are accessible by paved roads, but the interior of most Kebeles do not have proper access.

They are served with pedestrian tracks which are often confused with semiprivate space where a large part of domestic activities take place. The survey conducted 1988 by Group Huit shows that 32 % of Kebele rented houses are accessible by walkways and 10 % do not have defined access (Table 5).

Table 5. Accessibility of Kebele rented houses (Group Huit 1988).

Type of access	Number of houses	% of total houses
Asphalt road	22 890	16
Stone paved road	57 150	41
Walkway	45 000	32
Nothing	14 700	11
Total	139 740	100

3.5 Water services

3.5.1 Water supply

The Addis Ababa Water Supply and Sewerage Authority is responsible for the water supply service in the town. The present capacity of source treatment works and transmission mains is 180 000 m³/d. Presently the distribution system is being expanded to cater the present and future water demand up to 1994.

The present water consumption is about 110 000 m³/d. The number of water connections including public taps is about 117 000. The 1984 CSA census indicated that only 4 % of the houses have taps inside the house and 14 % of the houses use public tap (Table 6). In general the service level is modest and the water supply service is stable. However, water services in the low-income areas are quite different. This will be dealt with in Chapters 4 and 5.

Table 6. Water supply service in Addis Ababa (CSA Census 1984).

Mode of service	% of users
Tap inside house	4
Tap in compound	48
Tap in neighbourhood	26
Public tap	14
Others	8
Total	100

The consumption of water ranges 80 – 10 l/c/d. The study conducted by BCEOM 1977 for Addis Ababa Water Supply Project Stage II estimated the water consumption for 1990 to be as shows in Table 7.

Table 7. Estimated consumption by mode of service (BCEOM 1977).

Mode of service	Consumption l/c/d
Housing with individual connection	80
Housing with group connection	30
Housing served by stand pipes	10

Even though the major consumers of the water are commercial and industrial enterprises and relatively high income families AAWSA maintain a uniform water tariff rate of ETB 0.50/m³, and charge a fee of ETB 200 – 300 from consumers wishing to be connected to the water supply system.

3.5.2 Sewerage

Addis Ababa has a small sewerage system covering only a limited part of the city centre. Even though the capacity is good enough for about 10 % of the population, only about 500 customers are connected. Customers wishing to be connected to the system are required to pay a high connection fee (ETB 1 500 – 3 000). However AAWSA does not collect any sewerage fees from the customers connected to the system.

At the moment AAWSA, with a grant obtained from the African Development Bank, is commissioning a sewerage master plan study for the city of Addis Ababa. The objectives of the study as described in the TOR sent to consulting firms are:

1. "The principal aim of the study is to set up a long term strategy of rectifying and controlling the present unhealthy situation caused by inadequate waste water facilities in the city of Addis Ababa. A Master Plan and development programme for waste water facilities shall be prepared, and improvements to the existing institutional setup and legislation necessary for successful implementation of the programme be recommended.
2. The study shall culminate in preparation of detailed designs and tender documents of a project comprising the initial construction phase of the Master Plan."

3.5.3 Sanitation

The responsibility for providing sanitation services is divided between individual house owners and the three organizations, Ministry of Health, Addis Ababa Water and Sewerage Authority and City Council of Addis Ababa. In the city Ministry of Health

promotes water points and ventilated improved pit latrines and runs public educational programmes through the mass media and audiovisuals.

AAWSA has no formal responsibility for promoting the construction of pit latrines. However, it is responsible for providing vacuum trucks to empty septic tanks and pit latrines. Due to the few vacuum trucks and the accessibility of some of the facilities, the service is far from the demand.

The City Council is responsible for the construction and maintenance of public toilet facilities at market places, bus terminals, etc. The public toilets are attended by the employees of the municipalities and are open from 6 a.m. to 6 p.m. Some are closed due to minor maintenance problems. The cesspools are usually emptied once or twice a month and the septic tanks once every six months.

As a renter of 65 % of the houses in Addis Ababa (through the Kebele) the City Council is also responsible for the sanitation of these houses. However, due to the low rent (ETB 6 - 10 per month per house) and the relatively high cost of vacuum trucks (ETB 25 - 30 per trip) and the long waiting time involved in emptying no substantial input has been made. On the other hand the municipality and NGO's, as a part of a campaign to control an epidemic disease that broke out 1984/85, have built 1 300 communal latrines. Most of these pit latrines located in restricted compounds and on road side are reported to be in good condition.

In general the sanitation situation in the city and particularly in low-income areas is very bad. The 1988 Group Huit survey indicated that 93 % of housing units have a latrine in their use: latrines are either shared (84 %) or individual (9 %). However, these figures do not give a true picture of the situation. Because of the over use of the toilets (4-9 households per toilet), ground water build-up and/or impermeability of the formation, about 42 % of the latrines are constantly overflowing. This is more vividly seen in the low-income Kebele rented houses (Table 8).

Table 8. Type and condition of latrines.

Type	Number	% of total	Condition		
			Household per latrines	Frequent over-flowing	
				Number	%
Private	12 210	9			
Shared	118 610	84			
Non	9 430	7			
Total	140 250	100	9	59 500	42

3.5.4 Solid waste management

Of the approximately 290 tons of refuse generated daily in Addis Ababa only 50 % is collected. The rest is generally disposed off in open spaces, in drainage channels or in water courses. There are basically two collection methods in use:

- The first system operates along permanent accessible roads. The households along the road area are visited weekly and the household away from the main roads must bring their waste to certain collecting points. This system has been in operation for the last 35 years.
- The second system was introduced 1984. It is based on containers placed at transfer stations and each station is supposed to serve residents within 300 m radius. The residents dump the waste in the containers and each container is picked daily by skip loaders and transported to disposal site. The system has greatly improved the collection of waste and it increased the collection rate to 50 %. An improvement of this system – placing intermediate container for every 60 family –has been tried, but since many of the drums have disappeared and some of them have been shifted from the public street to private compounds, the system has been temporarily stopped.

The collected refuse is dumped at a crude dumping site located some 10 km south west of the city. It is operated against all rules and regulations; the site is not fenced or drained and many scavengers operate at the site. Potentially it creates an extreme hazard.

The composition of the solid waste in Addis Ababa is characterized by a high level of fines (54 %) and low level of combustibles. As a result of this the density of waste is about 2 – 3 times of the developed countries waste density. Studies made by Norconsult in 1984 and the Technical College of Municipalities in 1986 confirmed this. Table 9 and Table 10 show composition of household waste and waste density and generation from different income groups respectively.

The Environmental Health and Social Service Department within AAAR is responsible for the solid waste management in the city. Its effects are channelled mainly through the sanitation division. The division organizes collection, transportation and disposal of waste. The actual collection unit is placed in each Higher Urban Dwellers Association. The unit consists of sanitarian, assistant sanitarian, truck drivers, refuse collection crews, street cleaners and public toilet workers.

The Municipal Garage maintains, repairs and distributes fuel for the solid waste collection trucks. This service is outside the control of the solid waste management system and often the cause for complaint.

The direct and indirect costs of collection, disposal and management of solid waste in Addis Ababa are about ETB 2.00 per inhabitant (calculated from the municipality 1985/86 budget cost schedule) and the costs represent about 20 % of the municipal budget. The municipality does not charge for the collection of domestic solid waste, and a nominal fee is charged for commercial establishments.

Table 9. Composition of household waste in Addis Ababa (Norconsult 1984).

Waste fraction	Type of area			
	Low income	Medium income	High income	Average for Addis Ababa
	weight %	weight %	weight %	weight %
Paper	1.4	1.7	8.3	2.1
Food and green	4.2	5.6	49.6	8.8
Textiles	1.3	1.7	1.9	1.5
Rubber	0.3	0.8	0.5	0.5
Plastics	0.7	0.8	1.3	0.8
Other combustibles	24.8	26.7	10.9	24.2
Metals	1.0	0.7	1.2	0.9
Glass	0.4	0.5	1.9	0.6
Non-combustibles	6.4	7.0	2.1	6.2
Fines	59.4	54.6	22.3	54.4

Table 10. Waste density and generation (Norconsult 1984).

	Unit	Income group		
		Low	Medium	High
Waste generation	kg/c/d	0.14-0.27	0.09-0.11	0.22-0.30
Waste density	kg/m ³	400	400	290

3.5.5 Drainage

High precipitation during the wet season, rugged topography of the land, high density of land occupation and lack of pattern of settlement make run-off water harmful. Even though some of the main streets are provided with storm sewers, most do not function properly due to lack of proper maintenance. In the high density low-income areas drainage facilities are practically non-existent. This has resulted in the degradation of the existing poor housing and environment. A recent survey showed that 64 % of Kebele rented houses were affected by flood during the rainy season (Table 11).

Table 11. Housing units affected by flood during the rainy season.

	Number of housing units	%
Flood in compound	59 930	43
Flood in the house	29 965	21
Not flooded	50 355	36
Total housing units	140 450	100

3.6 Household income distribution

Over 65 % of families in Addis Ababa have income less than ETB 238 (USD 116) per month. The median income is ETB 150 (USD 75) per month and about 35 % of the households have limited resources (less than ETB 100 (USD 50) per month) (Table 12).

Table 12. Distribution of household income in Addis Ababa (AAMPPO 1984).

Income class ETB	%	Cumulative %
< 50	16.0	16.0
50 - 99	21.7	37.7
100 - 199	22.3	60.0
200 - 299	12.2	72.2
300 - 399	8.1	80.3
400 - 499	4.5	84.8
500 - 599	3.1	87.9
600 - 699	2.5	90.4
700 - 799	1.7	92.1
800 - 899	1.7	93.8
900 - 1250	3.1	96.9
Total	100	
Average	280	
Median	150	

3.7 Land use pattern

3.7.1 Existing land use pattern

Taking into consideration the type of housing, the density of housing, provision of infrastructure and other facilities along with the period of existence of the settlement

area, five district settlement areas are identified (Group Huit 1988):

- Old structured neighbourhoods: these areas are centrally located (close to the market area) and have a high population density (500 – 700 dwellers per hectare). The neighbourhoods were formed from 1936 to 1941.
- Unplanned old neighbourhoods: these areas are built without any pattern. They are located near the city centre and have population density of 300 – 500 dwellers per hectare. The houses are old and mainly made from wooden frames plastered with mud.
- Unplanned new neighbourhoods: these areas are located further from the city centre. They are built recently, but without any pattern. The average density is 220 dwellers per hectare.
- Planned new neighbourhoods: these areas have been recently allocated on the outskirts of the city. The building materials are concrete, stone, brick or chika and the houses are owned mostly by cooperatives. The population density is low with an average of 140 dwellers per ha.
- High income residential areas: these areas constitute villas and flats built of brick, stone or concrete. The units are either owned by individuals or run by Rental Housing Administration. The population density is very low; in most cases less than 80 dwellers per hectare. Table 13 shows the area, population and density of each settlement category.

Table 13. Settlement category data (Group Huit 1988).

Type of settlement	Area		Population		Density
	ha	%	1 000	%	INH/ha
Planned old neighbourhood	190	3	109	8	564
Unplanned old neighbourhood	1 440	24	528	37	366
Unplanned new neighbourhood	2 410	40	535	37	222
Planned new neighbourhood and high income residential area	1 960	33	252	18	129
Total	6 000	100	1 424	100	237

The distribution of these areas and typical layouts are shown in Figures 3, 4 and 5.

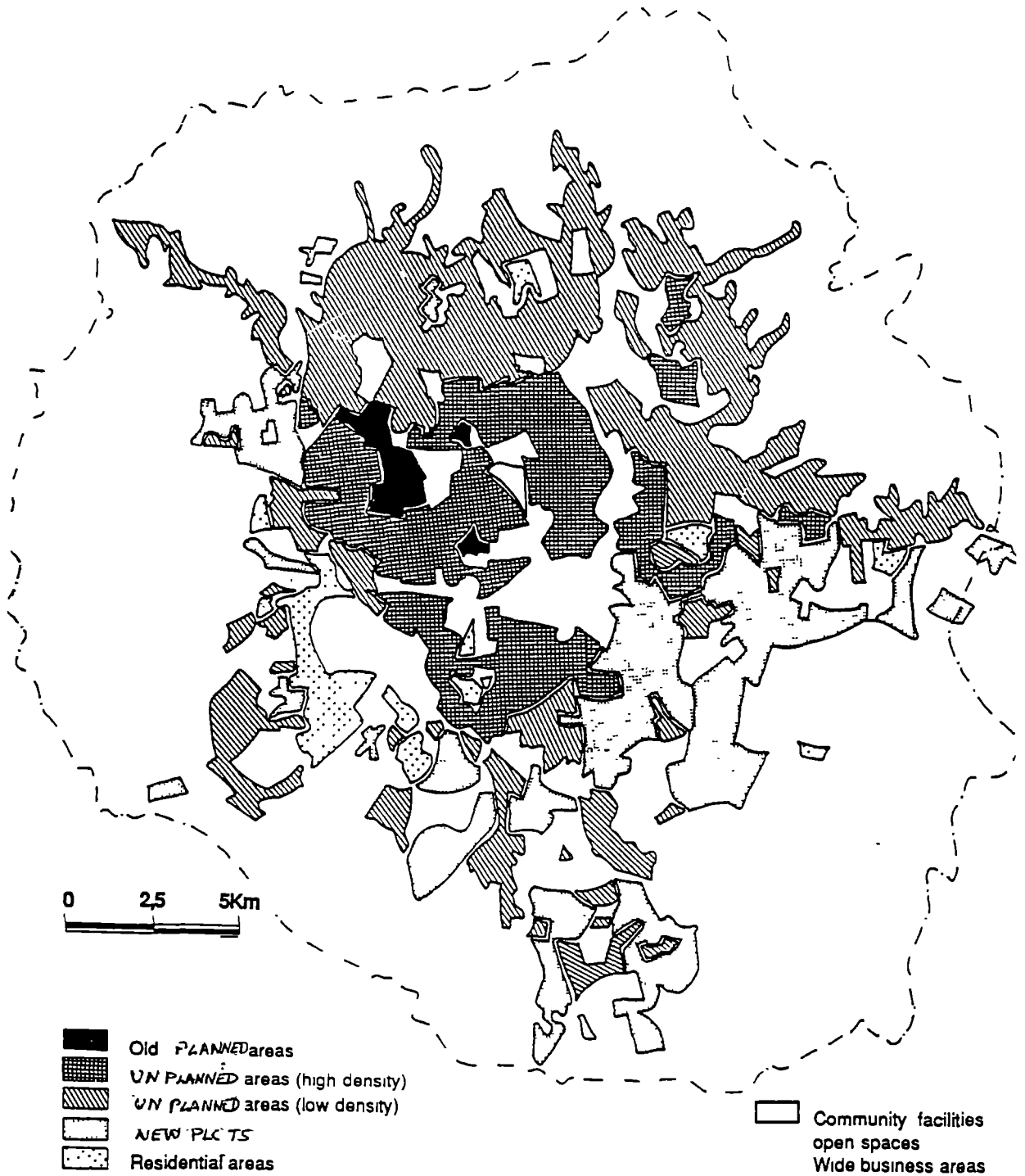


Figure 3. Homogeneous area.

1. OLD PLANNED NEIGHBOURHOODS

Density : 564 inh/ha



2. NON PLANNED DENSE NEIGHBOURHOODS

Density : 366 inh/ha



3. NON PLANNED DENSE NEIGHBOURHOODS

Density : 320 inh/ha

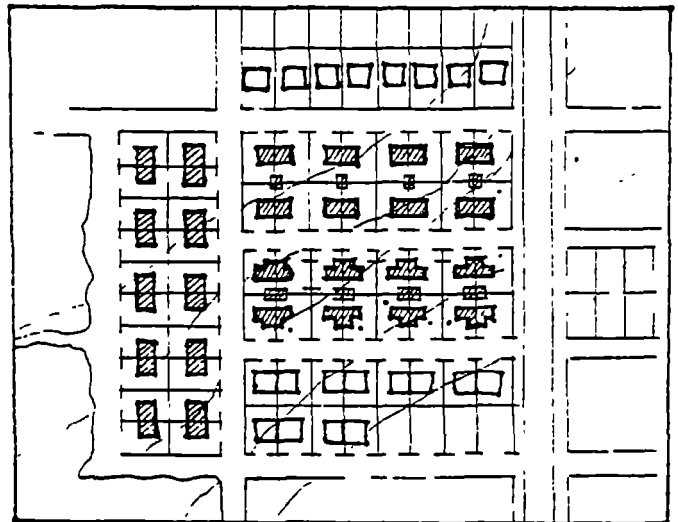


Figure 4. Layout of dense homogeneous areas.

4. NON PLANNED LESS DENSE
NEIGHBOURHOODS
Density : 222 Inh/ha



5. PLANNED PLOTS
Density : 140 Inh/ha



6. RESIDENTIAL AREAS
Density : 73 Inh/ha



Figure 5. Layout of less dense homogeneous areas.

3.7.2 Future land use pattern

The Addis Ababa Master Plan Project Office has divided the city into three zones for planning purposes:

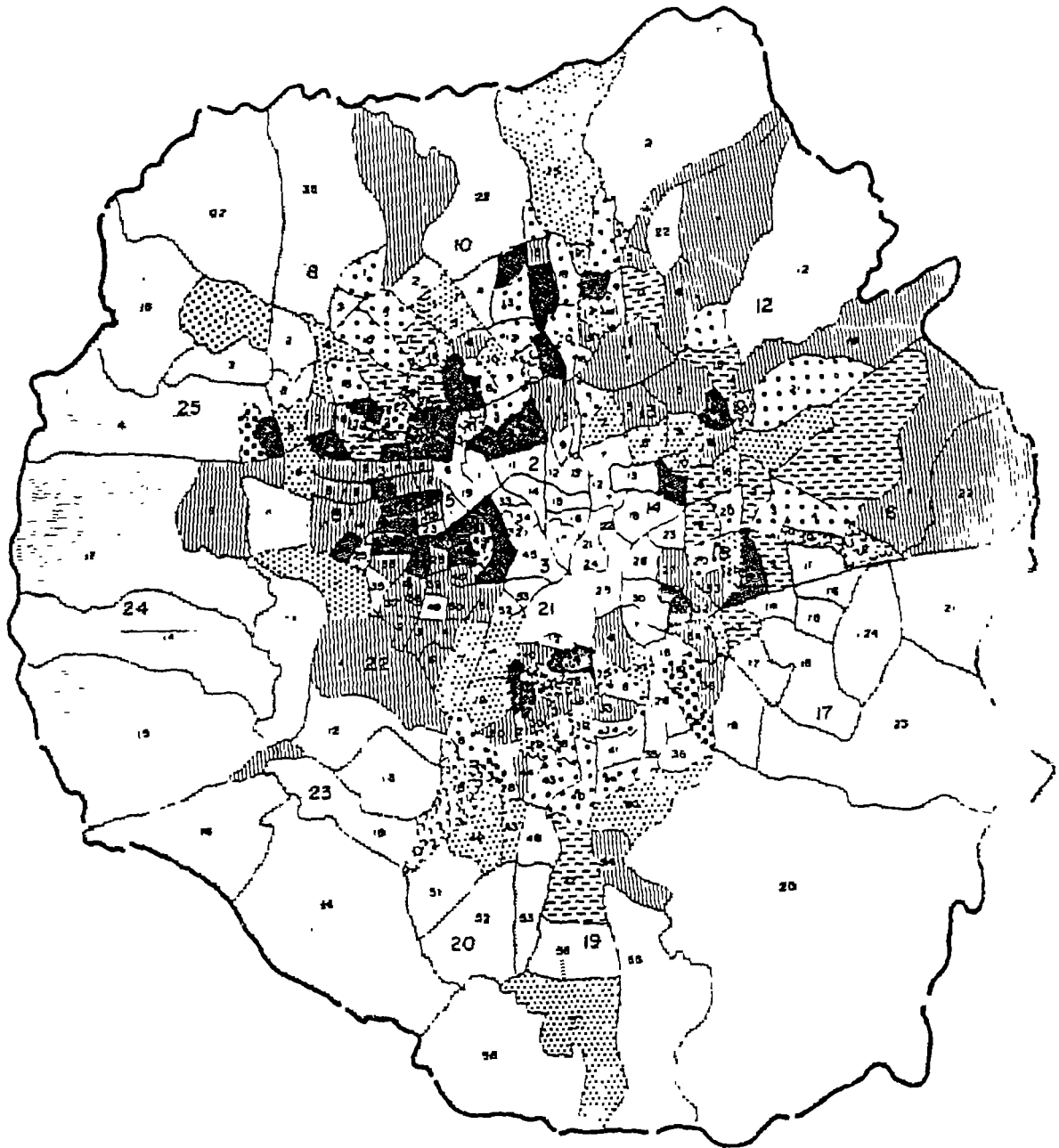
1. The inner-core zone (city centre): this is where urban renewal projects will be implemented and high rise of good quality topologies and terrace houses are supposed to be built.
2. The semi central zone: in this zone, in the areas where poor housing and infrastructure exist, upgrading and urban renewal or slum clearance is assumed to take place.
3. The fringe zone: this zone is to be used for in-fill projects with some localized renewal projects.










Based on this general concept and the condition of houses and infrastructural services the Addis Ababa Master Plan Project Office has proposed a plan to be implemented in the different parts of the city.

The plan includes:

1. Urban renewal: this has been proposed in areas where 60 % – 70 % of the houses are to be demolished. The rest of the houses need major maintenance. 70 % of the houses have problems with water and sanitation facilities. Clearance with the intention of reconstruction is expected in these areas.
2. Localized urban renewal: this has been proposed on specific areas where urban renewal for the whole coverage is not required.
3. Assisted upgrading: this has been considered as a solution where the houses to be demolished are identified to be 40 % – 50 % or where the houses to be demolished are 30 % – 40 % and the remaining 16 % of the houses require major maintenance. More than 60 % of the houses have problems with water and sanitation facilities.
4. Upgrading: this deals with the improvement of the environment through the maintenance or construction of roads, water and sewerage, street-lightening, provision of toilet facilities, improvement of garbage collection systems and other necessary infrastructural systems.

The details of this plan are shown in Figure 6 and the list of the areas where the different type of upgradings are to take place are shown in Appendix 4.



-  URBAN RENEWAL
-  UPGRADING WITHOUT ANY MODIFICATION OF DENSITY
-  ASSISTED UPGRADING WITHOUT ANY MODIFICATION OF DENSITY
-  UPGRADING WITH POSSIBLE INCREASE OF DENSITY
-  ASSISTED UP GRADING WITH POSSIBLE INCREASE OF DENSITY
-  INFILL TO INCREASE DENSITY
-  LOCALIZED URBAN RENEWAL WITH POSSIBLE DENSITY INCREASE
-  LOCALIZED URBAN RENEWAL WITH DENSITY DECREASE
-  CENTRAL ZONE (CBD) WITH URBAN RENEWAL

SOURCE: ADDIS ABABA MASTER PLAN PROJECT OFFICE

Figure 6. Upgrading map of Addis Ababa.

4 CASE STUDY OF A LOW-INCOME AREA IN ADDIS ABABA

4.1 Introduction

To illustrate the characteristic of a low-income area in Addis Ababa, data extracted from a study conducted by the students of the Technical College of the Municipalities for Kebele 25 Higher 6 are presented. Kebele 25 is located near to the market centre (Mercato) as shown in Figure 7. The Kebele covered an area of 8.13 ha and had a population of 6 210 in 1985. The Addis Ababa Master Plan Project Office has identified the Kebele for urban renewal.

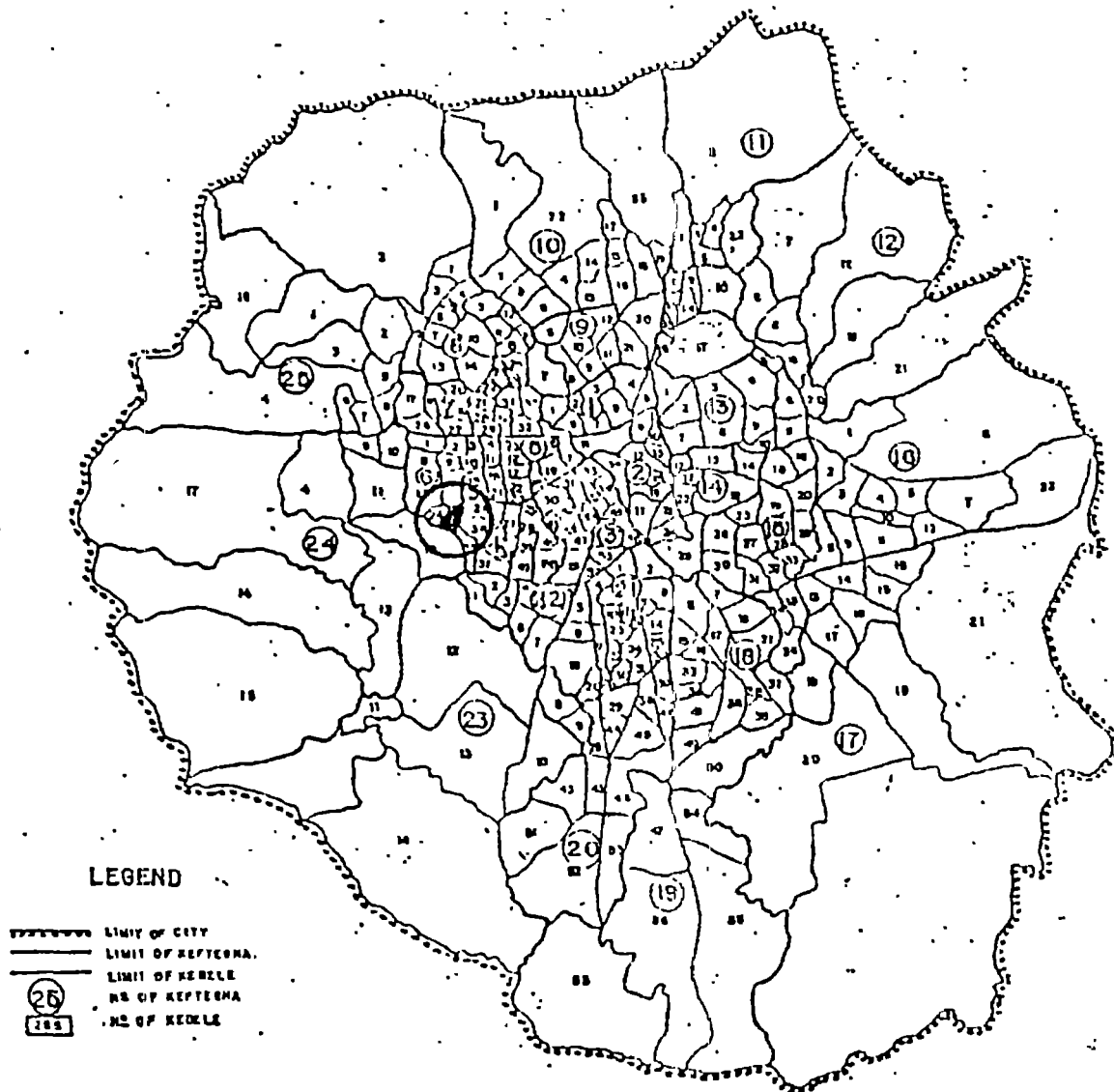


Figure 7. Location map of Kebele 25.

4.2 Demographic data

The total number of households in the Kebele is 1 137 making a total population of 6 210. The average size of a household is 5.45. The male female ratio is 0.86. The population of the Kebele is growing at 3.8 % per annum, out of which 2.3 % is due to migration. The population density was 764 inhabitants/ha in 1985 and today it is expected to be 920 inhabitants/ha. The age structure shown in Figure 8 is very flat at the bottom showing a high youth population.

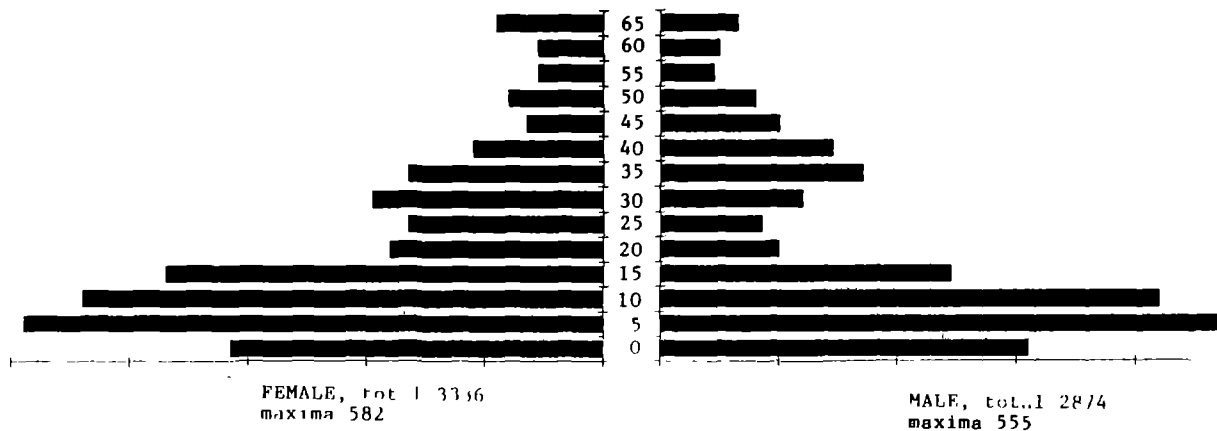


Figure 8. Age structure for Kebele 25.

4.3 Socio-economic data

4.3.1 Family status

Only 27 % of the household heads are married (Table 14).

Table 14. Family status.

Status	Number	% of total
Married	307	27.0
Widowed	43	3.8
Divorced	39	3.4
Single	748	65.8
Total	1 137	100.0

4.3.2 Household income and expenditure

The household incomes in the area are below the average for Addis Ababa. The median income is ETB 138 (USD 67) per month and the average income per inhabitant is ETB 25 (USD 12) per month. The distribution of the household income is shown in Figure 9.

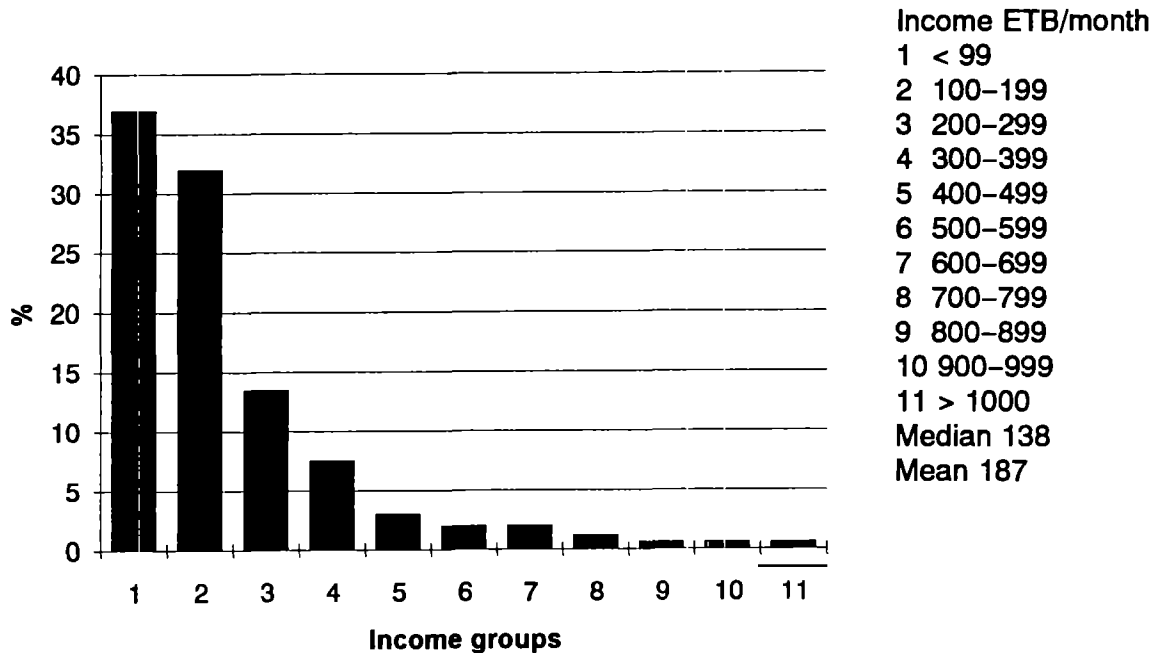


Figure 9. Household income.

The major household expenditure is food (67 % of income) followed by fuel (12 %) (Table 15). The actual expense for water is calculated to be ETB 0.53/month/person. At the official rate this is equivalent to 35 l/c/d. However, the average consumption is estimated to be about 8 l/c/d, which implies that households are paying about ETB 2.2/m³ for water.

Table 15. Household expense.

Item	% of total expense
Food	67.1
Fuel	11.8
Transport	3.7
Electricity	3.6
Housing	3.1
Water	2.1
Others	8.6
Total	100.0

4.3.3 Education

The educational status of the population is satisfactory considering the level of development in the country. However, 30 % have not attended regular school. Table 16 shows the educational status and Figure 10 the illiteracy rate by age group.

Table 16. Educational status.

Type of education	%
Higher education	2.0
Secondary education	23.0
Primary school	43.4
Read and write only	17.6
Illiterate	13.4
Total	100.0

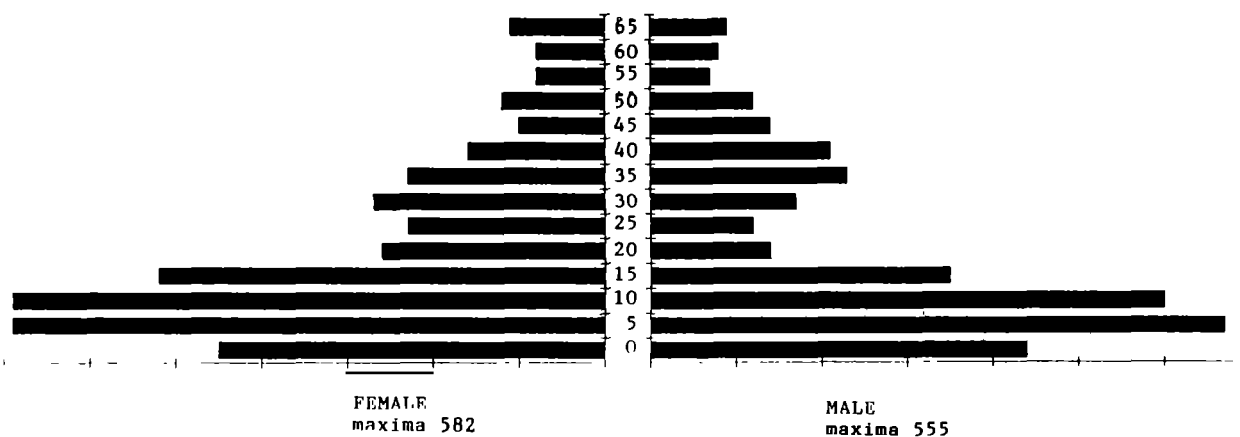


Figure 10. Illiteracy rates.

4.3.4 Employment

There are on the average 1.21 employed person per household. However, only 44 % of the employed have a permanent job, the rest are occasionally employed mostly in small trade at neighbourhood market level.

4.4 Physical data

4.4.1 Housing condition

The dominant use of the houses (94 %) is for residential purpose. In general, most of the houses are similar, and the differences in income are reflected in the shared services such as plots, water supply, toilet, kitchen, etc. There are usually two or three houses in a plot (compound). Each dwelling covers about 33 m² and has two rooms, two doors and two windows. The walls are made of wood plaster with clay and covered with corrugated iron sheet. The house has no ceiling and flooring is mud surfaced with cow dung or bamboo basket. The average lifetime of the house is 24 years, and few are 40 years old.

Due to the building materials and age the existing condition of the houses is deplorable: 26 % of the houses are in such a condition that their maintenance cost is higher than the cost of building a new one.

The house is inhabited in average by 1.1 households or six people. The open space in the Kebele is so small that the open space available for each person is only 5.4 m².

68 % of the occupants are Kebele tenants. The median rent of the houses is about ETB 4.1 (USD 2). This reflects both the condition of the house and the low-income of the people. Table 17 gives the basic housing data in the Kebele.

Table 17. Housing data.

Number of houses	1 041	
Number of inhabitants	6 210	5.96 INH/house
Number of rooms	2 454	2.53/INH/room
House area in m ²	33 312	32 m ² 5.4 m ² /INH
Number of plot	394	
Number of houses	1 041	2.6 house/plot
Area of plots	81 300	206 m ² /plot
Unbuilt area on plot	37 108	32.6 m ² /house
Number of kitchens	488	0.47 kitchen/house

4.4.2 Water supply

In general water is available, and the situation does not differ from a rural water system, but in some respect it is worse. During the study period in the Kebele there was only one working public tap. 40 % of the people in Kebele are served from this tap, i.e. one tap is serving about 2 500 people. The alternative, water fetched from a neighbours' tap, costs ETB 2.5 – 5.0/m³. As a result the average water consumption is very low. Table 18 shows mode of water supply.

Table 18. Source of water.

Mode of supply	%
Tap inside house	0.5
Tap in compound	41.6
Neighbours tap	17.8
Public tap	40.1
Total	100.0

4.4.3 Sanitation

Most houses have a pit latrine. However due to the over use and lack of emptying facilities most of the pit latrines are overflowing. Almost all pit latrines are dry, except eight water flushed pits (Table 19).

Table 19. Sanitary facilities.

Type	Number	%
Dry pit private	153	16.6
Dry pit shared	763	82.6
Flush toilet	8	0.8
Total		100.0

4.4.4 Solid waste disposal

Municipal solids are collected only along the asphalt paved roads. Because of the irregular collection, most of the waste is thrown into the nearby rivers during evening or early morning (Table 20).

Table 20. Solid waste disposal

Destination	%
River	79.4
Municipal collection	17.6
Burned	1.7
Buried	0.7
Pit latrine	0.6
Total	100.0

5 UPGRADING EXPERIENCES IN ADDIS ABABA

5.1 Teklehaimanot area upgrading project

5.1.1 History of Teklehaimanot area

During the Italian intervention 1943 – 1949 the first draft land use plan was developed for Addis Ababa. Instead of the traditional mixed way of living an attempt was made to divide the town into local living area, foreigners living area, market area, etc. At that time the Teklehaimanot area, today's upgrading site, was left empty for future market expansion.

After the Italians left, the area was left in the wild state. However, since it is adjacent to the market place (Merkato) part of the empty land on the banks of streams, was used for solid waste dumping. This illegal practise continued in some places up to today.

Later the southern part was settled by pensioners and war veterans. At the same time the Municipality built a temporary shed in the northern part of the area for the destitute poor and beggars. Soon most of the area was allotted and people started to construct houses. Because of the occupants income level, the construction materials were substandard. The houses were rented to small traders earning their living in the big market.

Most of the empty land was soon occupied; houses were even built on the solid waste dumping site, and the existing houses were expanded without any plan. The result was that the access narrowed and even disappeared in some places. This took place in the 1950s, but its effect remained giving the area a typical slum characteristic.

5.1.2 Initiation of the upgrading project

During the World Bank visit in 1977 Ministry of Urban Development and Housing developed the upgrading. In 1978 a Project preparation team of Urban Planners, Urban Geographers, Sanitary Engineers, Economists and Road Engineers representing different organizations was formed. The team selected Teklehaimanot Area to be the upgrading area, because of the size of the area, existing housing conditions and possibility for resettlement. A study report "Upgrading Teklehaimanot Area" was produced by Yohannes Hailu in 1978 to serve as a basis for loan negotiations with the World Bank. At the end of 1978 the draft preliminary project proposal "Addis Ababa World Bank Urban Development Project Phase I: Preliminary Development Proposal" was prepared by MUDH. Negotiations with the Bank took unexpected long time and the staff appraisal report was ready in 1982. The agreement was signed, and in March 1983 the project was launched under the name Addis Ababa Urban Development Project I.

5.1.3 Project components

The upgrading project was one component of the Addis Ababa Urban Development project I. The other components were:

- Nefas Silk Site and Service Project
- Kebele Development Fund
- Addis Ababa Public Transport Study
- Addis Ababa House Maintenance Study
- Addis Ababa Road Maintenance Study
- Addis Ababa Solid Waste Management Study
- Institutional Support

Table 2¹ gives short description of each component and the finance allocated for them.

5.1.4 Project objectives

The Project was designed to provide continued support for the nations capital, and had the following objectives (World Bank 1982):

- improving basic infrastructure and environmental conditions in the project area
- supporting a core housing development programme primarily for lower income families
- providing institutional support to implementing agency to carry out their activities more efficiently
- promoting the adoption of sound cost recovery policies and practices.

The overall responsibilities of the project comes under Ministry of Housing and Urban Development (MUDH). Under the Chairmanship of the Ministry of MUDH a Coordinating Committee consisting of the Vice Mayor of Addis Ababa, the Housing and Saving Bank General Manager, Addis Ababa Water Supply and Sewerage Authority General Manager, Ethiopian Electric and Power Authority General Manager, Urban Development Project Office Director and CAPIU's Project Manager was formed.

The actual Project Implementation was carried out by three project offices. Urban Development Project Office reporting to MUDH was responsible for the Site and Service Project and coordinating some of the other projects. Housing and Saving Bank was responsible for disbursing the housing construction and maintenance loans. Central Association Project Implementation Unit (CAPIU) was responsible for Upgrading Project, Kebele Development Fund, Addis Ababa Public Transport Study, Addis Ababa Road Maintenance Study and Addis Ababa Solid Waste Management.

Table 21. First Addis Ababa Urban Development Project (Urban I): Project components and descriptions.

Component	Project cost ETB 1000 ¹⁾	Brief description of the project components
Site development and servicing		The site development and servicing component includes:
- serviced sites	2900	- development of 2950 serviced plots for residential, commercial and industrial use
- upgrading	3256	- provision of improved roads, additional water outlets, storm drainage and pit latrines for about 8200 households in the upgraded areas
- commercial/industrial extensions	180	- procurement of refuse collection vehicles and spare parts
- solid waste	1000	- resealing, patching and general repairs of roads under the project and several major roads in the city
- maintenance	2373	
Subtotal	9709	
Construction loans	34212	Loan funds were made available for house construct, services, pit latrines and house improvements.
Kebele development fund		The Kebele development fund is provided for the construction of market places, primary schools, communal centres and pilot development projects.
- primary schools	873	
- community centre and markets	2018	
- pilot development fund	651	
Subtotal	3542	
Institutional development		This component involves staff trainings, advisory services and studies. Studies conducted under the first urban development project include:
- project management	6810	- Addis Ababa road maintenance study
- training and advisory services	1440	- Addis Ababa passenger transport study
- studies	1530	- Addis Ababa house maintenance study
Subtotal	9780	- financial system study
		- landfill site study
Total	57243	

¹⁾USD 1 ≈ ETB 2.07

5.1.5 Implementation strategy

The only project document available for implementation was the Staff Appraisal Report of the World Bank from 1982. Its data sources, assumptions and justification were based on the 1978 situation. Since then the revolution had taken place and there have been a lot changes in the country. To cope up with the new policy, administrative set-up, physical and socio-economical changes and the people's wish a new implementation strategy was developed. This implementation strategy consisted of the following:

1. Conducting a socio-economic and physical survey: to know the detailed information on the existing situation of the area with respect to; housing condition, water supply and sanitation situation, solid waste disposal practice, house ownership rent, demographic data, income and expenditure, employment status, people's wish, etc. A socio-economic and physical survey was put as a priority task.
2. Physical planning of the area (re-plotting): based on the analysis of the survey a re-plotting of the area to identify the varies infrastructural services (water supply, drainage, solid waste collection, access roads, etc.) was to follow.
3. Establishing CAPIU, Site Project Office: since the project document had underestimated the need of Project Implementation Office for the Upgrading, the establishment of the Central Association Project Implementation Unit Site Project Office was taken as a separate task. This was not an easy job as there was no readily available free plot or a house to rent on the site. Like the tradition in the area, the remaining solid waste dumping site had to be cleared, filled and adjusted for the site office.
4. Design of the civil engineering element: it was found that several details are to be taken into account in the construction of the access roads, water main, drainage system, etc. Therefore, in order to give flexibility during the construction period the detail design was decided to take place right on the site.
5. On force account construction: initially the construction of the access roads and drainage was planned to be carried out through international competitive bidding (ICB). However, it was difficult to put all the construction details into a bidding document, because there were several administrative arrangements to be coped with multitude organizations and the occupants. It was anticipated that this might cause claims and cost escalations, so it was decided to carry out the construction on force account bases by the site project office.

5.1.6 Implementation

Initially the socio-economic and physical survey was conducted. This revealed the actual problems in the area and the wishes of the people. The main findings were:

- the area is densely populated with average of 480 persons/ha
- 33 % of the houses are in a very poor condition that it is not worth maintaining them, and 55 % need urgent maintenance
- the area is devoid of access and drainage
- 74 % of the houses are owned by Government/Kebele
- 34 % of the population (15 700 people) fetch water from three public taps
- the majority of the pit latrines are full or overflowing

- 65 % of the population earn less than ETB 100 (USD 50) per month
- the solid waste generated is dumped on the river bank and on other available open spaces.

The list of main problems of the area are summarized in Table 22.

Table 22. Main problems in Kebele.

	%
Lack of water service (latrines and water supply)	27
Poor housing	20
Lack of income	19
Poor physical environment (access)	17
Poor health	10
Others	7
Total	100

Housing, access and water were identified as the three major problems. 27 % of the people want water service (i.e. latrines, water, drainage, solid waste) to be improved first. However, these services could not be managed without a proper access; to plan the hierarchy of the roads and water services the whole site had to be re-plotted (planned).

The re-plotting was carried out based on the following main guidelines:

- plots will not be farther than 40 m from the access road
- to provide one public tap per 100 houses
- to arrange solid waste disposal for the area
- to provide one toilet for every four households
- to increase the green area and vacant space
- to reserve a reasonable area for public facilities.

The re-plotting plan was a kind of Master Plan for the area and, therefore, all targets were not meant to be achieved during the project life. However, a lot has been accomplished and because the results were encouraging re-plotting was found to be worth while to be repeated in similar places.

The works accomplished were:

Access: 27 000 m² of asphalt paved, 11 000 m² of gravel paved vehicular roads and 6 000 m² of pedestrian walk ways and four bridges were constructed.

Drainage: Drainage along all the roads and necessary open channel drains were constructed. In addition to contain the over flow of the streams retaining walls were constructed along the river banks where found necessary.

Water supply: Once the access roads were opened tertiary pipe lines were laid and the old pipes were replaced. 20 new public taps were constructed and the old ones maintained.

A short study conducted by the author in May 1990 showed that by August 1989 there were 1751 yard and house connections and 27 public taps in the area. The average monthly consumption was 20 313 m³, giving an average per capita consumption of 5 l/d. However, most of the new public taps were not put into operation. Traditionally the Addis Ababa Water and Sewerage Authority was responsible for all public taps operating in Addis Ababa. Lately AAWSA, to decrease its operating costs, has started to shift the responsibility of operating public taps to the Kebeles. Thus due to the lack of proper administrative set-up in the transfer of the responsibilities, problems have been faced in the operation of the public taps. Table 23 shows the status of public taps constructed under the upgrading project.

Table 23. The status and distribution of public water taps constructed under the upgrading project.

Kebele	No. of public taps	Remarks
3/43	3	The public taps have not yet been put into operation, but the Kebele has started process for employing persons to be in charge of the public taps.
3/42	2	The Kebele has not yet started coordinating the activity. The Kebele has reported that the public taps will not get demand due to their location near existing public taps.
4/28	4	The public taps have never been put into operation. The Kebele and AAWSA did not want to take the responsibility for running the project.
4/39	2	Two of the public taps are out of use. The Kebele has failed to cover the operating costs.
4/29	1	The Kebele has failed to cover the operating costs.
3/47	1	The tap is currently out of service for maintenance.
3/30	2	Two of them are in operation.
3/41	2	Two of them are in operation.
4/40	3	One of the taps has been temporarily out of use.
Total	20	

Solid waste management: A solid waste management study covering the whole city was implemented at the same time. Therefore, special emphasis was given to this area. Once the access in the upgrading area was opened, 8 m³ containers were placed at a transfer station for each Kebele. The residents dump their solid waste into the containers and the containers were picked every other day by skip loaders and transported to the disposal site. This system has greatly improved the collection of waste in the area as well as in the city.

To further improve the system intermediate containers (130 l drums) were introduced, each to serve 60 families. To transport the 130 l drums up to the transfer station and dump them into the 8 m³ container 2 men were hired by the Municipality for each Kebele. The purpose was to bring the containers close to the house and thereby attract more solid waste. At the beginning the system worked efficiently. However, since the drums were not chained they started to disappear. To keep drums safe, responsibility of guarding them was given to selected individual families, who shifted the drums from the public area to their private compound. Therefore, instead of serving the originally planned 60 families they ended up serving 2 – 3 families.

Sanitation: Because most of the houses were accessible it was also possible to empty sewage from some of the pit latrines. In addition, there was provision for a bank loan for the construction and/or maintenance of pit latrines. However, this opportunity was not fully exploited because of the following policy and administrative problems:

- Since 65 % of the houses are owned by the Kebele (Government) the tenants were not interested to take a bank loan and invest on pit latrines construction or maintenance.
- The usual practice in the country is that the owner, in this case Kebele, takes care of the construction and maintenance of the houses. However, since the average rent of the houses is ETB 6 and about 50 % of this is paid to previous house owners as compensation and the cost of a service of a vacuum truck per trip is ETB 25 the Kebeles were not interested to invest their money. Even if they had wanted there was no way the Banks would have lent them money for a non-profiting venture.
- AAWSA had only few vacuum trucks: the bureaucratic procedure and the long waiting time to get the service of a vacuum truck was highly discouraging. Especially difficult it was when the pit latrine was used by several families.

The last problem was partially solved recently when one non-governmental organization (NGO) provided one vacuum truck for the use in these Kebeles only.

5.1.7 Problems encountered during implementation

House and land ownership: The major problem was that because most of the residents do not own the houses and the rents are low, the Kebele is not willing to invest on improved sanitation and water supply. Because of this the benefits which should have derived from the improved access have not been fully achieved.

Institutional arrangement: During the construction of the access alignment, grades and levels were changed. These necessitated the removal of existing water lines, electric lines and telephone lines. Even though all the institutions involved were willing to assist, it was very difficult to coordinate these jobs. A considerable amount of time was lost first

to remove the existing utilities and latter to institute them back along the new access and re-connect the individual connections. The problem was extremely serious with water supply; sometimes it took more than a year to re-connect people to the system.

Lack of proper institutional arrangement in AAWSA to transfer financial and operational responsibilities of the public taps to the Kebeles have left most of the nearly constructed public taps closed.

Finance: More could have been achieved. Even though some of the problems are well identified some works had to be left out due to limited financial sources.

Technical problems: Since the area was devoid of any access opening of new access was a difficult job. Some houses had to be destroyed, roads had to be built on top of old pit latrines and garbage dumps, which required special consideration for each part of the road.

Besides, the introduction of access had changed natural drainage course and, therefore, special consideration had to be given in the provision of drainage channels.

The change of the road grade level and the provision of the open drainage channels left some houses suspended above the road level exposing their foundation and some houses below the road level submerged. This required unanticipated retaining wall construction to protect the houses and special arrangement for the entrance to the individual houses. Due to the lack of open space, the arrangement of the utility and the drainage was a very difficult task. This necessitated the introduction of new road width standards, and some times drainage channels had to be constructed in the middle of the road.

5.1.8 Impact of Teklehaimanot area upgrading project

To report the impact of the implementation of the Teklehaimanot area upgrading project a post survey should have been the appropriate approach. In the absence of the survey the personal observation by the author are summarized as follows:

- The provision of access, drainage and solid waste disposal system has improved the living environment of the residents.
- The employment of several hundreds of residents as a labour force during the construction has in a way increased the income of the household and also taught some new skill by which they can support their living.
- The project proved to the local authorities and to the residents that positive changes can be brought with a reasonable input.
- The project made the way for further neighbourhood improvements possible. As a result several NGO's have started integrated neighbourhood projects in the same area.
- The project proved to the financiers that the procedure is worth repeating. In fact, the finance of a new, large project has been approved the World Bank.
- The project created a new and positive image towards the upgrading.

5.2 Redd Barna upgrading activities in Addis Ababa

Redd Barna is a non profit making humanitarian organization that supports and implements child centre, relief and development projects. It has been in operation in Ethiopia for 20 years. Its first activity in urban low-income areas started 1981 in Kebele 41 Higher 3. Then two projects in Kebele 13 Higher 21 and Kebele 14 Higher 11 were undertaken.

"The basic aim of the project is to improve the social, economic, physical and environmental conditions of low-income families and their children" (Azeleth 1983). To achieve these aims, the projects have the following major components:

- physical infrastructure improvements
- income generating activities
- preventive health/mother and child care
- human development/social awareness building.

Kebele 41 project was completed in 1986. The achievements are: out of the 788 dwelling units 368 have been maintained and 153 new houses have been built, 24 kitchens have been constructed, a public water closet with eight showers, two latrines and five washstands have been constructed and a solid waste collections system consisting of 80 bins and five (4 m³) containers have been put to service.

In addition, a weavers and spinners association house, a mill house, a day care centre, a grain store, a cooperative shop, a health clinic and a nutrition rehabilitation centre have been built. The costs of the project were ETB 3 852 256 (USD 1 861 00) in 1981–1986, equal to an average investment of ETB 980 per person. The project had initially problems with access and drainage. However, since Kebele 41 was part of the Teklehaimanot Upgrading Project Area the access and drainage problems were solved in due course.

As all the operational and maintenance activities were covered (subside by REDD BARNA) at the completion of the project the Kebele had faced financial problems to take over. However, with the assistance of the Municipality and efforts of the residents the problem is solved. For example the project used to pay for the service of vacuum trucks to empty pit latrines. When this stopped the pit latrines were soon filled and started to overflow; the people did not afford to have it emptied, and since the revenue from the rent is not covering this expense the Kebeles did do it neither. However, finally an NGO provided a vacuum truck for the service of three adjacent Kebeles.

This fact was realized by Redd Barna. The following statement reflects this: "Phase-out and transfer of responsibility received a great deal of attention when Redd Barna first introduced itself to the Kebele and to Addis Ababa City. The community found the concept both frightening and challenging. The first move towards transferring financial responsibilities away from the organization was to make the Kebele administration take full responsibility for employing and paying staff the community needed for running its institutions avoiding dependency on strained government budgets must be an aim, and success of the efforts of an NGO depends on local institutionalization. This fact was underestimated by REDD BARNA at the start of the project. Social justification was too often accepted, while sustainability and financial criteria were neglected" (Redd Barna 1988).

5.3 Oxfam's upgrading project in Kebele 29

Kebele 29 is located within the Teklehaimanot upgrading project area. The area is characterized by low-income (average ETB 56 per month), severe over crowding, poor sanitary and lack of communal services.

In April 1986 the City Council of Addis Ababa and Oxfam signed an agreement in which the latter was to provide development assistance through establishing an urban upgrading project in Kebele 29 Kefetegna 4. The project was designed to be complementary to the Teklehaimanot upgrading project, which covers 9 Kebeles.

The Kebele 29 upgrading programme contains six major components:

- Income generating activity (to increase household income and make the revenue available to the Kebele administration for development projects as well as for the maintenance and flood prevention work).
- A programme of sanitation and flood prevention work.
- The upgrading and construction of houses as well as the provision of communal latrines and communal cooking facilities.
- A community development programme (including health and education).
- A proposal for resettlement to reduce severe over crowding.

The project components are similar to that of Redd Barna. However, unlike Redd Barna the Oxfam project has in built the cost recovery concept through which the Kebele will be able to maintain repair and possibly undertake new construction.

Except the construction of housing, which is waiting for a policy change, the rest of the project is being realized and has already scored some achievements.

The total project budget estimate is ETB 4 298 158 representing an investment of ETB 754 per person.

5.4 Rexcoop's pilot project in Kebele 40

Kebele 40 is one of the nine Kebeles covered by the Teklehaimanot upgrading project. The Kebele 40 Pilot Project is financed by the French Co-operation Interministerial Programme (REXCOOP) and the Municipality of Addis Ababa. The main aims of the Project are:

- To complete the upgrading work undertaken by the Teklehaimanot upgrading Project in Kebele 40 by improving the neighbourhood urban services.
- To experiment, by a field intervention, a municipal strategy in the field of urban rehabilitation and decentralized modes of management which can later on be applied to other areas.

The project started in 1988, but until to date nothing substantial has been achieved. Even though the original completion date has expired, the project is still going on and REXCOOP has replaced its expert and is trying to salvage the project.

5.5 Irish activities

Irish have one on-going project in Kebele 36 in the Teklehaimanot area and it has entered into agreement to undertake similar projects in two Kebeles adjacent to Kebele 36. The major components of the projects are:

- maintenance and re-construction of dwelling house, kitchens and latrines
- provision of primary health care education and family planning
- training of school drop-outs and house wives
- preschool education of children
- provision of public water taps and communal injera bakery.

6 RECOMMENDATIONS

6.1 Policy issues

6.1.1 Land and housing legislation

The existing land and housing legislation is a hindrance to low-income area improvement programmes. In general the key to a successful upgrading project is the rallying of public participation in the formulation of the programme and in terms of financial and labour contribution. This can well be achieved if the residents have the land and housing legislation in their favour.

6.1.2 Administrative setup

Institutional constraints have in a number of cases, contributed considerably to diluting the efforts of single agencies to find solution to sectorial problems of low-income areas. The upgrading projects undertaken in Addis Ababa are considered to be successful. However, they are limited in size and number and the whole task cannot be done by patch work. This project by project approach does not remove the constraints on the vast majority of people, who are not part of the successful projects. This indicates the need for establishing an efficient central agency responsible for planning, programming and coordinating the upgrading of low-income areas. The form and responsibility which this organization shall have should be a result of further study.

According to the organization chart of AAWSA, sanitation is not given a due attention. Neither does the proclamation of establishing AAWSA include sanitation as part of the responsibility of the organization. AAWSA is responsible for sewage services and operation of vacuum trucks.

To date only 500 customers are connected to the sewage system. The emptying of pit latrines and septic tanks is taken as a simple mechanical operation without the organization being involved in the planning, promotion and control.

On the other hand the City Council of Addis Ababa is responsible for the promotion of sanitary improvements and the provision public toilet facilities. But it does not control the vacuum trucks with which the system is maintained.

This indicates the need for re-arranging the institutional responsibilities with respect to sanitation services. The decision which part is the responsibility of which organization should be further studied.

6.2 Technical approach

6.2.1 General approach

The information on the proceeding chapter indicates that water services in the low-income areas of Addis Ababa is not satisfactory. The task of improving the situation is not easy. As there are no ready available formulas, it requires very special attention and dedication. Often it requires the efforts of planners, engineers, sociologist from

different institutions.

Water service cannot be tackled separately. The provision of revised plan of the site and the opening of access is a prerequisite for a water service improvement programme. This implies that upgrading of water service in a low-income area has to be part of a multisectorial upgrading programme.

From the experience of the implemented project the following outline is drawn to serve as guideline. However, as every site has its specific problems and as there are no readily available formulas, specific solutions have to be used for each site:

1. conduct socio-economic and physical survey of the site
2. gather information on the opinion and preference of the residents
3. set out the upgrading target and strategy
4. carry out a re-plotting (planning) of the area taking the above point into consideration.
5. discuss the target and the plan with the residents and form resident implementation coordinating committee
6. carry out the implementation with a task force with full authority to decide the details of the construction right on the site
7. discuss the implementation plan and strategy with all institution involved in the programme and from a standing coordinating committee.

6.2.2 Water supply

Coverage of the low-income areas by territory lines to allow more yard and house connection will improve the water supply and sanitation situation more than the mere installation of public taps. The administrative problem of the operation of public taps will have to be studied in detail if public taps are expected to have a greater role.

6.2.3 Sewerage

The number of houses with water connection is insignificant. Therefore piped sewerage system will not be appropriate in the low-income area.

6.2.4 Sanitation

Until piped sewerage systems become appropriate, on site sanitation should be encourage. The choice of the on-site sanitation technology to be used should be based on investigations on availability of materials, equipment, existing institutional constrains, type of soil, availability of space, accessible of the plot and the number of users.

6.2.5 Solid waste management

The simple dumping of garbage has much more adverse effects in highly dense, low-income areas than low density areas. The introduction of containers in Addis Ababa has greatly improved the solid waste collection. It has to be improved by increasing the use of 130 l drums. The action should be taken based on further investigations on the problems involved in the process.

6.2.6 Drainage

Due to the topography of the low-income area and the type of existing access, drainage is required to protect life and property against floods and the provision of a safe and health neighbourhood.

Therefore, drainage facilities should be invariably provided along the access ways and the interrelationships between other infrastructure services should well be attended in the replotting of the area. The drainage system will operate as initially intended only if an effective means of refuse disposal is provided and the public awareness is well developed.

6.3 Financial considerations

6.3.1 Municipal finance

The municipal tax system has not been revised since 1952. As a result the city revenue has been stagnant for many years. Most of the revenue goes for staff salaries and only a little goes for investments. Quite recently the municipality has started to invest in low-income areas unlike investing in well-to-do developed areas.

The revision of the municipal tax will provide the municipalities more money for investments. This in turn will encourage the municipalities to invest on the improvement of low-income areas. However, with the present situation it is unlikely to get any positive change.

6.3.2 Water tariff

The per capita water consumption ratio of a low-income person and high income person in Addis Ababa is 1:8. The revenue from water sales has not been able to cover the costs, and the Government had to subsidize a substantial part of the cost. Since the water tariff is the same for every customer, the Government is subsidizing more the well to do than the low-income person. However, the intention is the opposite. To make the water service self-sufficient and put the government subsidize in the right order a structured tariff on the basis of amount of water consumed should be implemented.

Most of the residents of low-income area fetch water from public taps or vendors. The water connection fees in Addis Ababa range ETB 200 – 300. 30 % of the households in low-income areas earn less than ETB 100 per month. It is, therefore, very difficult for these people to pay the connection fee at once. On the other hand, the low-income people, not having the water connection, pay 4 – 10 times the actual tariff for water vendors. Therefore, a special financial arrangement has to be set for the low-income

area to enable them to have their own water connection.

6.3.3 Solid waste management charge

The City Council of Addis Ababa does not charge the residents for domestic solid waste collection and disposal. The waste generation is low compared to other areas. On the other hand, the collection rate of waste in the low-income area is very lower than in other areas. By giving free service the municipality is subsidizing the well to do area more than the low-income areas. To give a equitable service and generate more revenues the municipality should be charging for its services on the basis of waste generated. However, the implementation of this would require further analysis and study.

7 CONCLUSIONS

People live in low-income areas, because they do not have any other alternative. Water services in low-income areas are inadequate. These people, like all the other people in the city, require an efficient and adequate water service to maintain good health and better living environment.

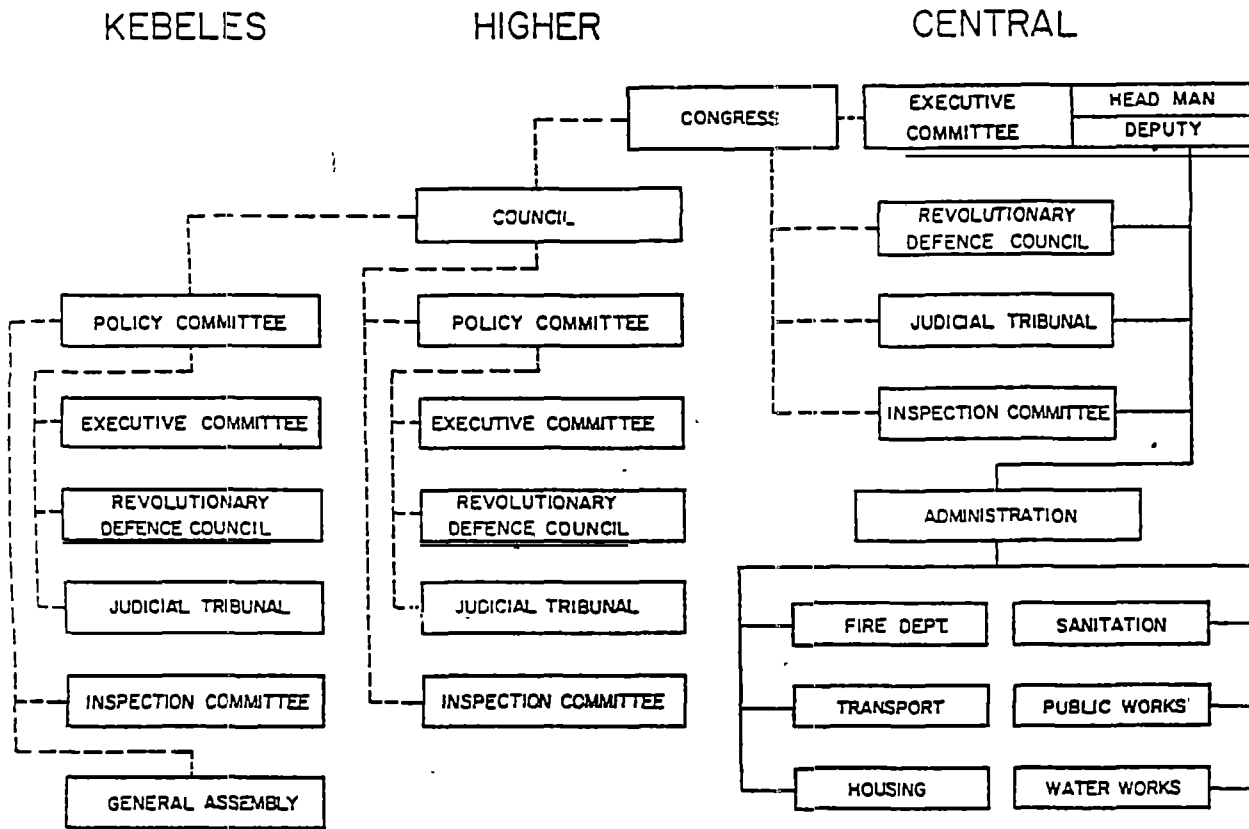
Improvement of the water service in low-income urban areas will be well achieved if is preceded with the replotting of the area and provision of access ways. In addition the revision of pertinent policies, formation of appropriate administrative set-up and revision of the water tariff system will render possible a just and equitable service.

The attitude of the City Council of Addis Ababa towards the general upgrading of low-income areas is encouraging. The Addis Ababa Urban Development Project I, which has been completed and which is in the pipe line and the several NGO projects are a clear manifestations of this. However, the problems of low-income areas cannot be solved by this project by project approach. A comprehensive plan towards low-income areas have to be developed and implemented in an orderly regulated and coordinated manner. The city can allocate adequate funds for upgrading only when its revenue is improved. Therefore the revision of the municipal tax law will be an important input to the upgrading endeavours.

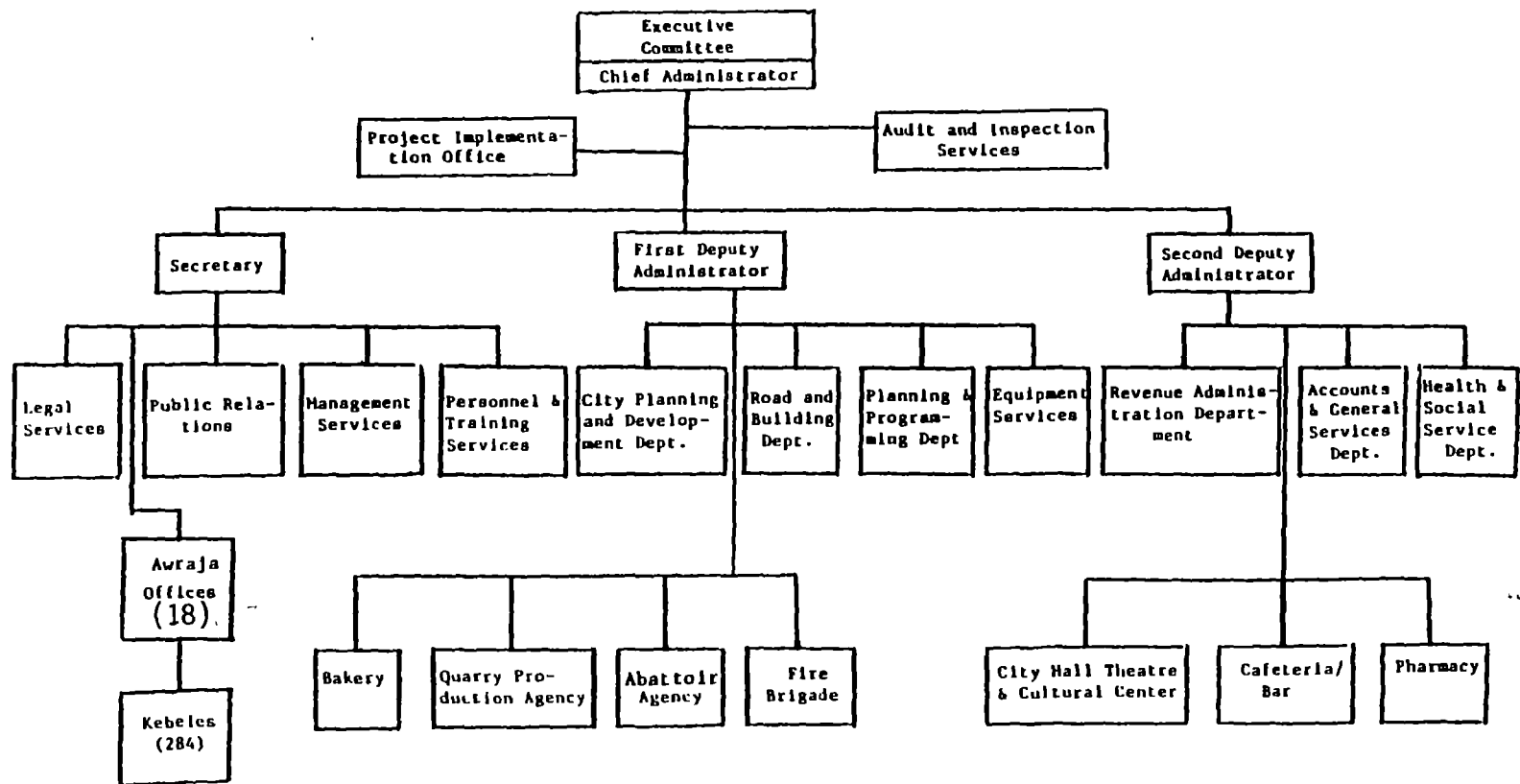
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Appendix 1.

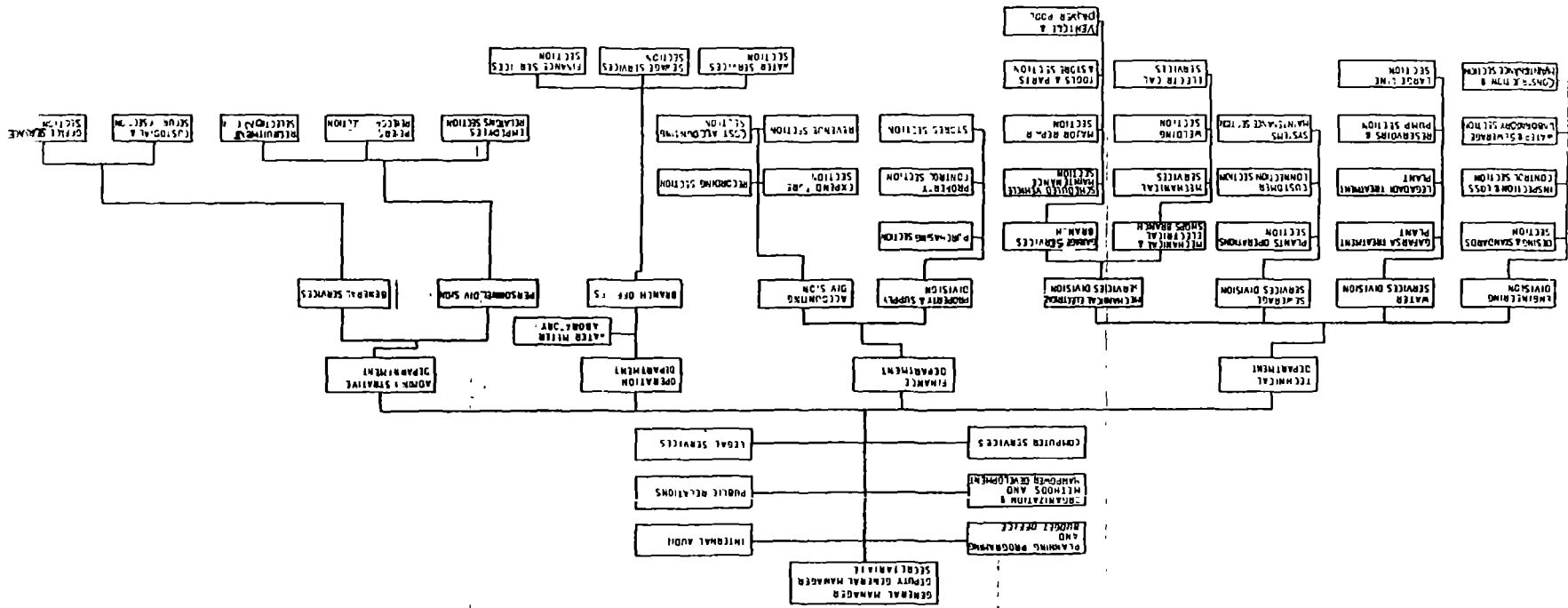


Organization chart of the Urban Dwellers Association.



Organization chart of the Addis Ababa Administrative Region.

Organization chart of the Addis Ababa Water Supply and Sewerage Authority.



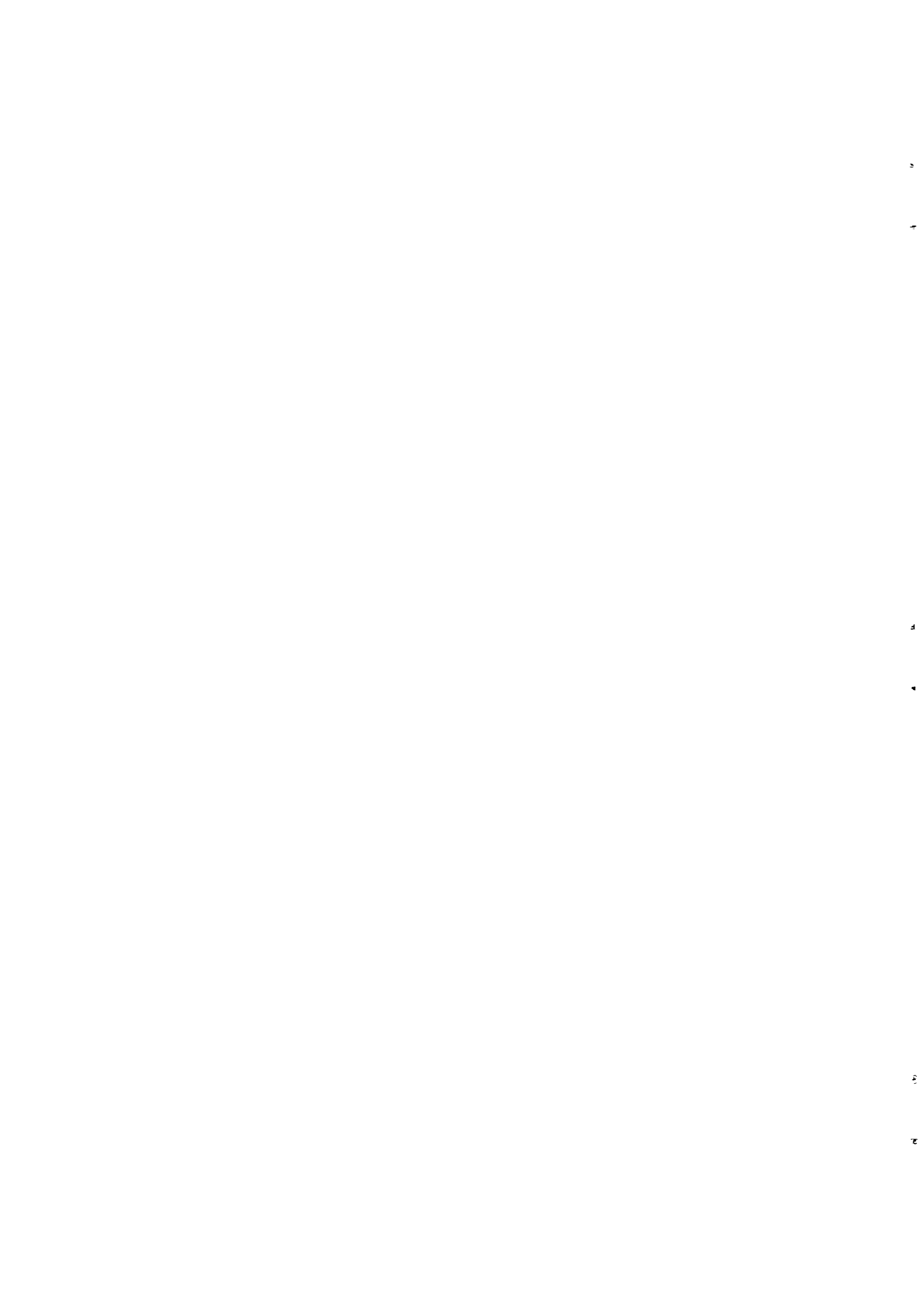
Appendix 4.

ASSISTED UPGRADING				URBAN RENEWAL				UPGRADING			
Kefteqna	Kebele	Code	remark	Kefteqna	Kebele	Code	remark	Kefteqna	Kebele	Code	remark
13	8	AUP	-	18	12	UR	+	18	22	UP	-
14	14	AUP	-	18	10	UR	-	18	7	UP	-
15	31	AUP	-	12	20	UR	-	24	11	UP	-
18	8	AUP	-	9	11	UR	-	25	3	UP	-
21	21	AUP	-	9	1	UR	-	25	3	UP	+
19	49	AUP	+	8	23	UR	+	25	18	UP	+
18	5	AUP	+	8	15	UR	+	12	19	UP	-
16	4	AUP	+	8	23	UR	+	12	7	UP	-
16	3	AUP	+	8	22	UR	+	12	6	UP	-
15	28	AUP	+	7	28	UR	-	11	17	UP	-
15	20	AUP	+	7	19	UR	-	13	5	UP	-
12	21	AUP	+	6	25	UR	-	13	11	UP	+
12	11	AUP	+	3	43	UR	-	13	3	UP	-
13	1	AUP	+	21	23	UR	-	15	27	UP	-
11	14	AUP	+	21	24	UR	-	15	33	UP	-
11	1	AUP	+	21	25	UR	-	15	32	UP	-
9	20	AUP	+	23	10	UR	+	15	34	UP	-
10	18	AUP	+					15	38	UP	+
10	17	AUP	+					18	8	UP	-
10	13	AUP	+					18	33	UP	-
9	12	AUP	+					19	34	UP	-
1	3	AUP	+					20	44	UP	-
8	1	AUP	+					21	20	UP	-
8	5	AUP	+					19	50	UP	+
8	10	AUP	+					19	57	UP	+
8	13	AUP	+					15	35	UP	+
21	19	AUP	+					18	1	UP	-
23	8	AUP	+					13	29	UP	+
20	43	AUP	+					13	18	UP	+
20	29	AUP	+					13	8	UP	+
20	38	AUP	+					13	9	UP	+
20	40	AUP	+					13	10	UP	+
18	18	AUP	+					13	2	UP	+
18	34	AUP	+					11	13	UP	+
21	9	AUP	+					11	19	UP	+
21	14	AUP	+					11	3	UP	+
21	13	AUP	+					11	23	UP	+
3	44	AUP	-					11	19	UP	+
1	7	AUP	+					9	10	UP	+
1	8	AUP	+					10	3	UP	+
9	21	AUP	+					10	5	UP	+
10	18	AUP	-					8	6	UP	+
10	14	AUP	-					25	8	UP	+
11	8	AUP	-					25	1	UP	+
25	7	AUP	-					24	10	UP	+
7	28	AUP	-					24	12	UP	+
7	20	AUP	-					22	7	UP	+
7	28	AUP	-					21	4	UP	+
7	30	AUP	-					20	42	UP	+
7	31	AUP	-					20	36	UP	+
7	33	AUP	-					20	45	UP	+
7	32	AUP	-					18	15	UP	+
1	8	AUP	-					18	17	UP	+
9	7	AUP	-					21	22	UP	-
8	24	AUP	-					21	30	UP	-
8	10	AUP	-					21	31	UP	-
5	15	AUP	-					21	32	UP	-
5	18	AUP	-					21	11	UP	-
5	17	AUP	-					21	10	UP	-
5	21	AUP	-					1	5	UP	-
5	20	AUP	-					1	4	UP	-
4	28	AUP	-					10	15	UP	-
4	27	AUP	-					11	4	UP	-
4	29	AUP	-					11	5	UP	-
3	47	AUP	-					11	15	UP	-
3	41	AUP	-					7	17	UP	-
3	30	AUP	-					7	18	UP	-
3	31	AUP	-					9	8	UP	+
								10	1	UP	-
								24	9	UP	-
								8	1	UP	-
								8	8	UP	-
								8	13	UP	-
								8	14	UP	-
								8	9	UP	-
								8	2	UP	-
								8	3	UP	-
								8	4	UP	-
								5	5	UP	-
								5	12	UP	-
								8	11	UP	-
								5	22	UP	-
								4	36	UP	-
								4	28	UP	-
								4	40	UP	-
								4	37	UP	-
								4	38	UP	-
								4	39	UP	-
								4	50	UP	-
								3	51	UP	-
								22	4	UP	-
								22	28	UP	-
								22	2	UP	-
								22	1	UP	-
								22	11	UP	-

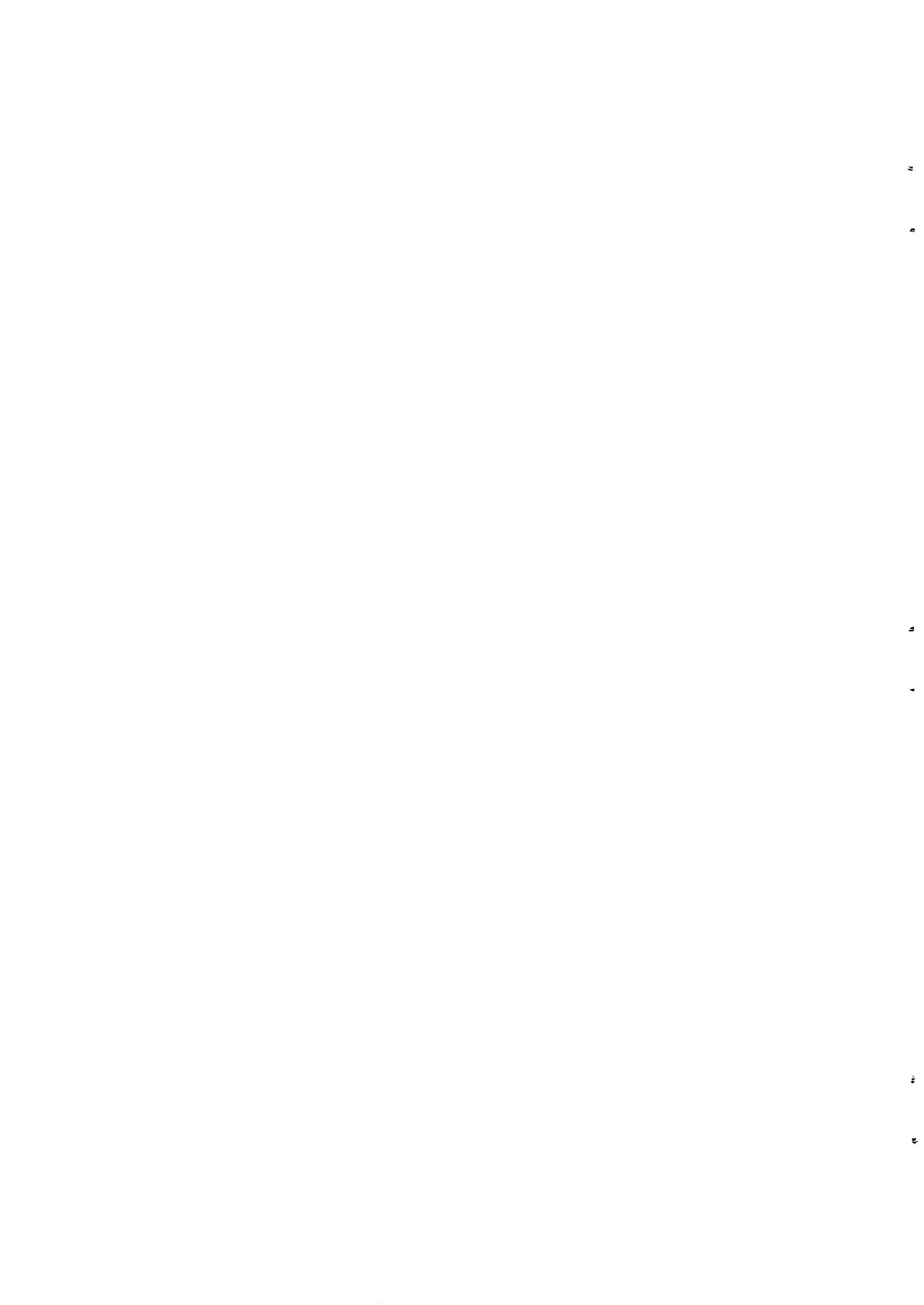
LOCALIZED URBAN RENEWAL			
Kefteqna	Kebele	Code	remark
11	10	LUR	+
11	16	LUR	-
12	18	LUR	+
13	15	LUR	+
15	19	LUR	+
16	2	LUR	+
16	6	LUR	+
16	9	LUR	+
17	13	LUR	+
18	27	LUR	+
19	47	LUR	+
23	9	LUR	-
23	14	LUR	-
3	42	LUR	-
7	21	LUR	-
7	21	LUR	+
8	11	LUR	+
5	14	LUR	+
8	25	LUR	+
25	8	LUR	+

IN-FILL PROJECTS TO INCREASE			
Kefteqna	Kebele	Code	remark
17	21	I	+
17	1C		+
17	24		+
17	15		+
17	18		+
17	14		+
17	17	I	+
17	19	I	+
17	20	I	+
17	23	I	+
18	18		+
18	26		+
18	36		+
18	35	I	+
18	41	I	+
19	58	I	+
19	55		+
19	58		+
20	53		+
20	52	I	+
20	51	I	+
20	26		+
20	48		+
23	15	I	+
23	13	I	+
23	12	I	+
24	15	I	+
24	14	I	+
24	13	I	+
24	17	I	+
25	4	I	+
25	2	I	+
8	35	I	+
8	2	I	+
8	3	I	+
10	2	I	+
10	22	I	+
10	4	I	+
11	2	I	+
12	22	I	+
12	12	I	+
18	11	I	+

Upgrading areas in Addis Ababa.



**Part II: WATER AND SANITATION SERVICES IN LOW-INCOME AREAS OF
NAIROBI, KENYA**



WATER AND SANITATION SERVICES IN LOW-INCOME AREAS OF NAIROBI, KENYA

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Patts M.A. Odira and Ezekiel N. Nyangeri: Water and Sanitation Services in Low-income Areas of Nairobi, Kenya

ABSTRACT

This report is a review of the water supply and sanitation situation in the low-income/shanty areas of the city of Nairobi Kenya. The paper looks at the socio-economic characteristics of the estates identified as of low-income communities particularly the housing policy which is found to be an important ingredient when an evaluation of delivery of sanitation services is considered. There is a brief look at the solid waste management in the city generally and in the low-income areas in particular.

The review highlights the fact that whereas substantial investments have been put in the water supply delivery services the input in sanitation provision and improvement has remained fairly insignificant. Policy constraints particularly on quality of housing vis-a-vis services provided have contributed much to the present state of affairs.

Much of the information put in this review has been obtained from various reports while some of the information is part of findings from preliminary field surveys made by authors.

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1 PHYSICAL FACTORS OF NAIROBI

1.1 General

The city of Nairobi encompasses some 6 000 km with the City centre supporting an expanding commercial and industrial community. The urbanized area to be provided with water, drainage, sewerage and other infrastructural development now covers approximately 450 km².

Traditionally domestic wastewater disposal has taken advantage of natural ground characteristics and has been allowed to drain to rivers, watercourses or to simply soak into the ground. The city lacks adequate water resources within its environs and drinking water has to be transported for as far as over 80 km away from the Aberdare Ranges. Any master planning for water and sewerage services must take into account the relevant physical attributes of the area concerned to optimize the available physical and financial resources. Additionally, in the planning and provision of waste disposal systems, be it on site disposal or a water-borne sewerage system, a basic priority must be the maintenance of a healthy and clean environment.

1.2 Climate

Nairobi area is predominantly controlled by its equatorial position and the large scale pressure systems of the African Continent and Indian Ocean. Places near the Equator experience two clearly distinct rainy seasons coinciding with when the Inter Tropical Convergence Zone (ITCZ) is overhead on its way north and south. For Kenya this occurs during April/June and October/December. In Nairobi average annual rainfall is about 875 mm.

1.3 Topography

Nairobi is located in the south eastern foothills of the Aberdares. The area slopes gently down from west to east with an approximate change in elevation of 300 m across the city boundary area. The areas within Nairobi city boundary are drained in the main by the Nairobi river and its main tributaries; Karen Langata area and Airport area at Embakasi are drained by tributaries of the Athi River.

1.4 Geology

Geology of Nairobi consists of pyroclastic rocks comprising of various lava flows or their weathered derivatives and also palaeo-soils developed during intervening periods of sub-aerial weathering. Rock outcrops occur in the area especially south and east of the City and the rock horizons are often close to the surface elsewhere. Weathering has produced residual and occasionally transported soils of considerable thickness. The most common soil produced is a reddish to yellow gravel type, the red coloration being due to an overall staining by iron oxide. More advanced weathering has produced grey to chocolate coloured soils devoid of gravel and invariably more fertile.

The so called "black cotton" soils occur in areas of internal or ill-defined drainage such as swamps. The soil is a fine grained black clay-like soil, which when dry is hard and fissured by contraction cracks though when wet it is sticky and extremely boggy. The black colour is due to an unusually high organic content. The red soils tend to be well

draining and the black soils of low permeability. The entire thickness of tertiary volcanics in the Nairobi area represents a complex sequence of aquifer and aquiclude horizons while the basement rocks are generally non-water bearing except where fracture or weathering has occurred. Ground water generally moves from west to east reflecting the topography of the area and prevailing rainfall/recharge pattern. Recorded water levels indicate the water table to be deep under most of Nairobi:

- Karen, 20 - 35 m
- Langata, 70 - 100 m
- Kamiti, 15 - 60 m
- Spring valley, 15 - 25 m

2 CURRENT DEVELOPMENT AND PLANNING

2.1 Overview

In 1985 Nairobi's population was about 1.2 million. This is 6 % of the national total, and it is growing at a current rate of 5.3 % per year. The latest comprehensive employment statistics for 1980 indicate that 36 % of the population were economically active either in the wage employment or as self-employed or unpaid family workers. 85 % of this figure were employed in the formal wage earning sector while the remaining 15 % were employed in the informal sector. The medium level population forecast suggests the growth rate will remain at 5.3 % until 1995, falling to 5.0 % by the year 2000 by which time the population will have doubled.

Within Nairobi the development plan will be successful if it can keep pace with market pressures by developing the required level of public service infrastructure. If it cannot, the level of control required will increase enormously further exerting a drain on resources.

The following examples highlight current planning problems. The most noticeable problem for the planners is that the unplanned shanty areas should be developed. This is a result of the real market pressure on the working poor who are settling in the open spaces near to their places of work. Once settled these areas are difficult to clear and development plans can be set aback (e.g. Kibera). Where the land is owned privately market pressures again can affect a change in land use as may be seen in the redevelopment of Mathare Valley which is currently starting to occur.

More traditional areas near the city centre are becoming shanty type areas due to the infill population pressure and sub-division of plots to the point where they cannot even support a subsistence level of farming. It is expected that these areas like Riruta will give way to urban redevelopment in the future.

2.2 Current land use

The current land use map is presented in Figure 1 with the areas delineated according to the nine general land use classifications given in Table 1. The map shows the Development District boundaries which were adopted in 1979 for general land use zoning and development control purposes.

Current land use in Nairobi is summarized in Table 2, and Table 3 lists the current land designated for low-income/poor settlement and unauthorized shanty areas within each Development District.

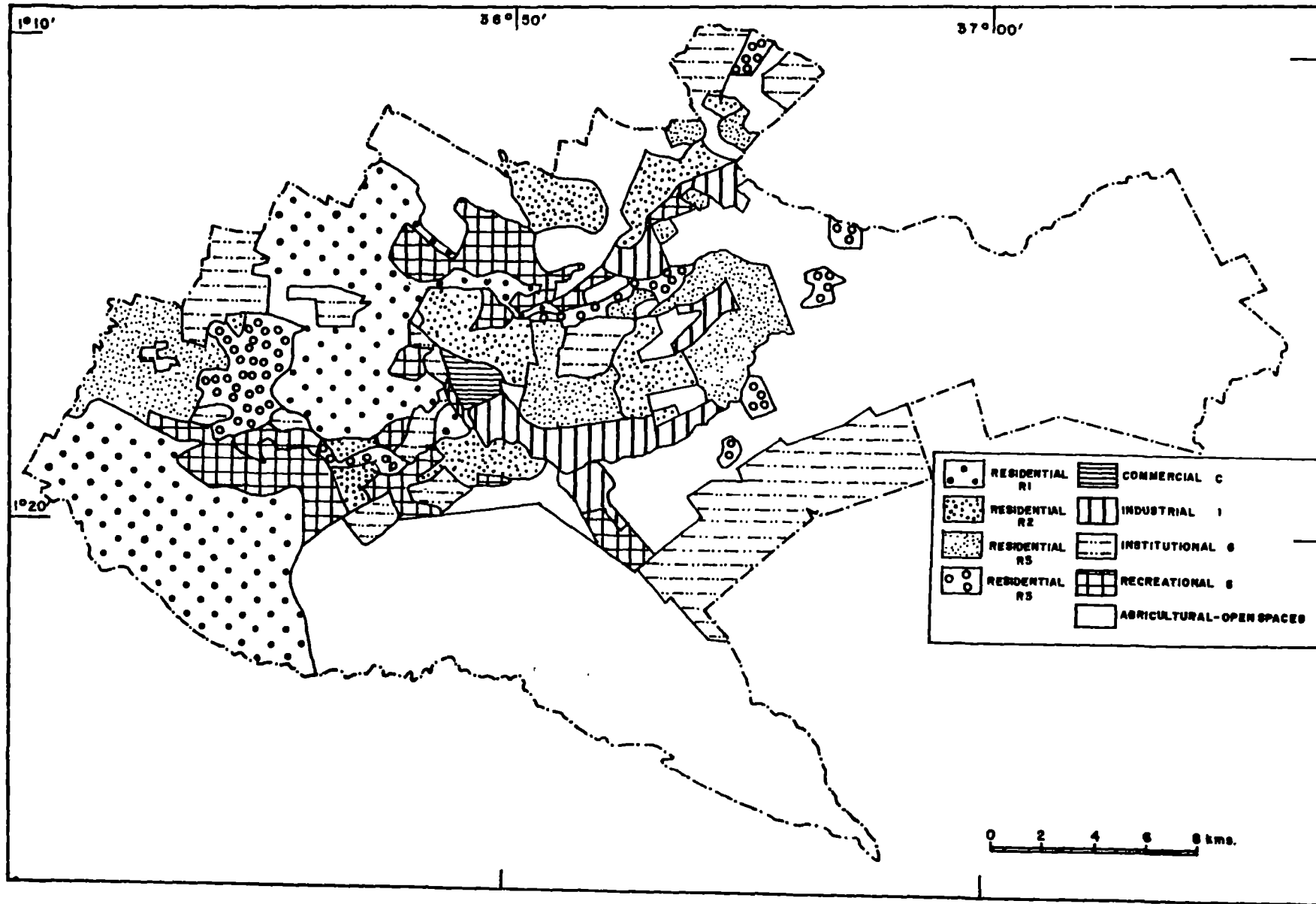


Figure 1. Current land use in Nairobi.

Table 1. Nairobi land use classification.

Category	General description	Density	Income	Typical areas
Residential:				
R1	Substantial detached houses often with medium to large gardens.	Low	High	Muthaiga, Karen, Langata and Lavington Estate
R2	Housing estate development and flats mixed with small commercial areas.	Medium	Medium	Umoja Estate, Donholm Estate, Nairobi South
R3	Flats and houses in older city areas, site and service areas mixed with small commercial and light industrial areas.	Medium/ High	Low/ Medium	Makongeni, Donholm I and II, Eastleigh
R4	Very low-income housing and unauthorized shanty areas.	High	Low	Kibera, Mathare Valley, Dagoretti
Commercial (C)	Central shopping and location of all major offices and commercial services in the public and private sector.			Central Business District (CBD), Westlands shopping Centre
Industrial (I)	Medium and heavy industry sited in designated industrial areas.			Between CBD and international airport, Ruaraka
Institutional (G)	Airport and airfields government institutions hospitals, schools, university, colleges, prisons and barracks.			Kenyatta International Airport, Eastleigh airfield
Recreational (S)	Forest reserves, sports fields, golf courses, game park.			Nairobi National Park, Ngong road Forest, City Park
Agricultural and open spaces (A)	Agricultural areas used for cattle grazing coffee, maize and horticultural crops.			East of Dandora, part of Karen/Langata North of the Karura Forest

Table 2. Summary of current land use in Nairobi.

Land use class	Area ha	Distribution %
Residential (R)	21 760	31.8
R1 High income	11 000	16.1
R2 Medium income	4 070	5.9
R3 Low income	4 500	6.6
R4 Poor settlements and shanty areas	2 190	3.2
Commercial (C)	270	0.4
Industrial (I)	2 410	3.5
Institutional (G)	7 480	10.9
Recreational (S)	15 530	22.7
Agricultural (A)	20 950	30.7
Total	68 400	100.0

Table 3. List of low-income current land use in Nairobi.

Sub district	Area classification	Area ha
Development district 2		
2.2 Eastleigh Pumwani	(R3)	300
Development district 7		
7.2 Mathare North site & service	(R3)	100
7.3 New Mathare Estate	(R4)	80
7.4 Mathare Shanty Areas	(R4)	150
Development district 8		
8.2 Makongeni Makadara	(R3)	600
Development district 10		
10.4 Kibera Shanty Area	(R4)	90
Development district 11		
11.3 Kibera Shanty Area	(R4)	110
Development district 14		
14.3 Aintree Estate	(R3)	120
Development district 15		
15.2 Dagoretti	(R3)	1660
15.3 Riruta Kangemi	(R4)	1170
Development district 16		
16.2 Baba Dogo Shanty Area	(R4)	40
Development district 17		
17.4 Kahawa Shanty Area	(R4)	150
Development district 18		
18.4 Duduvile	(R3)	50
18.5 -	(R3)	60
18.6 Kariobangi	(R3)	40
18.7 Dandora site and services	(R3)	550
18.8 Kayole site and services	(R3)	800
18.9 Soweto	(R4)	130
18.10 Korogocho	(R4)	100
18.11 Njiru Quarry Village	(R4)	140
18.12 Riverside Estate	(R4)	110
Total of all development districts		6550

2.3 Urban residential development

Consideration of the future urban development in relation to low-income is a necessary background for the projection of population and water consumption and hence sewage flows. Essential base information is obtained from the National Development plans of 1979 - 1983 and 1984 - 1988.

The Nairobi Metropolitan Growth Strategy (NMGS) 1973 in principal still provides the main planning framework for the future development of the city. However, it is worth noting that the Nairobi City Commission is of the opinion that the plan should be re-evaluated and updated in the light of the developments in the last 10 years (Capital works programme 1984 - 1988, Nairobi City Commission 1983).

Population size and growth are Kenya's most pressing problems which in turn generate an ever increasing need for food, housing, employment and social welfare services.

Improvements and increases in available water supplies will encourage further housing development. In general terms the growth of the city is expected to follow the historic lines of development in close proximity with services (e.g. roads and water supply) and centres of employment for the low to medium income groups.

Population growth will concentrate in the west (i.e. Dagoretti); the east (i.e. Dandora and beyond), and the north east (i.e. along the new dual carriage way to Thika).

2.4 Development outside city boundary

The present boundary was expanded from the Old City boundary at the time of independence in 1963. Plans to extend it again are not viewed favourably at present because of the additional burden this would impose upon the city's resources.

The policy of secondary urban centre is being pursued all around Nairobi in the River Ngong, Kikuyu, Limuru, Kiambu, Ruiru and Thika. Generally to the south and east the soils of the plains are agriculturally poor and unattractive for farming, but for urban development and industrialisation the flat lands are most acceptable. The shamba country is predominantly to the west where numerous lush fertile valleys provide attractive homesteads. To the north is the watershed of the Nyandarua Hills (Aberdares) where coffee and tea estates are predominant.

There are strong indications that the major contiguous urban development will occur outside the existing boundary in the western shambas and the Nairobi - Thika corridor (NMGS 1973). However, much of the development is unplanned and is carried out on a private individual basis as family plots/ranches are sub-divided to cope with growing population. So there will be increasing pressure on the local authorities to provide infrastructure and other services such as improved roads and water supply. There may be strong pressures to provide services to peripheral developments outside Nairobi and during this study it was noted that various reports have mentioned this possibility.

2.5 Housing policy in Kenya

2.5.1 General

Housing is the process and a product in shelter delivery system. Housing has been considered in this report basically as a highlight of the basic needs of a given community. Development of low-income housing in the unplanned areas tend to be done without regard for the basic services like water. Housing is in reality a package of services: land, public facilities, dwelling shelter, etc.

Supply of water and availability of sanitation facilities are vital services in all urban centres. The proximity to clean source of water for dwelling units is of paramount importance. In Nairobi 219 208 (89.8 %) of the units have water sources inside or within 100 m. Analysis of water proximity by income group shows high relationship. The majority of the high income group have relatively higher percentage of dwelling units with water inside compared with the other groups. Of the 477 948 housing units occupied by low-income households only 17 % have water inside. On the other hand out of 34 633 dwelling units occupied by high income households 28 647 (83 %) have water inside. It is therefore clear that provision of water in close proximity is a function of socio-economic status of the households. As a corrective measure a policy biased towards the less affluent should be encouraged through provision of more communal water points to the low-income group (Urban 1983). In Kenya the history of housing development shows significant changes in view of policy and house delivery process.

Attempts to fully satisfy housing demand in urban centres has not been successful allowing one to conclude that the national resources committed to housing by both the public and private sectors have not been enough. Financially housing is a long term investment which commands higher financial needs for it to be satisfied and like any other sector it has its constraints emanating from other economic sectors. Meeting housing demands successfully depends largely on the economic performance and policy commitment by both the public and private sectors to attain set goals in housing.

Historically Kenya's housing policy falls in two periods: the colonial period which lasted up to around 1963 and which was characterized by racial policies on housing and the post-independence period. Residential segregation was backed by legislation and the colonial politics dictated a greater financial commitment to non-African housing in the urban centres. African housing was often neglected and where provided this was only in terms of small rooms or "bed-space".

An employment ordinance required employers to provide "proper housing" for their employees or alternatively provide them with rental accommodation, but failed to specify how this requirement could be enforced. The inadequacy of this ordinance is shown by a report in 1939, which showed that while there was need to house 40 000 Africans in the city who had genuine employment the available houses could only accommodate 9 000. In 1953 another report revealed that only 35 % of Africans employed in the private sector were housed by their employers.

In response to this the Government, the Local Authority and a number of parastatals built accommodation facilities for the Africans in the eastlands resulting in Estates such as Ofafa, Shauri-moyo, Gorofani, Mbotela, etc.

The early fifties saw the looming out of the Vasey report which considered among others the low urban wages Africans earned, the rising prices of essential commodities

including rents, the accelerated rural - urban migration and the accessibility of Africans to trading rights and property ownership in the urban centres. The report urged the Government to encourage African tenant-purchase housing schemes as a way of relieving the Government from total responsibility of providing housing. The Vasey report led to the development of sites such as Pumwani for African housing.

European and Asian housing, however, was not facing the same constraints as the African housing. Finances for these seemed to be available from both Government sources the Railways administration and the private sector. The post-independence Kenya's housing policy was stated in Sessional Paper No 5 of 1966/67. Like most Government policies of the time it laid emphasis on the formal sector using capital-intensive methods to provide housing of high quality and related infrastructure.

Recognizing the financial limitations of the public sector funds were solicited from external donors while incentives were given to attract local private participation in housing delivery. These policies were later broadened in the second development plan (1970 - 1974) which stated that the government policy was to move towards a situation of decent housing for every Kenyan. This implied a greater financial commitment by the Government. The new policy for low-income housing involved the site and service programmes and the upgrading of the sub-standard settlements in the urban centres. Programme performance, however, lagged behind demand and by 1983 the shortfall was 290 000 housing units and the tendency was still on the rise.

A number of institutions were charged with the provision of housing in Kenya. These include the Housing Department, which has the responsibility to formulate review and modify policies as well as give implementation guidelines for shelter in urban developments and nationally. The National Housing Corporation has the responsibility of lending funds for housing purposes to local authorities, housing co-operatives, etc. and execute housing projects in any local authority where the implementation capability is not available as well as provide technical assistance to these authorities where possible.

The Housing Research and Development Unit of Nairobi University has the responsibility of undertaking research projects on low-cost housing, building improvement programmes, construction materials and techniques and house design plans as well as training of housing personnel. The local authorities were to identify housing and urban needs as well as prepare planning projections and implementation of programmes. The Housing Finance Institutions were charged with the responsibility to mobilize financial resources and participate in the proposed secondary mortgage market as well as assist the private developers. Lastly the National Cooperative Housing Union (NACHU) was expected to participate in shelter delivery process through the cooperative movement. These policies called for a greater cooperation and coordination of these institutions.

2.5.2 Existing by-laws and regulations

The current building by-laws and regulations were inherited from the colonial period and restrict buildings to what was then European standards of housing. In developing a new technology in housing there is an urgent need to revise these standards which so far have remained rigid in spite of them acting as constraints in provision of low-income housing. Their continued maintenance will not only result in wasted efforts by the researchers, but also mean continued squatter and slum dwelling units by middle-income groups into low-income housing.

Housing policy should in reality spell out demand rather than felt need for the administrative and management of public and private housing agencies to accept and adopt low-cost methods of housing supply.

2.5.3 Planning and implementation problems in housing projects

There is insufficient skilled personnel to carry out research and planning on housing. Planning problems include malfunction in the land allocation system which may divert land allocated for housing to other purposes. The market social differentiation in the urban society has also led to problems in providing housing with private financiers and developers tending to favour medium and high income housing at the expense of low-income housing. Lastly there is sufficient data on housing to allow planners to formulate and design policies which will cater for the target groups.

Implementation of programmes depends on clarity of goal and objectives for the various institutions involved in housing and proper coordination. Where such clarity and coordination is lacking then there are bottlenecks in implementation. Implementation is also hit by lack of enough technical managerial and administration personnel to ensure that housing programmes are implemented within the specified time.

The approved construction tendering also takes time and often the contractor who is awarded the tender has other construction engagements elsewhere leading to delays in implementation of programmes. Dishonesty in house allocation personnel has also contributed to houses meant for one target group being taken over by other untargeted groups. Even when computers have been used in allocation questions have still remained.

2.5.4 Cost implications

Housing is regarded as a social good which cannot be left to the dictates of market forces. There is a realization, however, that the public sector has inadequate resources to fully meet the demands of the sector, hence the large role played by the private sector in housing. Between 1977 and 1980 private developers accounted for 78 % of all housing units and 80 % of expenditure on housing. These, however, went to provide housing mainly for the middle and upper income classes.

There also exists the problem of increasing construction costs which are often beyond the inflation rates and these act as constraints in house delivery. In 1979 for example 70 % of the housing units completed cost KES 100 000 - 240 000. 13 % of total housing units cost over KES 240 000. Rising costs raised these and by 1980 40 % of the completed housing units cost at least KES 240 000. These costs have made it difficult to provide housing for the low-income groups who lack the afford ability element for most of the privately developed housing units.

2.5.5 Housing finance

Finance for housing in Kenya comes from three main sources: private institutional housing finance, public housing finance and infrastructural funds for housing. Private institutions differ in their choice of borrowers and investors they serve and to what amount of the total housing cost they can finance. Apart from the building societies who operate under a separate Act of Parliament the state has established institutions such

as Housing Finance Company of Kenya. These offer mortgage facilities of up to 90 % of the cost of the house with an interest ranging 15 % and 19 %, but security must be provided before loan acquisition.

Public housing caters mainly for public employees or they can be let to the general public. There are cases where housing is provided through public authorities, but can be allocated to anyone. The public sector does not only offer housing directly, but may give incentives or subsidies as an act of reducing market rents or the total cost of a house.

International sources for housing finance include semi-public agencies such as the Commonwealth Development Corporation (C.D.C), USAID, Shelter Afrique or private financial institutions which may offer financial assistance to undertake a housing project.

The rising costs and the problems in rent controls as well as poor rent collecting systems of Municipal Council housing means that local sources for housing finance will increasingly become difficult leaving much dependence on foreign financial houses, whose lending policies are dictated by exogenous factors beyond the country's economy. Their interest rates are high leading to increase in construction costs and thus increasingly making it difficult to have adequate houses for the low-income groups.

2.5.6 Towards an appropriate technology in housing delivery

The Housing Research Development Unit (HRDU) of the University of Nairobi is currently undertaking practical research on both physical structures and housing aspects of the community to improve housing delivery in the country. The aim of developing an appropriate technology is to try to reduce the building costs, yet allow use of improved housing materials. The current building technology is capital-intensive relying on standard structures and materials which conform to existing urban by-laws.

The new technology stresses use of local materials i.e. those close to a building site. Thus effective housing delivery will depend on availability of cheap and durable materials locally. Its greatest challenge is to meet housing requirements of an economically diverse society particularly low-income housing giving due consideration to the differences in the physical environment of different parts of Kenya.

To diffuse this appropriate technology institutions such as village polytechnics, technical schools, institutes of technology and schools could be used for construction of demonstration houses. Those engaged in the building industry must readily accept it.

There is need to research into locally suitable equipment for preparation of wall and roof materials at construction site. HRDUs' new technology is expected to reduce construction costs by 50 %. It intends to carry out research into cement/sand ratios, intensive use of labour in construction and building materials other than conventional ones. If successfully adopted the new technology would allow more people in both urban and rural areas to own shelters of higher standards at cheaper costs.

2.6 Water supply and sewage flow projections

2.6.1 Population projections

This section summarizes the relevant population data from the Third Nairobi Water Supply Project (1986). The 1979 census figures indicate that the urban growth in the Nairobi area was not highly polarized towards Nairobi with the satellite towns around Nairobi absorbing some of the population increase which might otherwise have moved into the capital city.

Migration is one of the most important components on urban growth. Nairobi Rift Valley and Coast provinces were the major receiving areas accounting for 67 % of all immigrants. Western, Central and Nyanza Provinces accounted for 60 % of all emigrants. Population densities increased considerably throughout the Nairobi region in the 1970's. In Nairobi itself the increase was nearly 70 % from 744 persons/km² in 1969 to 1 256 persons/km² in 1979.

The population projection prepared for Nairobi and used in this review are based on the following:

- The interpretation of historic trends with particular reference to the results of the 1979 census, which provides the latest demographic data on population trends.
- The last population projections for Kenya 1980 - 2000 by the Central Bureau of Statistics in March 1983. These projections are generally accepted as the official national figures and they provide projections by District including Nairobi for the years 1990 and 2000.

The Nairobi Metropolitan Growth Strategy projected the expansion of Nairobi to the West and to the East and North- East along the axis of the Thika Road.

The strategy plan for the year 2000 was based on a minimum population projection of 2.9 million arising from a base population of 509 000 in 1969 (census) to a projected 980 000 in 1979 and 1.4 million in 1985. However, the progress of the development has not kept pace with the proposed program. There are several important reasons for this:

- The growth in the city population has been slower than predicted.
- In some areas population densities have increased particularly in the well established areas of the old city and in shanty areas like Kibera and Mathare Valley.
- The city has lacked the financial resources and organizational capacity to implement extensive infrastructural works and to promote the development of secondary employment centres and commercial facilities in the outskirts of the city.
- In housing the public and private sectors have not been able to keep pace with the demand which in turn has led to the increasing size of the shanty areas.

2.6.2 Population growth 1969, 1979 and 1985

Census figures indicate that the highest population growth rates have taken place in census wards outside the old city area such as Dagoretti, Roysambu, Kibera, Dandora and Mathare. These are all areas with a high proportion of low-income high density developments (Table 4).

The total population within the current city boundary was 800 000 (9 %) below the NMGS (1973) projection for 1979 and 140 000 (11 %) below for 1985. However, the population increases in the old city and Ruaraka were close to the target populations in 1979 and 1985 while the Eastern extension was below target in 1979, but appears to have picked up considerably in the early 1980s. Dagoretti and Spring Valley were 40 - 50 % below the expected population in 1979.

The four major conclusions are:

- Population growth falls below the trend projected by NMGS (1973).
- Population densities have continued to increase in some parts of the old city.
- Some of the peripheral areas of the city have not grown as rapidly as expected due in to the lack of investment resources to develop infrastructure and services in the outlying areas.
- There has been considerable growth of unauthorized and unplanned shanty areas in various parts of the city.

Table 4. Population projections in Nairobi (Central Bureau of Statistics, Census 1969 and Census 1979, and Nairobi Metropolitan Growth Strategy 1973).

Year	Actual population (10 ³)		Projected population (10 ³)				
	1969	1979	1980	1985	1995	2000	2010
Low	509	828 ^a 859 ^b	897	1145	1800	2270	3360
Medium	509	828 ^a 859 ^b	897	1162	1950	2490	3860
High	509	828 ^a 859 ^b	897	1200	2150	2810	4580
Growth rates (%/a)							
Low	5.3		5.0	5.0	4.5	4.0	
Medium	5.3		5.3	5.3	5.0	4.5	
High	5.3		6.0	6.0	5.5	5.0	

^a = Census, ^b = Adjusted

2.6.3 Residential population by development district

Populations for each development district for 1969, 1979 and 1985 (estimated) are presented in Table 5 together with their residential category and densities. These figures relate to the current land use map shown in Figure 1. The population distribution by residential category is based on the growth rates 1969-1979, known developments in the districts and estimates prepared by the City Planning Department. The figures for 1985 show 139 000 people (12 %) in type R2 residential areas, 460 000 (40 %) in type R3 and 274 000 (23 %) in type R4 areas. Thus approximately 63 % of the population are living in the low-income housing areas type R3 and R4. Table 6 presents the population distribution in Nairobi by residential category.

Table 5. Population and densities by development district (medium projection) in Nairobi.

Devel. district	Area (Hectares)		Population (10 ³)							Density (persons/ha) 1985			
	Total	Resid. Gross	1969	1979 ^a	Resid. category				Total	Resid. category			
					R1	R2	R3	R4	Total	R1	R2	R3	R4
1	810	250	47	50	21	-	31	-	52	84	-	180 ^o	-
2	730	730	99	114	-	62	63	-	125	-	144	210	-
3	620	550	27	39	-	45	-	-	45	-	82	-	-
4	1700	1700	27	46	55	-	-	-	55	32	-	-	-
5	1750	1450	9	20	25	-	-	-	25	17	-	-	-
6	450	350	4	10	12	-	-	-	12	35	-	-	-
7	550	370	25	84	-	15	40	60	105	-	125	222	40
8	950	890	121	148	-	15	154	-	169	-	52	257	-
9	1080	-	10	10	-	-	10	-	10	-	-	-	-
10	4130	740	24	72	-	55	-	35	90	-	85	-	389
11	420	420	12	38	-	28	-	35	63	-	90	-	318
12	6000	6000	11	14	16	-	-	-	16	3	-	-	-
13	2690	1260	5	6	10	-	-	-	10	8	-	-	-
14	2650	1170	8	20	-	30	20	-	50	-	29	167	-
15	4100	2890	46	89	-	18	80	45	133	-	133	48	38
16	400	110	6	10	-	10	-	13	23	-	143	-	325
17	1560	540	8	12	-	16	17	7	30	-	24	121	47
18	10800	2350	20	77	-	25	85	39	149	-	68	57	81
19	7820	-	-	-	-	-	-	-	-	-	-	-	-
Total	49210	21760	509	859	139	289	500	234	1162	13	71	111	10

Notes:

^a = total excludes public areas

^b = adjusted figures to account for under-enumeration in 1979 census

^o = estimate for those living in the Central Business District.

2.6.4 Water demand projections

Within the 1985 water service areas there were areas where:

- there was a restricted supply due to problems with the distribution system
- water supply was limited by the low number of service connections.

The Third Nairobi Water Supply Project is aimed at providing solutions to current water supply problems and deficiencies and will extend the service area to supply adequate water to the whole Nairobi according to the class of development and the associated level of water usage envisaged.

Project estimates indicate that currently about 89 % of the city's population are served through direct house connections, communal watering points and kiosks in the shanty areas. The survey of urban housing carried out by the CBS in September - November 1989 census should provide a more accurate indication when the results are available.

Estimated levels of water usage are given for each residential classification. These estimates were determined by the water distribution study team - Third Nairobi Water Supply Project (1986).

- Residential category R1 contains substantial detached houses and modern houses with medium to large gardens. Houses in this category would have internal plumbing with high water consumption for normal domestic purposes plus additional amounts of water for luxury purposes such as garden watering and car washing. 12 % of the population were classified under category R1 in 1985. The analysis of the billing records for 1984 indicates a consumption of 191 - 212 l/person/d.
- Residential Category R2 applies to housing estates and flats whose occupants are in the middle income bracket. These households have full internal plumbing and use water for car washing, but generally little is used for garden watering. About 25 % of the population are classified as living in R2 accommodation. The billing records for representative meter sections in 1984 indicate a consumption of 93 - 100 l/person/d.
- Residential Category R3 applies to the majority of the population in the low-income category and who live in small houses and flats in the older parts of the city and the new site and service areas such as those being developed in the eastern extensions. This type of accommodation is generally only partially plumbed, often with only a yard tap and one or two internal taps. Some are served by communal water points as in the Shauri Moyo Estate. The houses in this category do not necessarily have flushing toilets. Estimates prepared indicate that approximately 43 % of the population fall within the R3 category with an average water consumption of 44 - 51 l/person/d
- Residential Category R4 represents very low-income housing and the unauthorized shanty areas like Kibera and Mathare Valley. In these areas people are almost entirely dependent on licensed kiosks or wells for their daily water supplies. The kiosks sell water at rates that are 4 - 6 times greater than the normal tariffs levied by the Water and Sewerage Department. Therefore in relation to the low-income levels in such areas the high cost of water and the low level of service results in low levels of per capita consumption.

In the late 1970's and early 1980's the population in shanty and very low-income housing areas increased significantly. It is estimated that 20 % of the current population live in areas classified as R4. Examination of the billing records for the water kiosks serving the Kibera and Mathare Valley shanty areas suggests that the water consumption is of the order of only 10 - 14 l/person/d.

The population served by mains water supply appears in Table 6 in five-yearly steps for each residential category up to the year 2010. Table 7 presents the projected per capita water consumption for the same five-yearly steps and by relating these consumptions to the projected populations served by the mains supply gives the total water consumptions for each residential category. The average per capita domestic water consumption rates are summarised in Table 8.

Table 6. Projected population served by the mains supply (medium projection) in Nairobi.

Year	Population (10 ³)				Population		Percentage of total population served
	Residential category				Served Total		
	R1	R2	R3	R4	Served	Total	
1984	105	275	400	203	983	1104	89
1985	113	289	420	213	1035	1162	89
1990	163	342	613	267	1385	1505	92
1995	214	455	844	340	1853	1950	95
2000	261	573	1157	374	2365	2490	95
2005	310	702	1527	406	2945	3100	95
2010	365	856	2008	438	3667	3860	95

The higher percentages of rate of growth indicated for 1985 - 1995 reflect the NCC proposals to improve the availability of potable water to the population in general. In particular the rise in the per capita consumption in the residential category R4 takes into account the need to increase water consumption to reduce the dangers to public health presented by inadequate water supplies and to reduce water kiosk selling prices to encourage greater water consumption.

Table 7. Projection of water consumption from the mains supply (medium projection) in Nairobi (Third Nairobi Water Supply Project 1986).

Year	Residential category								Avg l/h/d	Total m ³ /d
	R1		R2		R3		R4			
	l/h/d	m ³ /d (10 ³)	l/h/d	m ³ /d (10 ³)	l/h/d	m ³ /d (10 ³)	l/h/d	m ³ /d (10 ³)		
1984	200	21.0	100	27.5	50	20.0	12	2.4	72	70.9
1985	210	23.7	115	33.2	50	21.0	15	3.2	79	81.1
1990	220	35.9	120	41.0	55	36.8	20	5.3	86	119.0
1995	230	49.2	130	59.2	60	50.6	25	8.5	90	167.5
2000	235	61.3	135	77.4	65	75.2	30	11.2	95	225.1
2005	240	74.4	140	98.3	70	106.9	30	12.2	99	291.8
2010	245	89.4	145	124.2	75	150.6	30	13.1	103	377.3

Table 8. Per capita average domestic water consumption.

Year	Water consumption (l/h/d)			
	Residential classification			
	R1	R2	R3	R4
1985	210	115	50	15
1995	230	130	60	25
2010	245	145	75	30

The average annual percentage rates of growth in per capita water consumption shown by the above figures are indicated in Table 9.

Table 9. Average annual growth in per capita water consumption.

Residential category	1985 - 1995 %	1995 - 2010 %
R1	0.9	0.4
R2	1.3	0.8
R3	2.0	1.7
R4	6.6	1.3
Total	1.2	1.0

2.6.5 Sewage flow projections

Sewage flows are calculated on the assumption that sewered areas have 100 % connections to properties. A degree of selection has been employed to exclude those areas where it is considered that provision of a sewerage network would be wholly inappropriate or the cost benefit ratio is unduly high. As can be seen from the land use plans the development areas themselves are divided into sub-areas by residential classification (see Table 3).

To obtain domestic wastewater flows for each sewerage catchment area the residential areas have to be related directly to current and future land use plans. To obtain domestic wastewater flows for each sewerage catchment area the residential areas shown on the current and future land use maps (Figure 1 and 2) will have to be related directly to the sewerage catchment areas. Further work will be to determine:

- sewerage catchment populations for each design year
- the projected water consumptions for each sewerage catchment area for each residential sub-catchment area contributing to the sewer system. These consumptions will be calculated using the projected per capita medium water consumption figures given in Table 10 and multiplying them by the populations from the areas deemed to be sewered.
- the domestic wastewater flows from each catchment area. These flows will be obtained by applying the percentages of water consumed that is discharged as waste. The percentages are 90 and 60 for R3 and R4 residential classifications respectively.

Table 10. Per capita average water consumption in 2010.

Use	Per capita consumption (l/h/d)			
	Residential classification			
	R1	R2	R3	R4
Kitchen	25	20	15	9 ^{*)}
Lavatory	50	40	20	7 ^{*)}
Bathing	75	35	18	7 ^{*)}
Laundering	45	28	15	7 ^{*)}
Garden watering	35 ^{*)}	7 ^{*)}	2 ^{*)}	-
Other **	15 ^{*)}	15 ^{*)}	5 ^{*)}	-
TOTALS	245	145	75	30
Percentage of total discharged to sewers	80	85	90	60

* = used water discharge to sewers

■ = wastewater discharged to sewer via communal washing/latrine block = 85 %

** = water used in car washing, plumbing, losses, drinking, etc.

° = sullage discharge to ground or ditch.

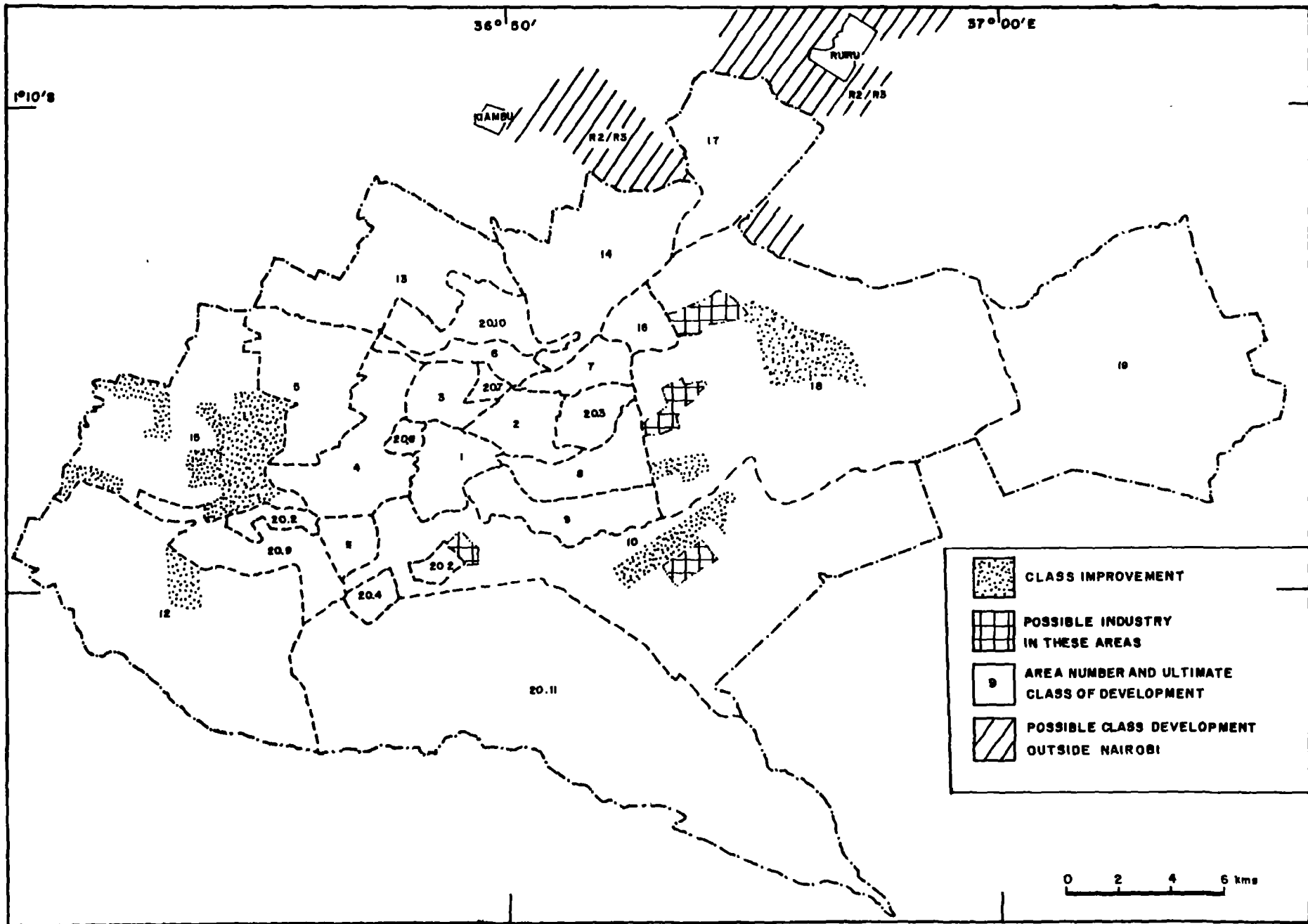


Figure 2. Nairobi future land use by development district.

3 SOCIO-ECONOMIC CHARACTERISTICS OF THE LOW-INCOME AREAS

3.1 Introduction

According to UNCHS-HABITAT survey of slums and squatter settlements it is difficult to have a simple system of classification of low-income residential areas in Third World cities (UNCHS-HABITAT 1988). Sometimes it also becomes difficult to distinguish between slum and squatter settlements. Squatter settlements are defined as illegal occupation of land. However, not only is legality difficult to define but there are many unplanned settlements which have a mix of legal and illegal characteristics. In addition there are many unplanned settlements lacking services and amenities which are occupied by people recognized in one way or another by the authorities (UNCHS-HABITAT 1982).

Slums are usually run-down housing in older established legally built parts of the city proper. Buildings are mostly old and poorly maintained, and the residents rent their accommodation although owners occupy some of the dwelling units. Densities are generally high because settlements have reached the limits of their growth (Ondiege and Syagga 1990).

Squatter settlements are mainly uncontrolled low-income residential areas with an ambiguous legal status regarding land occupation; they are to a large extent built by the inhabitants themselves using their own means and are usually poorly equipped with public utilities and community services. Their usual image is of a poor underserved overcrowded and dilapidated settlement consisting of make-shift improvised housing area. Their location is often but not always further away from the city centre than in the case of slums. Often but not always the houses are built and occupied by their owners. The land is often occupied illegally while in many other cases the legality of occupation is complicated or unclear.

With age some squatter settlements take on the characteristics of slum areas. The original buildings are poorly maintained while the number of tenants increases as many of the owners move out and extend their buildings for rental purposes. Dwellings built by entrepreneurs for rental purposes may be regarded as a slum providing cheap rental accommodation for the rural migrants (UNCHS-HABITAT 1988).

In Nairobi it is not easy to distinguish between slums and squatter settlements as some of the residential areas exhibit similar characteristics of both the slum and squatter settlements. Low-income residential areas have therefore been identified and classified as follows (Ondiege and Syagga 1990):

- i) **slum/squatter settlements on public lands** - these include Kibera, Korogocho and Mukuru where rents are affordable on account of the poor conditions of the settlements
- ii) **slums/unplanned settlements on private land** i.e. Dagoretti, Kangemi and Kawagware with generally higher rents than in both (i) and (iii) but lower than in (iv)
- iii) **low-income public rental housing** - this includes Shauri Moyo and Jerusalem with the former having some of the characteristics of a slum in terms of the dwelling structure

- iv) **site and service schemes** which include Mathare North, Kayole and Umoja II. Mathare North was formerly a squatter settlement and is being redeveloped into low and middle-income housing. It has in many respects the characteristics of Kayole. It shares the full cost recovery principles with both Kayole and Umoja II and have ended up being unaffordable by the poor. Single rooms in Mathare North and Umoja II let for more than KES 500/month.

The first two types of settlements and Shauri Moyo have much of the characteristics that UNHCS survey observed in their study on the Third World slum and squatter settlements survey and cater for mainly the urban poor and the low-income families.

3.2 Household composition

According to the Urban Housing Survey of 1983 Nairobi average household size in 1983 and the estimates up to the year 2000 is 3.45. Holin's (1987) survey of rent in six low-income neighbourhoods in Nairobi shows that these neighbourhoods have a substantial number of relatively small households of one or three persons. In Ondiege and Syagga's (1990) survey of low and middle-income neighbourhoods the average household size was 3.59 persons with ranges of 2 to 4 persons per household (Table 11).

Table 11. Household composition and mean monthly income by estate (Ondiege and Syagga 1990).

Zone	Mean income of household members						H/H head income		% H/H heads	
	Mean house-hold size	H/H head	Husband	Wife	Child	Other	male	female	male	female
Umoja II	3.57	2469	2645	1819	353	1775	2424	2680	82.3	17.7
Mathare North	4.0	1967	1879	701	90	1523	1986	1783	90.0	9.1
Kayole	3.34	1946	1986	1250	153	281	2041	1330	86.6	13.4
Shauri Moyo	3.56	1551	1852	1060	1132	1158	1591	1411	77.6	23.4
Jerusalem	4.51	2146	2670	1403	572	1173	2073	2496	82.7	17.3
Kawagware	3.21	1646	1882	1349	1298	555	1619	1749	79.2	20.8
Kibera	3.37	1467	1463	767	205	989	1521	1165	84.0	15.0
Mukuru	3.89	1357	1180	901	23	739	1351	1616	86.3	13.7
Korogocho	4.55	1213	1588	606	490	836	1332	832	76.2	23.8
Kangemi	2.55	2060	2180	1672	300	2213	2094	1872	85.7	15.3
Dagoretti	3.97	1547	2444	1214	495	553	1531	1591	74.4	25.6
Average means	3.59	1711	1889	1611	409	1095	1732	1627	82.3	17.7

Most of these households are headed by males accounting for 82 % in all the low-income areas. The female headed households account for 18 %. However, in Shauri Moyo, Kawagware, Korogocho and Dagoretti females account for 21 % - 26 % while the rest of the neighbourhoods are below the average 18 %. Of all the members of the households surveyed 50 % were single and 47 % married; less than 3 % were either divorced/separated or widowed (Table 12). Most of the members of the households surveyed were male who accounted for 59 % and the remaining 41 % percent were

females. However, in Kayole, Jerusalem and Kangemi areas the male and female members of the households were almost 50 - 50 % (Table 13).

Table 12. Marital status of household members (Cndiege and Syagga 1990).

Area	Single %	Married %	Sepa- rated %	Di- vorced %	Wid- owed %	No. of resp.
Umoja II	58.54	40.95	0.25	-	0.25	398
Mathare North	56.54	40.95	0.28	1.39	0.28	361
Kayole	40.77	56.15	1.92	-	1.15	260
Shauri Moyo	56.37	40.11	1.63	1.08	0.81	369
Jerusalem	55.68	41.43	0.89	0.89	1.11	449
Kawagware	49.09	43.45	2.55	2.36	2.55	550
Kibera	42.51	55.46	0.38	0.89	0.76	788
Mukuru	55.09	44.65	-	-	0.26	383
Korogocho	62.14	36.17	0.24	0.97	0.49	412
Kangemi	26.85	72.22	-	-	0.93	216
Dagoretti	53.09	43.04	0.77	0.52	2.58	388

Table 13. Sex of household members (Ondiege and Syagga 1990).

Area/Estate	Male %	Female %	No. of respondents
Umoja II	60.52	39.48	499
Mathare North	54.25	45.75	365
Kayole	49.19	50.81	307
Shauri Moyo	67.58	32.42	472
Jerusalem	50.27	49.73	547
Kawagware	60.79	39.21	783
Kibera	63.68	36.32	1261
Mukuru	56.58	43.42	433
Korogocho	61.06	38.94	529
Kangemi	50.27	49.73	372
Dagoretti	57.79	42.31	520

Table 14 shows that the site and service schemes have relatively young heads of households whose ages are 20 - 29 years accounting for 73 %. Only 4 % of household heads in these areas are over 40 years. This could be explained by the fact that the estates of the site and service schemes studied here are new and that most of these heads could be tenants that are young and employed in formal jobs.

In public low-income rental housing of Shauri Moyo and Jerusalem about 37 % of household heads are aged below 30 years, 33 % of them are 30 - 39 years while about 18 % are over 40 years old. These estates are old and their occupants might have been staying here for a number of years hence a relatively significant proportion of older persons.

50 - 56 % of the residents of slums and squatter/unplanned settlements on both public and private land are aged below 30 years. This could be a reflection of a high number of them being tenants who might be migrants to the city and are lowly paid wage earners. These are estates that provide them with cheap and affordable housing. They, however, could earn higher income later through promotions upward mobility.

Table 14. Household heads age distribution (Ondiege and Syagga 1990).

Area/ Estate	Age (years)									No. of resp.
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	
Site & service scheme	4.44	31.11	42.22	13.33	4.44	4.44	-	-	-	45
Public low- income rent	7.41	11.11	18.52	14.81	22.22	7.41	14.81	3.7	-	27
Kawagware squatter upgrading	3.57	28.57	21.43	10.71	17.86	-	10.71	7.14	-	28
Public land slum/squatter settlements	-	19.3	36.84	24.56	7.02	1.75	8.77	1.75	-	57
Private settle- ment on private land	50 3.39	20 22.6	30 32.2	15 16.95	15 11.3	- 2.82	5 7.34	5 2.82	5 0.56	20 177

3.3 Incomes

The distribution of household incomes are shown in Table 15. The average monthly income for all the household heads in all the areas surveyed is KES 1 711. The highest household head average monthly incomes is KES 2 469 which is in Umoja II, while the lowest is KES 1 213 which is the slum/squatter settlement of Korogocho. This shows that most of the urban poor are to be found in slums and squatter settlements. The male household heads have on the average higher monthly incomes than female headed households i.e. KES 1 732 and 1 627 respectively. This suggests that female family heads are disadvantaged when compared with male heads. This would be attributed to the type of jobs and also their education levels. Table 15 also shows that husbands have relatively higher income than wives among the family members, on the averages

of KES 1 889 and 1 161 respectively. The children earn the lowest incomes, on the average of KES 409 among the family members. This could suggest children labour exploitation as they may be forced to supplement family incomes.

Taking the households heads income it is observed that on the average household heads surveyed and their individual family members are in the category of low-income earners i.e. having monthly incomes of less than KES 3 000. However, the picture might be different when total household incomes are taken. The distribution takes a different picture when analysed from the point of view of male and female household heads and residential areas. For instance out of the 11 residential areas surveyed only four areas i.e. Umoja II, Kayole, Jerusalem and Kangemi have male household head average monthly income falling in the upper low-income group (KES 2 001 - 3 000) and the rest fall in middle low-income group (KES 1 000 - 2000). Out of these four areas only Kangemi is unplanned settlement area, the others are planned. This supports the hypothesis that most of the poor and low-income urban residents tend to live in slums and squatter and unplanned settlements.

However, the female household heads income indicates that only in Umoja II and in Jerusalem they belong to the average upper low- income group. The rest again except Korogocho fall in the middle income group. The Korogocho female household heads, who are on the average poorest of the lot, are in the very low-income group (less than KES 1 000/month). Korogocho being slum/squatter settlement on urban public fringe land supports the fact that women family heads are the poorest and that the poorest will be found in the slums/squatter settlements usually on the urban fringe.

The poorest children income earners are to be found in Mukuru, Kibera and Mathare North. This again confirms that children and the women especially in slum/squatter areas form the majority of the urban poor and therefore require special attention by the authorities if their living standards let alone survival has to be ensured.

3.4 Employment

The main source of income of persons surveyed in these areas is permanent employment followed by business/trading and wages from casual employment which respectively accounted for 23.7 %, 16.07 % and 9.66 % (Table 15). However, 34.88 % of the numbers of the household surveyed had no source of income.

In the site and service residential areas of Umoja II and Mathare North the majority of the family members were in formal/permanent employment which respectively accounted for 34.83 % and 24.85 % which are above the total survey mean of 23.7 %. The same applies to Jerusalem and Kangemi which had permanent employment respectively accounting for 42.01 % and 41.02 %. In these four residential areas permanent employment is more than double of business/ trading as the main source of income except for Kangemi area which is less than double. This implies that planned settlements will tend to have most of the residents in the formal permanent employment while slum and squatter settlements will either be operating business/trading or be in casual wage employment as indicated by significant percentage of these in Kawagware, Kibera, Mukuru, Korogocho, Kangemi and Dagoretti. Shauri Moyo which depicts the characteristics of a slum has also a significant percentage of its residents in business/trading and casual wage employment.

Farming as a source of income is not significant as it is only Dagoretti that has about 11 % of the residents depending mainly on farm income. Apart from Kayole and

Kangemi which together with Dagoretti are in the suburbs of Nairobi city the rest have less than 0.7 % of the residents depending on farming as the major source of income.

The main occupation of the household members are shown in Table 16 and they have similar trends with the main source of income discussed above. The above observations indicate that most of the urban poor and low-income area residents depend on formal employment business/trading and casual wage employment. Since it has been observed that the majority of these residents have lower incomes than those engaged in business/trading are likely to be in the informal sector and small scale business and those in permanent employment are in the lower cadres of their profession or employment. This could be explained by the family background in terms of educational levels which is discussed below.

Table 15. Main source of income of household members (Ondiege and Syagga 1990).

Area	Farming %	Business/ training %	Wages casual employment %	Permanent employment %	Nothing %	N/A	No. of resp.
Umoja II	0.28	8.43	1.97	34.83	23.88	30.62	356
Mathare North	-	6.97	5.76	24.84	24.24	38.18	330
Kayole	2.01	16.07	8.84	25.7	36.14	11.24	249
Shauri Moyo	1.49	17.56	11.9	18.15	48.81	2.08	336
Jerusalem	0.31	10.66	2.82	42.01	43.89	0.31	319
Kawagware	2.25	21.88	11.04	14.93	49.9	-	489
Kibera	0.3	20.38	12.7	24.22	41.95	0.44	677
Mukuru	0.6	10.24	17.17	19.28	12.95	39.96	332
Korogocho	-	22.01	8.88	15.06	54.05	-	259
Kangemi	2.05	22.13	11.79	41.03	18.98	1.03	195
Dagoretti	10.88	15.59	10.29	10.29	13.12	39.12	340

Table 16. Main occupation of household members (Ondiege and Syagga 1990).

Area/Estate	Farm- ing %	Business/ Trading %	Wages Employ- ment %	Permanent Employ- ment %	Noth- ing %	N/A %	No. of resp.
Umoja II	0.84	29.50	1.88	26.15	20.29	21.34	478
Mathare North	0.29	6.73	5.56	24.56	27.49	35.38	342
Kayole	1.50	15.41	9.77	24.81	37.22	11.28	266
Shauri Moyo	5.23	29.85	9.15	13.94	40.31	1.53	459
Jerusalem	0.31	12.85	3.13	43.57	37.93	2.19	319
Kawagware	14.86	17.12	18.62	11.41	37.99	-	666
Kibera	12.63	15.68	21.69	17.01	32.69	0.31	982
Mukuru	1.13	10.99	17.46	18.31	14.65	37.46	355
Korogocho	8.29	18.65	19.43	11.14	42.49	-	386
Kangemi	2.31	19.19	10.65	38.89	27.31	0.93	216
Dagoretti	18.42	14.56	18.70	7.92	12.85	28.05	467
	7.78	17.69	13.94	19.25	30.49	10.86	4936

3.5 Education

Formal education levels will in principle hold out the promise of equality of opportunity and finally the increased social equality. Table 17 shows the levels of formal education of household members. About 43 % of all household members have had primary education while 32.5 % have secondary education. However, only 3.8 % have post-secondary school education while 15.5 % have no formal education. The latter could also be attributed to those children below school going age.

Kangemi, Jerusalem and Umoja II have significant percentages of their residents with secondary education i.e. 40 % - 47 % and 7 % - 14 % with post-secondary education. Kawagware, Kibera, Mukuru, Korogocho and Dagoretti have only 23 % - 30 % of the residents with secondary education and (with the exception of Dagoretti) less than 2 % of the members have secondary school education. This again demonstrates the difference between planned and unplanned urban settlement residents' socio-economic status in form of education. The slum/unplanned settlements are observed to have fewer residents who have access to post-primary education which may affect their offsprings' accessibility to educational facilities. Formal education accessibility may have greater impact on parents' income and employment opportunities and consequently on their children's future socio-economic status.

The observed lower levels of education of the residents in the slum/squatter settlements explains the lower average income levels noted in the preceding sub-sections. Because of the lower education levels of the residents in unplanned settlements residents have less access to permanent employment and their incomes are on the average relatively low. This will affect their living standards and their children's access to formal education and employment now and in the future. The authorities have therefore to address this issue if these families' welfare and employment opportunities are to be increased in order to promote equal opportunities for all the urban residents.

Table 17. Level of education of household members (Ondiege and Syagga 1990).

Area/Estate	No Ed. %	Lower P. %	Upper P. %	Second. %	Above sec. %	N/A %	No.of Resp.
Umoja II	14.82	8.89	14.82	39.62	14.02	7.82	371
Mathare North	7.28	11.20	25.49	31.93	1.96	22.13	357
Kayole	14.65	10.20	29.41	38.83	2.93	3.30	273
Shauri Moyo	20.06	15.88	32.87	30.08	1.11	-	359
Jerusalem	8.40	8.96	26.33	47.06	7.56	1.68	357
Kawagware	20.98	18.74	35.44	23.42	1.43	-	491
Kibera	18.98	13.50	35.92	30.22	1.27	-	785
Mukuru	12.05	10.14	27.40	27.12	-	23.29	365
Korogocho	26.42	2.26	35.53	24.21	1.57	-	318
Kangemi	7.47	8.71	26.56	45.23	12.03	-	241
Dagoretti	11.68	19.57	26.90	29.89	4.08	7.88	368

3.6 Housing

Housing has substantial social benefits including the welfare effects of shelter the elements of sanitation facilities and access to health and education services. Improved

health education and better access to income-earning opportunities can lead to higher productivity and earnings for the urban poor and low-income families. It is thus for sound reasons that after food housing is typically the largest item in household expenditure among poor families and that they are willing to go far away to obtain employment even if it means incurring the risk of illegal squatting.

Various studies on housing development have noted that urban housing development problems in Kenya are mainly due to high urban population growth rates resulting mainly from rural-to-urban migration, a lag in the development of urban infrastructure that supports housing development, a low purchasing power of the majority of the urban households and the lack of appropriate building standards and by-laws especially for low-income housing. In addition to these city size and public policy influence housing development.

Population growth rates will determine the rate of household formation which in turn will affect the demand for housing. These growth rates will also determine the city size thus leading to jurisdictional boundary expansions. The city size will affect accessibility to employment commercial and social centres. The rate of urban growth intensifies problems created by the city size while per capita income and its distribution together with the housing price/rent will determine the amount of housing that the household can afford.

Housing has tended to be built without regard for the services its dwellers need when it is viewed from the narrow sense of shelter as has been the case of unplanned settlements. Yet housing is in reality a package of services: land, public facilities, access to employment and other social services as well as the dwelling structure itself. Effective responses to housing problems must consider the affordability and employment needs combined with realistic standards of construction.

There are a number of agents involved in housing provision, including not only shelter construction but also subdivision, the provision of on-and-off site services and tenure security. Suppliers include individual private developers owners squatter and other service providers as well as Government public utilities and housing agencies.

Low-income housing especially in unplanned settlements and in the site and service schemes are generally constructed by landlords, where tenements are concerned and by owner-occupiers or squatters who normally improve their dwellings in stages. Renters rarely make significant improvements to their housing and public housing agencies have also rarely contributed to large-scale low-income housing especially in this decade in Nairobi.

In the following sub-sections present empirical results of housing consumption expenditure and supply by the urban poor and low-income families in Nairobi based on surveys of selected slums/squatter and unplanned settlements as well as planned low-income housing.

3.6.1 Tenancy

The 1983 Urban Housing Survey in Kenya showed that in Nairobi 66 % of the households are renters while 29 % are owner-occupiers. This implies that most of the Kenya urban dwellers do not own housing they live in. Ondiege and Syagga (1990) have shown that out of 1 440 household surveyed only 15.83 % claim to be owners of their dwelling units while 84.2 % are tenants (Table 18).

In the site and service schemes of low-income housing Umoja II, Mathare North and Kayole had respectively 23.1 %, 7.6 % and 27.2 % as owner-occupiers; the rest are tenants. Except for Mathare North these were above the average of 15.8 % as owner occupiers observed in the survey.

Table 18. Tenure in low-income housing (Ondiege and Syagga 1990).

Area/estate	Yes Owner	No Tenant	No. of respondents
Umoja II	23.15	76.85	108
Mathare North	7.61	92.39	92
Kayole	27.17	72.83	92
Shauri Moyo*	-	95.28	106
Jerusalem	-	94.87	117
Kawagware	12.82	87.18	195
Kibera	5.41	94.59	296
Mukuru	13.64	86.36	110
Korogocho	17.24	82.76	87
Kangemi	18.18	81.82	132
Dagoretti	61.90	38.10	105

* These are owned by Nairobi City Commission and those claiming to be owners may have misunderstood the question and should therefore be ignored.

In the slum/squatter settlements on public land Kibera, Mukuru and Korogocho there were respectively 5.4 %, 13.6 % and 17.2 % owner-occupiers. In Kawagware and Kangemi settlements there were respectively 12.8 % and 18.2 % owner-occupiers. It is only in Dagoretti area where the percentage of owner-occupiers was quite significant accounting for 62 %. It is observed that a small proportion of low-income families and the urban poor do not own the dwelling units in which they occupy but are mainly tenants. One way of improving owner-occupancy would be to allocate plots in the squatter settlements on public land to tenants when settlement upgradings are made. This will in a way promote sharing of urban wealth in the form of real estates which in turn will improve income redistribution in the urban areas.

3.6.2 Owner-occupier

Most of the owner-occupiers either constructed or purchased their housing structures accounting for 18 % and 51 % respectively. The remaining 31 % claim to have inherited their housing units (Table 19). The higher number of respondents indicating construction of own housing implies that the low-income families are willing to improve their housing situation and should be encouraged to do so by regularizing land tenure systems especially in the unplanned settlement areas. This could also imply that they are motivated to construct housing for renting to earn income. This is supported by the fact that about 93 % percent of the respondents are subletting their dwelling units most probably to augment their income given that their monthly incomes formal and informal sources could be relatively low.

To purchase or construct their housing units about 62 % of the respondents used their own saving to make down payments and 24 % got loans from cooperatives. Only 10 % received loans from commercial banks. The average deposit paid was KES 4 502 and ranged from KES 142 in Kibera to KES 18 500 in Kangemi. The average monthly repayment for the loan was KES 486 with the highest being in Umoja and the lowest in Kibera.

The higher percentage of these residents using own savings to make down payments for housing acquisition indicates that they do not have access to formal credit institutions. This acts as a constraint for the urban poor and low-income families to acquire urban real estate and hence they have no access to urban wealth. This is likely to hamper promotion of income redistribution in the urban areas. The women whose savings are likely to be lower would be the hardest hit. Assuming that owner occupiers spend 25 % of their incomes on housing the very low-income group families with monthly incomes less than KES1 000 who include the urban poor account for about 22 % of Nairobi wage employees would not afford the mortgage payments in any of these residential estates. They would therefore resort to renting. It is clear from the survey that the urban poor cannot own housing at the market rates.

Table 19. Mode of housing ownership (Ondiege and Syagga 1990).

Area/Estate	Purchased %	Constructed %	Inherited %	No. of respondents
Umoja II	86.96		13.04	23
Mathare North		83.33	16.67	6
Kayole	17.86	46.43	35.71	28
Shauri Moyo Jerusalem				
Kawagware	6.90	24.14	68.97	29
Kibera		61.11	38.89	18
Mukuru	11.11	66.67	22.22	9
Korogocho	11.76	70.59	17.65	
Kangemi	10.34	41.38	48.28	29
Total	18.22	50.85	30.93	236

3.6.3 Tenants

It has been observed that the majority (84.2 %) of the residents in surveyed areas are tenants. This percentage is high even in the residential areas originally designed for owner-occupancy, like Umoja II, Mathare North and Kayole. This indicates that the allottees are letting their houses to generate incomes. Housing is therefore taken to be an investment good apart from being a consumption good by these allottees.

The average monthly rent in all the areas surveyed is KES 375 which is expensive for the urban poor assuming that they spend 25 % of their income on housing (KES 250).

However, the urban poor would afford rents mainly in the squatter settlements of Kibera Mukuru and Korogocho whose mean monthly rents are KES 266, KES 235 and KES 234. They would also afford rents in Kawagware (KES 212) and Shauri Moyo (KES 211). These are the areas where most of the urban poor live as discussed earlier. However, it happens that even council rental estates are being sublet at rents higher than the council receives, like in Shauri Moyo.

Expenditure on housing by families surveyed come second after food accounting for about 24 % as shown in Table 20. Residents of Umoja II have a relatively higher share of their monthly income on housing. This is not affordable by the urban poor and low-income families and is basically a middle income residential area. Rents in Jerusalem are about the same with Kangemi and Mathare North, yet the latter two have inferior accommodation simply because they are not subsidized. Rents in Dagoretti are the lowest on account of distance from town as well as quality of housing.

Table 20. Household monthly expenditure (Ondiege and Syagga 1990).

Area/Estate	Exp. on food	Exp. on water	Exp. on elect.	Exp. on cooking	Exp. on school	Exp. on transp	Savings to date	Rent paying now	Years of residence
	past 1 KES	past 1 KES	past 1 KES	past 1 KES	past 1 KES	past 1 KES	KES	KES	
Umoja II	734.4	117.9	22.93	106.7	285.2	67.65	6834.4	1007.2	8.7
Mathare North	653.7	55	28.6	86.4	250.3	57.5	2294	509.3	6.1
Kayole	605.1	90.4	17.2	104.3	302.1	64.4	4347.5	414.8	9
Shauri Moyo	610	0	20.4	118.3	533.1	49.7	2173.9	210.7	14.7
Jerusalem	771.1	128.6	73.3	123.1	693.9	75.8	9286.6	511	15.9
Kawagware	560.1	105.8	72.2	114.3	324.9	56.5	6170.2	212.1	11.3
Kibera	568	60.1	15.7	84.2	194.5	37.8	2013.5	265.9	8.6
Mukuru	515.9	68.8	1.7	91.8	228.3	59.6	2455.3	234.9	9.2
Korogocho	558	50	0.4	70.8	124.4	28	259.6	233.7	10.5
Kangemi	621.8	125	73.4	123	365.8	114.5	5798.3	519.5	12.5
Dagoretti	586.2	143.4	72.8	117.8	383	91.2	7761	198	24.3
Total	609	86.7	36.3	102.7	322.6	61.2	4376.8	374.7	11.5

3.6.4 Housing quality

Housing quality may be measured in terms of durable and non-durable building materials used. A floor is deemed non-durable if it is made of earth or timber otherwise it is classified as durable. A roof is considered non-durable if it is made of tin thatched with grass or plant leaves, otherwise it is declared durable. Walls are considered non-durable if they are not made of stones blocks, concrete or bricks (Urban Housing Survey 1983, Basic Report 1986).

According to the definition of durability most of the housing in the site and service estates of Kayole, Umoja II and Mathare North are durable (Table 21). The public rental housing of Shauri Moyo and Jerusalem are built with stone walls which are durable though the maintenance levels are poor. Their quality would be enhanced if the maintenance levels were raised. These durable materials may explain the relatively

higher monthly rents they command on the market and thereby preclude the urban poor in residing in these estates.

The squatter settlements and slums of Mukuru, Kibera, Korogocho and the private settlements of Kawagware, Dagoretti and Kangemi are mainly constructed with non-durable wall materials. Housing units in squatter settlements and slum areas with durable wall materials are less than 25 %. These non-durable wall materials tend to lower the cost of construction and hence monthly rents making it possible for the urban poor and the low-income families to afford these types of housing.

It is evident that low-income families and the urban poor can only afford housing that is constructed with non-durable materials on the current market. The authorities should therefore search for cheap construction materials. It is also evident that the urban poor cannot afford higher quality housing that the public sector constructs and finances, such as site and service schemes, unless they are subsidized. It is suggested that building by-laws should accept alternative materials so that the private sector is encouraged to construct more low-income urban housing. It is also suggested that standards for infrastructure services should be appropriate to be afforded by the urban poor. Savings can be made for example by reducing road widths providing minimum security, lighting, having storm water drains only on one side, etc.

Table 21. Type of walls (Ondiege and Syagga 1990).

Area/estate	Stone	Mud bricks	Wood	Mud & wattle	Other	No. of respondents
Umoja II	96.49	1.75	0.88		0.88	114
Mathare North	95.70	2.15			2.15	93
Kayole	78.22	4.95	11.88	0.99	3.96	101
Shauri Moyo	99.08	0.92				109
Jerusalem	96.83	2.38	0.79			126
Kawagware	19.02	11.22	55.12	4.88	9.76	205
Kibera	6.71	18.79	8.72	64.77	1.01	298
Mukuru	3.31	14.05	7.44	47.11	28.10	121
Korogocho	2.15	5.37	23.66	64.52	4.30	93
Kangemi	24.62	2.31	63.85		9.23	130
Dagoretti	10.61	6.06	42.42	9.85	31.06	132
Total	40.67	8.21	21.22	21.94	7.94	1522

4 WATER SUPPLY AND SANITATION SITUATION IN URBAN CENTRES OF KENYA

4.1 Water supply

A survey of 23 urban centres in Kenya showed that 85 % of households have water inside or within 100 m (Kenya 1986). However, only 17 % of low-income housing units have water inside compared to 83 % of high income units. The Nairobi City Commission which supplies the capital's water has always realized a surplus on its water account and this has been used to subsidize other services (Odipo 1989). Yet, most of the spontaneous settlements are poorly supplied with water. The Commission supplies stand-pipes and charges for water at the usual rate, but the vendors sell at three times the cost. Since the Commission earns enough revenue from water it should be able to supply all residents with water within 100 m. The cost to users can be adjusted so that they are paying more than metered consumers by using a community metre rate and controlling charges made by vendors. These might be private sector local authority or community based organizations.

4.2 Expenditure on water

Amount spent by households on water depends on the source of water which varies from one estate to another. Table 22 shows that only 56.5 % of the respondents had water within plots and that these were mainly rental schemes and the site and service projects which were planned initially. A proportion of the plots in upgraded areas (59 %) also had water on the plots and so was a similar proportion in privately developed estates. The slum areas, however, had only 11.7 % of the plots with water. The majority of the population (85.6 %) in the slum areas obtained their water in tins from kiosks. Similarly 39 % of residents in upgraded areas and 28 % of those in private estates obtained water from kiosks. Other sources of water in these areas include roof catchments, boreholes or river water.

Table 22. Source of water by percentage (Ondiege and Syagga 1990).

Town/area	River	Water kiosk	Within plot	Other sources (roof)	No. of respondents
Site and service scheme	0.32	0.97	96.75	1.95	308
Low-income rental	0.43	0.43	96.60	2.50	235
Squatter upgrade	0.98	39.02	59.02	0.98	205
Slums	0.78	85.55	11.72	1.95	512
Private	3.45	27.59	59.00	9.96	261
Total	1.12	39.05	56.54	3.29	1521

Table 23 summarizes the amount of water consumed daily by the households and this together with the source of water will determine how much households would need to spend on water. The quantity of water consumed varied with family size source and price. Majority of the households (48 %) consumed 40 - 50 l of water daily and nearly 26 % consumed more than 80 l. Only a small percentage (4 %) consumed less than 20 l and these were mainly single persons.

Table 23. Quantity of daily water consumption by percentage (Ondiege and Syagga 1990).

Town area	<20 l %	20-40 l %	40-80 l %	>80 l %	No. of respondents
Site and service scheme	1.62	16.56	47.08	34.74	308
Low-income rental	6.81	23.83	41.70	27.66	235
Squatter upgrade	5.37	22.44	50.24	21.95	205
Slums	4.10	25.98	51.76	18.16	512
Private	3.82	17.94	45.80	32.44	262
Total	4.14	21.88	48.03	25.95	1522

Table 24 shows that the majority of the residents (90.3 %) spent less than KES 200/month despite the fact that they consumed more than 20 l a day. Consequently only 14.85 % of the households said that water was expensive and these were mainly people living in slum areas (26 %) and settlement upgrading (22.4 %). These are the people who buy water from kiosk vendors in tins at about three times the official water rates. Those in other areas did not think water was expensive. However, in all cases the households complained of water shortages in terms of pipes running dry or kiosks closed.

While 31.5 % and 28.1 % of those in the site and service and rental schemes complained of shortages the percentage rose to 39 % and 41 % in the upgraded and slum areas respectively. It may therefore be concluded that what is required is efficient water supply without present shortages. The number of water operators with kiosks should be increased in those areas where supply cannot be taken to each plot. Thus water will be available in greater supply and consequently the competition would regulate the price. However, it was the wish of the majority of the respondents (92 %), in upgraded areas (86 %), in slum areas and (77 %) in the private estates that water be connected to every plot. This they thought would reduce not only the cost but the amount of time taken in fetching water. Together with this is the recommendation that the City Commission could possibly regulate the price at which the vendors should sell water.

Table 24. Expenditure on water by percentage (Cindiege and Syagga 1990).

Town area	< KES 200 %	KES 200-400 %	KES 400-600 %	KES 600-800 %	> KES 800 %	No. of respondents
Site and service scheme	86.47	9.77	3.01	0.75		133
Low-income rental	85.80	11.11	1.85	0.62	0.62	162
Squatter upgrading	86.92	6.92	4.62	0.77	0.77	130
Slums	97.07	2.24	0.45	0.22		447
Private	79.19	10.00	6.67	0.83	3.33	120
Total	90.32	6.25	2.32	0.50	0.60	992

4.3 Waste disposal

In Kenya only 21.8 % of urban dwellings have private flush toilets while the rest use communal toilets or pit latrines. Most of the pits are in low-income areas where there is lack of sufficient water. Since water-borne sanitation systems are expensive people in low-income areas can be encouraged to use alternatives such as improved pit latrines. Urban Housing Survey (1983) in Kenya on garbage collection revealed that 65 % of the towns needed improvement in garbage collection. Only 35 % of the towns collected garbage at least once a week most of them being smaller towns. The major urban centres have poor records. The reasons include lack of serviceable refuse collection vehicles and supervisory staff. Contracting out cleaning services would be disproportionately expensive.

4.4 Level of sanitation

Table 25 shows that 54.4 % of the households used pit latrines mainly in squatter and upgraded areas (93 %), slum areas (75 %) and private housing (80 %). Only 28.9 % of the households used flush toilets and these were in site and service schemes and rental estates. The existence of other forms of toilets in these estates is attributed to the lack of understanding of the respondents about the type of toilets, depending on how the questions were put to them.

Table 25. Type of toilet (Ondiege and Syagga 1990).

Area	Pit	Flush	Pour-flush	No toilet	No. of resp.
Umoja II	11.4	88.6			114
Mathare North	3.23	95.7	1.08		93
Kayole	6.93	68.32	15.84	8.91	101
Shauri Moyo	17.43	21.1	61.47		109
Jerusalem	2.38	96.03		1.59	126
Kawagware	93.17	5.37		1.46	205
Kibera	91.17	0.34	1.01	7.38	298
Mukuru	26.45	0.83	3.31	69.42	121
Korogocho	84.95	1.08	1.08	12.9	93
Kangemi	81.54	11.54		6.92	130
Dagoretti	78.03	6.06		15.91	132
Total	54.4	28.91	6.04	10.64	1522

It is understood that the type of toilet is related to the presence of piped water and provision of sewage facilities. Since the slum areas and the upgraded areas as well as private housing have the least share of these facilities it is not a surprise that they rely to a large extent on pit latrines. The drainage system is in many cases open, particularly in the areas without sewers. Consequently the drains are used as dumping grounds for refuse. Many areas are therefore littered with refuse and contaminated with rotting waste posing a danger to health.

Table 26 shows that an overall 67.2 % of the households had inadequate sanitation. This had to do with lack of sewers, use of open drains, lack of containers for refuse disposal and lack of provision for bathrooms. Table 27 shows that many estates (Mukuru 85 %, Korogocho 65 %, Kawagware 55 % and Kibera 54 %) have no provision for bath/showers. Consequently people wash themselves in pit latrines where available. This results in the pits being filled regularly with the result that many sites overflow with foul sewage.

Table 26. Sanitation adequacy (Ondiege and Syagga 1990).

Area	Yes	No	No. of respondents
Site and service scheme	65.91	34.09	308
Rental	51.06	48.94	235
Upgrade	21.95	78.05	205
Slums	8.95	91.21	512
Private	32.82	67.18	262
Total	32.79	67.21	1522

Table 27. Type of bathroom (Ondiege and Syagga 1990).

Area/estate	Bath	Shower	No. bath/ shower	No. of respondents
Umoja II	3.51	95.61	0.88	144
Mathare North	5.38	92.61	2.15	93
Kayole	9.90	60.40	29.70	101
Shauri Moyo	18.35	71.56	10.09	109
Jerusalem	5.56	92.86	1.59	126
Kawagware	42.93	2.44	54.63	205
Kibera	40.94	4.70	54.36	298
Mukuru	14.05	0.83	85.12	121
Korogocho	34.41	1.08	64.52	93
Kangemi	39.23	14.62	46.15	130

4.5 On-site sanitation

4.5.1 Introduction

The coverage of waterborne sewerage in Kenyan urban centres is still quite low, hence on-site sanitation is widely practised. The situation in Nairobi as a major metropolitan city is outlined here. There are locations within and just outside the city boundary where on-site sanitation is practised. For the purpose of this review on-site sanitation is taken to include pit latrines, conservancy tanks, night soils and buckets. Details are summarized in Table 28. In Mathare Valley the on-site sanitation system consists of communal latrines connected to the City's sewerage system. The Valley is a large area of concentrated shanty development activity close to the city centre. Kibera being a notable largest shanty area practices the use of pit latrines. It has been reported that:

- the majority of the pit latrines are three or more metres deep
- nearly half of the latrines are excavated into rock
- nearly half of the latrines have concrete floors
- less than a quarter of the latrines are classified to be in bad condition.

Table 28. On-site sanitation survey-analysis of pit latrine inspection in Nairobi (Nairobi City Commission Records).

Location	Number of latrines	Number of cubicles	Depth (m)			Number of latrines		
			0-3	3-6	6-	In rock	Con-crete floor	Bad condition
Kiambaa	1	2						
Lisura Estate	2	2						
Water Yard	1	2	0	1	0		1	0
S. of Ruiru	1	1	0	1	0		0	0
Ndenderu	4	15	0	1	3	4	4	0
Kahawa FS	2	2		1			0	1
Kahawa	5	5				5	0	0
Githurai	2	3	0	2	0	2	2	0
Githurai	1	4				1	1	1
Kikuyu	4	4					0	0
Shiva Estate	5	5					0	0
Dag. Chesire	4	4	0	4	0		4	*
Kawagware	1	1	0	1			0	0
Dag. Moslem V	3	3				3	0	0
Gatina	2	4	0	2		1	2	0
Riruta	2	4	0	2	0		2	1
Ngando	2	4					2	0
Kibira	19	9		3	3		0	5
Korogocho	14	23	0	14	0	14	7	4
Glucola	1	2	0	1	0		1	0
Soweto	2	2	0	1			0	1
Kirima	1	1	0	1	0	1	1	1
Njiru	2	2	0	1	1	2	2	0
W. of Riversid	1	2	0	0	1	1	1	
Embakasi	3	20					3	1
Embakasi	2	11				2	1	1
Buru Buru	4	7					2	1
Matathia	3	3	3	0	0		1	0
Ongata Rongai	7	7	1	5		7	1	0
Ongata Rongai	4	6		1			4	1
Athi River Road	1	22	0	1	0		1	0
Athi River Hill Tps	4	9	1	1	1		3	
Total	100	171	5	44	6	46	46	18

* Latrine construction adequate but latrines dirty.

4.5.2 Pit latrines

Pit latrines are constructed of a variety of materials and in both permeable and impermeable ground. The conditions in which they are maintained are also found to be very variable. In general there seems to be an appreciation of the advantages of digging pits of such depth that nuisance is minimized and in the majority of pits inspected the depth appears to exceed three metres. It is believed that there are many pit latrines even in sewerred areas. Reluctance of plot owners to provide water-carried sanitation facilities appears to be due to the high initial cost of plumbing and sewer connection and the recurrent cost of water for flushing.

4.5.3. Communal latrines

A large number of communal latrines had been provided throughout the Mathare Valley by Nairobi City Commission (NCC). These consist of well constructed block buildings with separate access for male and female users. A piped water supply is connected to each latrine block. Latrines are connected to a sewer and maintained by NCC. Originally a flushing system had been provided with tipper buckets, the water passing along channels at the rear of the cubicles and hence to the sewer. The tipping mechanisms are no longer working due to misuse and vandalism. Level of service of sanitation facilities is poor, toilets are too few, there are no lights at night and latrines are cleaned once a day. Sometimes there is no water, and there is no privacy due to lack of doors. From the observations it is noted that some people do not squat over the open gutter of constantly running water along which the excreta is automatically swept away. Reasons given for this behaviour is that some people fear to have the sewage splashing on their backs when they defecate and the children fear slipping into the gutter.

4.6 Solid waste management in Nairobi

4.6.1 General

The general survey of garbage collection in urban centres of Kenya in 1986 revealed that the major urban centres had the poorest records of solid waste management. In this review Nairobi case is given as an example of existing situation.

The task of collection handling and disposal of solid wastes is undertaken by the Cleansing Section of the Public Health Department of Nairobi City Commission. For transportation of the solid wastes from points of collection to disposal sites the Cleansing Section relies completely on the City Engineer's Department which is in charge of all vehicles. Solid wastes are collected in several different types of receptacles:

- 70 and 90 litres metal dustbins for domestic and some commercial refuse
- 980 litres standard containers and 900 litres dustless loading containers for other commercial and industrial solid wastes
- 12 000 litres bulk containers.

For ease of administration the city is divided into five working districts. The districts are further divided into sub-districts known as beats. Each beat is served by one collection vehicle and one labour crew.

4.6.2 Composition of solid wastes in Nairobi

Table 29 shows the major constituents of solid wastes found in Nairobi whereas Table 30 indicates the variation of vegetable matter in different collection areas. These tables show that the garbage in the city is bound to have a high specific volume (of about 300 kg/m³) due to a high percentage of vegetable matter. Further investigations done at the University of Nairobi to check suitability of the garbage waste for energy generation showed that the calorific values were rather low for economic utilization. However, the garbage shows promising characteristics for use in production of fertilizers.

Table 29. Composition of solid waste (Farid 1985).

	Moisture %	Ash %	Volatile matter %	Calorific value cal/g
Vegetable matter	45 - 85	6 - 10	15 - 30	3900 - 4900
Paper	20 - 30	1.5 - 5.5	65 - 75	4000 - 4600
Plastic	7.8 - 17	1 - 5	79 - 90	5000 - 1200

Table 30. Variation of vegetable matter content with collection area (Farid 1985).

Area	Moisture %	Ash %	Volatiles %	Calorific value cal/g
Low density residential areas	64.3	10.9	24.5	4200
Medium density residential areas	64.5	6.7	30.1	3200
High density residential areas	81.0	7.5	19.8	4000
Slums	57.6	10.9	28.0	3500
Industrial areas	47.3	2.4	32.0	4900
City centre	74.5	6.3	20.1	

4.6.3 Quantities of solid wastes collected

The current plan for collection of solid wastes from the various respectacles to the disposal points is as follows:

- city centre - 6 times in a week
- all other areas - 2 times in a week
- bulk containers - 2 to 6 times depending on the type of premises served by such containers.

Figure 3 summarizes the trend of quantities of solid wastes collected over the years. The figure reveals a surprising trend that the amount of refuse collected (in weight) is falling against a rapidly increasing population. Two reasons have been suggested for this trend:

- poor collection efficiency
- private or individual disposal possibly by burning.

The former reason seems more possible judging by the increasing incidences of uncollected heaps of solid wastes especially in low-income (and slum) areas.

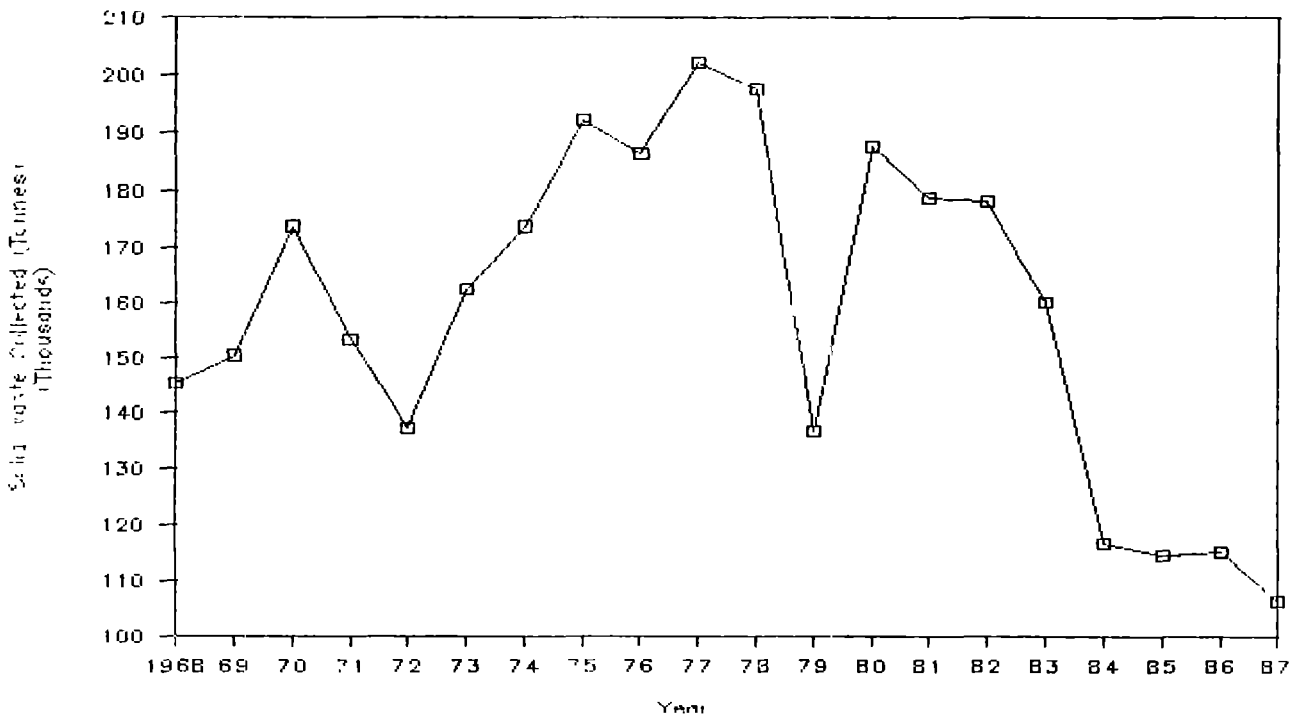


Figure 3. Solid waste collection 1968-1987.

The specific amount of domestic refuse produced per day is estimated at 0.65 kg/capita. According to available statistics this specific production grows at a rate of 0.06 kg/capita/year since 1972, while the rate of collection has been dropping with time since 1977 (Thuo 1988).

4.6.4 Charges on waste collection services

The charges levied on collection of solid wastes were established in 1983 and have not been revised, perhaps because the level of service rendered by the commission has not met with the satisfaction of the population served (Table 31).

Table 31. Charges on waste collection services (NCC 1987).

Description of service	Rate
Refuse collection per bin (domestic)	KES 10/month
Refuse collection per bin (trade)	KES 15/month
Hire of dustbin removal (trade)	KES 20/month
Hire of dustbin removal (domestic)	KES 10/month
Hire of standard container refuse bin	KES 200/month
Removal of standard container bin	KES 200/month
Hire of bulk container bin	KES 600/month
Removal of bulk container (regular)	KES 500/month
Special bulk container removal	KES 300/month
Special refuse removal (on request)	KES 300/month
Collection of dead animals (small)	KES 20/month
Collection of dead animals (large)	KES 100/month
Collection of night soil	KES 200/load
Exhauster services:	
(a) conservancy tank in sewered area	KES 200/tank
(b) conservancy tank in unsewered area	KES 100/tank
(c) pit latrines	KES 200/load
(d) septic tank:	
(1) sewered area	KES 200/tank
(2) unsewered area	KES 100/tank
Exhauster service outside city boundaries:	
- service	KES 300/month
- administration	20 % of service charge
- transport	KES 20/km
Industrial waste	KES 300/load
Gully emptying	KES 200/load
Tipping charges	KES 30/load
Choke clearance	KES 50/job
Hire of cleansing labour	KES 10/h/head
Destruction certificate	KES 100
Recovery of articles from gullies	KES 100

Most of the waste collection charges are often included in the monthly water bills for properties that are metered. However, in the slum areas collection of the rates for solid waste services is extremely difficult because it is difficult to establish tenancy of the dwelling units. Solid waste collection services in these areas therefore becomes a free service for which residents cannot forcefully demand accountability of the City Commission.

In Kibera area the local administration including the District Officer and the Chiefs mobilize the community once or twice a month to gather refuse into specific dumps where it is convenient for the NCC cleansing teams to collect it for transportation to the final disposal sites. Similar arrangements are being encouraged in the other slum areas in the city.

4.6.5 Transportation and disposal of solid wastes

The cleansing section of Nairobi City Commission has blamed the low collection efficiencies on shortage of vehicles and manpower. The cleansing section depends on the transport depot in the City Engineer's Department to supply the various types of vehicles needed for handling solid wastes. Besides short supply of the appropriate vehicles even the available ones are in a poor state of operation and maintenance. Some vehicles require special repairs that are outside the transport depot's routine maintenance. A recent press conference addressed by the chairman of the commission revealed that 85 % of the current fleet of cleansing vehicles need replacement with modern vehicles to realise a significant improvement in the solid waste handling services.

A survey of collection distances and times was performed in 1985 the results of which are summarised in Table 32 for the various operating districts.

Table 32. Solid waste collection distances.

District	Average collection		Average to tip	
	Travel time (h)	Distance (km)	Travel time (h)	Distance (km)
Eastern	1.2 - 1.9	3.84 - 6.88	0.22 - 0.33	1.76 - 9.12
Southern	1.53 - 2.21	11.36 - 12.48	0.27 - 0.37	10.4 - 12.64
Central	2.63	6.56	0.18 - 0.26	8.32
Western	2.45 - 4.76	10.72 - 28.64	0.46 - 1.05	15.36 - 20.
Northern	1.88 - 4.46	6.72 - 52.64	0.50 - 0.70	9.28 - 17.4

The two slum areas, Kibera and Mathare, are located in the western and eastern districts respectively. The current dumping sites are also located in the same districts. Despite the close proximity of the dumping sites to the slum areas the frequency of refuse removal from these areas is very low and in most cases is non-existent. Heaps of garbage scattered next to dwelling houses and providing breeding areas for rodents and flies are common in slum areas. Also because the refuse is not collected away promptly, open scavenging on garbage heaps is a common practice, as unemployed people strive to salvage reusable materials e.g. papers, tins, bottles, etc.

One observed problem which is also characteristic of slum areas is that whereas they are delimited by good roads the internal streets are mostly inaccessible by refuse collection vehicles because of narrowness and lack of maintenance. Since these slums are unplanned, buildings come up haphazardly and very rapidly often on ways of access. It is therefore not uncommon to find garbage collection services provided on the peripheries, but no service within the estates where it is most needed.

The final disposal method is open dumping on two sites which have been designated for this purpose. An old abandoned quarry located near the Kibera slum area serves most of the western part of the city whereas the Dandora dumping site serves the eastern part. Both dumping sites are not fenced so there is open scavenging and often part of the garbage is scattered around by animals and wind.

Since most of the slum areas are not adequately served part of the garbage is usually reduced by occasional burning, a method which is often rendered ineffective because of poor drainage especially during the wet seasons. Rotting garbage therefore is a source of odour nuisance and often pose health risks especially among children.

There have been proposals to privatize the handling of solid wastes including collection transportation and disposal. However, these have been difficult to implement due to the large scale loss of employment this would create within the Commission. Proposals have also been made to open new disposal sites far from residential areas to reduce nuisance.

4.7 Policy guidelines on water supply and sanitation in the low-income areas

4.7.1 Introduction

A convenient supply of safe water and sanitary disposal of human wastes are essential ingredients of a healthy, productive life. Water that is not safe for human consumption can spread disease. Water that is not conveniently located results in the loss of productive time and energy by the water carrier, and inadequate facilities for excreta disposal reduce the potential benefits of a safe water supply by transmitting pathogens from infected to healthy persons. Invariably, it is the poor who suffer the most from the absence of water and sanitation, because they lack not only the means to provide the necessary facilities but also information on how to minimize the ill effects of the unsanitary conditions in which they live. As a result, the debilitating effects of endemic disease lower the productive potential of the very people who can least afford it.

The primary constraint to the successful provision of sanitation facilities are the lack of funds and the lack of knowledge about acceptable alternative technologies. As a part of the sanitation planning process, the existing or likely future pattern of domestic water use should be ascertained so that the most appropriate method of sullage disposal can be selected.

4.7.2 Sector legislation

The Water Act revised in 1972 together, with its subsidiary legislation, covers the broad field of conservation control apportionment and use of water resources. The control of the use of all water resources is vested in the Minister of Water Development. The minister's powers to issue permits for use of water and control of abstraction and

pollution is exercised by the Water Apportionment Board (WAB).

Complimentary to the Water Act is the Public Health Act revised in 1968 which includes many provisions relating to water and sewerage from the health point of view. The Local Government regulations (1963) gives power to local authorities in urban areas to undertake water supply sewerage and drainage works; to maintain water works and to make appropriate by-laws.

The main service authority in Nairobi is the Nairobi City Commission with three acts of parliament involved the Water Act 1952 the Public Health Act 1921 and the Local Government Act 1963. There are three departments immediately relevant to the review, foremost is the Water and Sewerage Department (W&SD) which have capital work programmes and operation and maintenance sections. Secondly, there is the Public Health Department (PHD) which liases with the public sector on behalf of W&SD - in case of legislation to uphold drainage by-laws against polluting industries in such cases where the public health is concerned. Among other things the PHD is responsible for control of mosquitoes and can bring action against people for unsatisfactory surface water drainage conditions. W&SD operates the exhaustor vehicle service since 1985. This was previously handled by the PHD. The City Engineer's Department is responsible for road drainage and ditch maintenance.

The sewerage development policy of NCC is based on the 1974 Masterplan formulated after NMGS - UNDP/WHO studies. The plan though comprehensive is very broad and strives towards an ideal or optimum solution which the W&SD has been unable to adequately finance. Nonetheless, despite the lack of funds considerable progress in sewerage development has been made.

4.7.3 Sector organization

Reflecting the growing importance which the Government attaches to the water sector over the past two decades responsibility for water supplies has passed from the Ministry of Works to Ministry of Water Development (MOWD) which was established in 1974 to concentrate on the development of the water sector. In the urban sector the Nairobi water supply and sanitation system is owned and operated by the Nairobi City Commission (NCC).

4.7.4 Development programme

Kenya's water sector objective is to supply safe water to its entire population by the year 2000. The Government also endorses the targets of the International Drinking Water Supply and Sanitation Decade. Annual development expenditure by MoWD in the water supply and sanitation sector grew very rapidly in the seventies to about USD 25 000 000 annually by 1979 (World Bank 1988). Sewerage and sanitation development expenditures amount to only 10 % of the sector expenditures.

4.7.5 Cost-recovery/tariffs

Government policy on cost recovery is that water charges should cover operation and maintenance costs and in urban centres, water charges should, in addition, contribute to capital costs. Tariffs are increased from time to time to meet inflation and other cost increases. The present arrangements for approval of tariff increases involve both

financial and socio-economic considerations. Tariff increases are first approved by NCC then by the MoLG (NCC's parent ministry) and finally by the Minister of Water Development who, under the Water Act, has the power of Veto.

Table 33 summarizes the current tariffs for water and sewerage in Nairobi while Tables 34 and 35 show the rates adopted by Ministry of Water Development in the minor urban centres surrounding Nairobi.

Table 33. Water and sewerage tariffs in Nairobi.

Water tariff Consumption Range	Rate
10 - 9 000 l	KES 4.00/m ³
9 001 - 18 000 l	KES 6.00/m ³
18 001 - 30 000 l	KES 8.00/m ³
30 001 - l	KES 10.00/m ³
Registered water kiosks	
Whole consumption	KES 1.32/m ³
Sewerage Tariff	Rate
10 - 18 000 l	KES 3.00/m ³
18 001 - 30 000 l	KES 3.50/m ³
30 001 - l	KES 4.25/m ³
Minimum Charges Per Month	
1 (a) Water	KES 18.00
(b) Sewer	KES 13.50
(c) Dustbin	KES 10.00
(d) 0.5 inch metre rent	KES 7.00
1 KES 48.50	
4D Meter Rents Per Month	
1 < 0.50 inches	KES 7.00
9 > 10.50 inches	KES 10.00
9 > 10.75 inches	KES 30.00
9 > 11.00 inches	KES 60.00
9 > 11.50 inches	KES 100.00
2.00 inches	KES 180.00
4.00 inches	KES 280.00
6.00 inches	By agreement
1 Water Kiosks	KES 500.00
Eastlands	KES 200.00
Other Domestic Estates	KES 400.00
1 Testing of meters	KES 20.00
Reconnection fee	KES 100.00
Special reading	KES 40.00
Sewer connection charge	KES 750.00

Table 34. Monthly water supply consumption charges (Wider Area).

Thika Municipality	
0 - 45 m ³	KES 1.80/m ³
Above 45 m ³	KES 2.40/m ³
Minimum charge	KES 25.00/month
Athi River Municipality	
0 - 36 m ³	KES 0.50/m ³
37 - 113 m ³	KES 0.70/m ³
Above 113 m ³	KES 0.80/m ³
Minimum charge	KES 25.00/month
Kiambu Municipality	
All consumption	KES 2.00/m ³
Ministry of Water Development	
Urban Areas	
- Unmetered - Flat rate	KES 36.00/month
- Metered - Consumption	KES 2.00/m ³
- Minimum	KES 18.00/month
Rural Areas	
- Unmetered - Flat rate	KES 15.00/month
- Metered - 0 - 9 m ³	KES 15.00/m ³
Over 9 m ³	KES 2.65/m ³

Note: MoWD Operates a number of tariffs but the ones shown generally apply in the wider area.

Table 35. Monthly sewerage charges (Wider Area).

Thika Municipality	
10 - 45 m ³	KES 1.55/m ³
Over 45 m ³	KES 2.10/m ³
Minimum charge	KES 15.00/month
Also small charges included in general rates	
Athi River	
10 - 36 m ³	KES 0.28/m ³
36 - 112 m ³	KES 0.33/m ³
Over 112 m ³	KES 0.39/m ³
Minimum charge	KES 25.00/month
Kiambu Municipality	
All consumption	KES 0.44/m ³
Limuru	No charges being raised
Ngong	No charges being raised

5 CASE STUDIES OF PUMWANI/MAJENGO, KIBERA AND MATHARE VALLEY

5.1 General

Three residential areas have been selected to illustrate in detail the existing trends of water supply and sanitation situation in the low-income squatter/slum communities in Nairobi. Pumwani/Majengo is an old planned estate located no more than 3 km from the city centre and dating back to the pre-independent era of 1930s. Because of lack of expansion and quality of housing in this estate the rents have remained fairly low encouraging an influx of lowly paid workers. What has resulted is a slum dwelling area. Kibera and Mathare Valley are examples of the many squatter areas where people have squatted on government land (in the case of Kibera) and privately owned land (in the case of Mathare Valley) providing cheap and temporary dwellings for the low-income urban dwellers.

Whereas the general socio-economic characteristics of low-income urban dwellers in Nairobi have been covered earlier some specific characteristics of the selected slum/squatter areas of Pumwani/Majengo Kibera and Mathare Valley are included in this section to further highlight the plight of the low-income communities in terms of water supply and sanitation. More detailed information exists for Pumwani/Majengo since it is a much more studied area earmarked for upgrading.

5.2 Pumwani/Majengo

5.2.1 General characteristics

The 1987 population of Majengo was estimated to be 12 600 forming about 1.03 % of the population of Nairobi. Given an area of 0.2/km² the density of Majengo stands at 6 300 persons per km² which is well above the Nairobi average figure of 1 788 persons per km². The 1987 average house-hold size was 4.0 persons while the Nairobi figure was about 3.2 persons per household.

The population structure of the area is relatively balanced with a sex ratio of 0.93:1 compared to the ratio of Nairobi which is 0.73:1 (1979 data). However, the dependence ratio is relatively high at 52 % compared to Nairobi's 47.4 %. 69 % of the respondents have lived in the area for over 10 years while 49 % have lived there for over 20 years and 28 % of the residents were born in Pumwani and have been staying in Pumwani ever since, implying a very stable population (Table 36).

Field survey revealed that 51 % of the respondents were Christians, 48 % Muslims and 1 % others. This kind of composition has had quite some influence on the character of study area-predominance of swahili culture. Finally 60 % of the respondents were found to be married; 21 % single and 13 % others. 61.5 % of the respondents were employed and the remaining 38.4 % were unemployed. Of those employed 45.3 % were self employed and 19.3 % in casual and temporary employment. Those employed in private and public sectors were 43.3 % and 11.4 % respectively. All in all 61.4 % were in permanent employment. The type of employment to a large extent determines the level of income which in turn determines the ability of the tenant to effectively demand for quality housing. In the study area the 38.4 % unemployed persons constitute a special problem because they have nil or near nil effective demand for housing and as such are excluded from the competitive housing market. The same is true with those engaged on

casual and temporary employment (Urban and Regional Planning 1987).

Table 36. Population characteristics for Pumwani and Nairobi (Urban and Regional Planning 1987).

Item	Pumwani	Nairobi
Total population	12 600	1 223 000
Density/km	6 300	1 788
Household size	4	3.2
Sex ratio	0.93:1	0.73:1
Dependency level	52 %	47.4 %

The average income was found to be 1 060 with 14 % of the people earning KES 500 or less and only 11 % earning KES 2 000 or more (Table 37).

Table 37. Income distribution of Pumwani residents (Urban and regional planning 1987).

Amount (KES)	Proportion (%)
< 500	14
501 - 1000	36
1001 - 1500	31
1501 - 2000	8
> 2000	11

While appreciating the possibility of under-estimation or over-estimation of the income figures by the respondents due to various reasons the expenditure pattern reveals that there are various competing uses of the household income with food taking the largest share 42.9 %. At income levels of say KES 500 42.9 % is about KES 215 leaving KES 285 for other needs including housing. What this implies is that for the 14 % persons who earn KES 500 or less the effective demand for housing is negligible if not lacking. The expenditure pattern has a lot of bearing on the kind of redevelopment to be proposed for the study area.

Expenditure on transport for example is a function of the distance from the work places. The proximity of the study area to the CBD and the industrial area has been to the advantage of the residents since they can save on this (transport cost) by walking to the work places. Expenditure on leisure should be looked at vis-a-vis the provision of community and social facilities while health and education expenditure should be considered against provision of relevant facilities.

It was established that 78 % of the households were tenants, 15 % were sub-tenants and 7 % were landlords; 94 % in two rooms, 1.3 % in three rooms and 0.6 % in four rooms. The average occupancy rate was four persons per room and the average room size was

3 m x 3 m. Each of these units goes at a rent of KES 80 (average). On improvement of the houses or dwelling units the respondents ability and willingness to pay for such varied (Table 38). Most of the households (81 %) felt that the rent of the structures should not exceed KES 100 that is prior to improvement. But on improvement of the structures 56.4 % would be willing to pay KES 200 for rent, 43.6 % would be willing to pay more than KES 200 (Urban and regional planning 1987).

Table 38. House rental assessment (Urban and regional planning 1987).

Rent range	Present rent %	Respondent unimproved %	Willingness to pay improved %
< 50	32	61	6
51 - 100	46	20	21
101 - 150	11	4	12.8
151 - 200	6	2.4	16.6
201 - 250	2.1	1.2	8
251 - 300	0.4	0.6	7.6
> 300	2.5	2.4	28

5.2.2 Water supply

There are 14 communal water points serving 83 % of the residents as sources of domestic water supply. However, most of these water points are operating under capacity resulting in congestion during water collection. On average people spend about 30 minutes to draw water. Some of the residents have tried to go about this problem by buying water from "water boys" who brave the queuing and later sell the water to the residents at their houses; 17 % of the residents buy water from these hawkers (Urban and regional planning 1987).

5.2.3 Sanitation

Data revealed that 97 % of Pumwani residents use 13 communal toilets out of 14, one being out of use. About 28 % of the residents have plot specific toilets which are shared by the tenants; 1 % of them have toilets inside their houses. The communal toilets are not properly maintained in terms of cleaning and availability of equipment that go with them - they were in such a state that it could take a lot of courage to venture into them (Urban and regional planning 1987).

Bathing facilities are virtually absent to the extent that despite the appalling state of the toilets, most residents use them as bathing places and the rest have to bath outside or inside their houses (Table 39).

Another problem faced by the residents is the lack of facilities for doing domestic washing (for example utensils and clothes). 61 % of the respondents do their washing at communal water points to the detriment of these places. 30 % of them do their washing inside their houses, while the remaining 9 % do it just outside their houses.

Table 39. Washing and bathing places (Urban and regional planning 1987).

Place where done	% of resp.	% of resp. (bathing)
Inside house	30	50
Communal points	61	43
Outside house	9	5
Others	1	2

Wastewater disposal and drainage facilities is one of the major problems experienced by the people here. 78.5 % of the respondents claimed that they experience the problems of wastewater disposal, 38 % identified the problem of blockage of the drains as being an area requiring attention, 23 % complained of the problem of the stench from the stagnant water in these drains which becomes a good breeding place for mosquitoes and flies. Generally the drains are shallow and poorly maintained. 67.5 % of the households dispose their wastewater into these drains while 31 % of them dispose wastewater just outside the houses. This poses a serious health hazard.

Solid waste disposal is another problem that is faced by people in this area. 72 % of the households interviewed felt that solid waste constitutes a major problem. Infrequent collection of garbage was seen to be the major contributing factor to the general environmental deterioration in the area. Apart from the infrequent collection of garbage there was lack of dustbins at the plots and the points of garbage disposal were found to be too far from some dwelling units or were too near to dwelling units - thus posing a real health hazard.

5.2.4 Other services

Only the secondary streets are tarmacked, access roads are made of murrum and pose a problem during the wet season. Electricity services are restricted to public places such as Divisional Headquarters, Social Hall, shops, the mosque, and a few dwelling units. Similarly telephone services are limited in the area. There are only a few telephone booths in the area.

5.3 Kibera

5.3.1 General characteristics

Kibera is the largest squatter settlement in Nairobi located 7 km from the CBD. It covers 1.06 km². The area is divided into an upper area which is the original Nubian settlement of Makina and the lower area that has been densely settled during the last decade. It includes numerous villages of Lainisaba, Luidi, Siranga and Ngurusiridu (Obudho 1987). The total population was above 80 000 in 1987 giving a population density of over 75 000 people per km².

There is no land use plan and houses have been built and extended without heed to existing building codes. Construction is largely semi-permanent (mud and wattle walls and corrugated iron sheets). There is overcrowding and rents are very high due to high demand for housing. Rent control cannot be applied as the residents are illegal. Construction of new houses or extensions proceeds at a very fast pace despite the congestion due to lack of space for further development.

5.3.2 Water supply

Communal taps rented from City Commission by private individuals who sell water to the residents is the common source of water. During the rainy season water costs are reduced because inhabitants tap water from their roofs, otherwise the price of water is three times the cost at which City Commission sells it to the vendors (Lee-Smith and Syagga 1990).

5.3.3 Sanitation

This squatter area is supplied with trunk sewers as a forward planning facility, however, individual dwelling units are not connected to the sewers. Most of the plots have detached pit latrines serving some 30 - 300 people per latrine. Because of the large number using one latrine it is often difficult to keep them clean, hence their unsanitary state forces people to use the open space between houses to help themselves. Some ingenious landlords have located their toilets above sewer manholes thus illegally "connecting" themselves to the sewerage system.

In most cases no bathing or cloth-washing facilities are provided by the landlord. The pit latrines are therefore also used as bathrooms where they are clean enough to be used for this purpose; clothes washing is invariably done near the communal water points/kiosks although these water points are not provided with appropriate facilities for this purpose. Some residents do their washing in front of the dwelling room.

Drainage of spent water is a major problem in this area; the critical time being the rainy season when the combined flow from overflowing pit latrines and discarded wash water fills the depressions and gulleys around the dwelling units. Garbage collection is rendered impossible because of inaccessibility of the area to cleansing vehicles. Some people practise burning of refuse, but most of the incombustible material can be found scattered between the houses or in heaps at the nearest open space. A project launched by UNICEF is, however, mobilizing the community through the chiefs to start a community based environmental sanitation programme.

5.3.4 Other services

Other infrastructure and community facilities available in Kibera settlements include: a road which is connected to the city and industrial area by the Jamhuri Park - Ngong roads. Penetration by car to the squatter settlement is difficult. Electricity and telephone connections are by Nubian landlords only and very few people have access to these facilities. There is one primary school built by the Government in 1953, one self help primary school built in the 1980s and one Koranic school built in 1946. There is no high school. There is a handicraft college mainly for women.

There are a number of fruit stands and kiosks which are at walking distance of five minutes from the settlement area. The market consists of temporary shacks and goods have to be laid out and packed everyday. Woodley Social Hall is within walking distance. It is the only one because most open spaces that can be used are either swampy or used as dumping grounds. There are active football clubs and festivals are connected with the church or mosque.

5.4 Mathare Valley

5.4.1 General characteristics

This is the oldest and largest squatter settlement in Nairobi dating back to the 1940s. It consists of nine villages covering a total area of 2.0 km². The 1979 National Census put the population of the area at about 68 500 people, giving a population density of about 34 000 people per km². Half of the land is privately owned by individuals and companies, although "landlords" have allocated themselves plots and have put up temporary dwellings (mostly mud-wall houses with iron-roofs). Because of its proximity to the city centre and the industrial areas (7 km and 8 - 9 km respectively) it attracts large numbers of low-income employees and small scale business people.

According to a survey conducted in 1987 (Obudho 1987) in village III where land is mostly owned by private companies, the households covered had an average size of 5.4 persons with a range of 1 - 12 persons. The average household income was found to be KES 739 per month with a range of KES 300 - 2 100 per month.

5.4.2 Water supply

Despite the existence of this squatter dwelling community since the 1940s, it was not until 1971/72 that city water supply was extended to the area in the face of a serious cholera threat. Village II which was socially better organized than the other villages, managed to have water extended to their village as early as 1968 through self-help efforts. Again water is supplied through community water points/kiosks rented from the Nairobi City Commission. The kiosk operators pay for licences to sell the water and often the prices are 3 - 4 times the metered domestic water charges.

5.4.3 Sanitation

When NCC extended water supply to Mathare Valley in 1972 it also put up a number of ablution blocks or communal toilets each consisting of 20 squatting chambers in two separate rows. Each of these blocks was proposed to serve approximately 400 persons. Toilets were connected to a network of sewers and NCC employed workers to maintain their cleanliness and serviceability. Within a short period of time these facilities were vandalised and the cisterns doors, electricity cables and fittings removed. The security and privacy of users were seriously curtailed and cleaning became very difficult. The facilities have therefore become disused and abandoned for the few pit latrines put up by the landlords.

The latrines are used at an average rate of 200 - 300 people per pit and because the water table is quite high in the valley, the pits fill up fast and begin to overflow into the surrounding areas. The general surface drainage is through shallow open drains which

are in most cases filled up with refuse and stagnant water. Collection of garbage is again rendered very difficult because of inaccessibility. The small internal streets are often flooded with spent water from washings creating a generally unhealthy environment especially for toddlers that use these limited spaces to play.

5.4.4 Other services

Unplanned narrow streets provide mostly pedestrian and very limited vehicle access. A few streets enjoy electricity lighting installed by shop owners who are conscious about the security of their property. Telephone facilities are usually sparsely provided. The inaccessibility of the area by vehicles is exploited to advantage by a few that venture into brewing of illicit alcohol.

A substantial redevelopment is planned for Mathare Valley. Site and service schemes are planned on the publicly owned land while the areas owned by private companies and individuals will be used for putting up villages according to the NCC building and land use standards through legal controls and economic incentives.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 System development proposals

6.1.1 Water supply system

It is apparent that the expansion of the distribution system has not occurred at a sufficient rate to keep pace with development of the city or the increasing demand for water. As the city has spread beyond its original boundaries a relatively complex system of zones and sub-zones has needed to be established to maintain system pressures within acceptable limits.

Several zones do not have adequately developed distribution and water supply is severely restricted. It is estimated that 89 % of the total demand of Nairobi is being supplied from NCC sources. It is proposed to increase this to 95 % by 1995 by improving and expanding the distribution system. The present distribution system is affected by a number of operational problems which are severely restricting supplies e.g. burst mains and service pipes, intermittent supply, poor pressures and excessive leakage.

It is also apparent that individual connection to the dwelling units in the shanty/low-income areas shall continue to be limited by policy and availability of finances. However, in the interim it would be possible to improve the water supply situation in these areas by provision of additional community water points (CWPs). This will alleviate excessive queuing that leads to proliferation of water vendors that charge up to four times the stipulated rates for water. As the water becomes more available and cheaper, perhaps water use shall increase with the accompanying improvement in personal hygiene.

6.1.2 Sewerage system

Guidelines for sewerage development are illustrated by the presentation of two different plans for sewerage system development. One plan assumes that sewerage will be provided ultimately for all sewerable areas in Nairobi; this is the optimum sewerage plan. The other plan assumes that only high priority needy areas will be sewerred and this is the minimum sewerage plan.

The current policy allows individual connection only to dwelling units that meet the building by-laws of NCC. It would therefore appear that unless recognition is extended to the "temporary" dwellings currently prominent in the low-income areas, sewerage connection will not be effected in the near future. It is also apparent that the pace of development of communal ablutions has slowed down in the sewerred low-income areas and even those already put up are being closed down due to abuse of use. Intensification of public health education has been recommended universally, but it must be recognised that the solution to abuse of public utilities is not an easy one.

General drainage for spent water and storm water in the shanty areas has been hampered by the haphazard manner of location of dwelling units and inaccessibility. Use of earthmoving equipment to open up drains shall continue to be limited hence mobilisation of the resident community to use hand tools is the only alternative for drainage improvement.

6.2 Current sanitation policy and implementation

The sanitation development policy of the NCC is based on the 1974 masterplan. The plan, though comprehensive, is very broad and strives towards an ideal or optimum solution which the NCC has up to now been unable to adequately finance. Since the general expansion of urban development spreading from the city centre has been generally in line with the masterplan projections the development pressures for service infrastructure in new areas, including water distribution and sewerage, has been predictable and the NCC has been to all intents and purposes following the masterplan; and despite the lack of funds, considerable progress in water distribution and sewerage development has been made.

6.2.1 On-going work

NCC has an on-going programme of work on a continuous commitment to the operation and maintenance of existing facilities. Some of the activities in the on-going programme can be listed as follows:

- Sewerage
 - a sewer connection survey
 - updating policy and records regarding sewerage changes
 - design and construction of sewers
 - cleansing sewers and removing blockages
- On-site sanitation
 - operation of septic tank emptying service
- Water supply
 - installation of new connection
 - updating policy and records regarding water charges
 - laying new infill - mains
 - repairing leakage and burst on mains
 - managing water demand.

6.2.2 Immediate needs for water supply and sanitation improvement

Water supply

- Detailed investigation of the existing secondary distribution network for the planning of infill mains to serve the target group within the respective supply zones especially low-income areas.
- Detailed investigation on the beneficiaries' willingness (as well as the ability) to pay the full cost of the proposed (extension) of the facilities. If not, are user subsidies (direct grants or soft loans) available? Can bridge financing be available? There is also need to investigate the expected upgrading sequence
 - the time frame involved the compatibility with the housing and water development plans and if more costly technologies in the upgrading sequence are affordable now.

Sewerage

- Investigation into the feasibility of connection of all low-income areas to the sewerage system and implementation of drainage plans according to the required standards and by-laws.
- Completion (or supplementation) of sewer connection survey to ascertain the demand for additional connections and consequent costs.
- Detailed design of trunk sewers and reticulation schemes to suit the immediate programme of works - as part of incremental sanitation particularly for the low-income areas.
- Financial planning and feasibility for the future (upgrading) development of the sewerage system according to the NCC development plan.

On-site sanitation

- Survey to ascertain reasons for non-connection to sewers in sewered areas and possible remedial action such as easy loans - through conducting social feasibility analysis.
- Renovation of communal latrines and better sullage disposal through conducting technical assessment of the household and community sanitation technologies.
- Study the institutional constraints which often prevent the satisfactory operation of sanitation technologies, even when they are properly designed because of lack of adequate maintenance at the user and/or municipal levels. The users may not be fully aware of the need of such maintenance; thus user education programmes and programmes for institutional development will gradually form an essential part of the sanitation programme planning.

If a sanitation policy is to be of as much benefit to the people with on-site sanitation as it is to people provided with sewerage and hence fulfil its role by maximising the public health benefit it should make provision for the following:

- Advice and assistance to local educational centres to provide the correct instruction on the construction and operation of pit-latrines and communal toilets.
- Subsidies for construction of on-site sanitation facilities (including super structure), if carried out to an approved design.
- General sanitation publicity and public education.
- Pilot/demonstration pit-latrines.
- Investment in a suitable mini-exhauster -vehicle system powerful enough to take away stabilised pit contents and able to manoeuvre in confined areas.
- Appraisal of on-site sanitation areas by public health inspectors who can give free advice and possibly arrange assistance for any improvements needed.
- Acceptance of pit latrines as an appropriate alternative sanitation system in the low-income urban areas by the Ministry of Health and hence promotion of this

technology until such time that water-borne sanitation will be extended to such areas. This recognition is absent at the moment; instead pit latrines are discouraged in urban centres by MoH.

Solid waste disposal

- Survey possibilities of establishing official accessible dumping areas for garbage within the residential areas from where NCC staff can regularly collect the wastes.
- Explore possibilities of extending the "self-help" spirit of keeping the residential environment clean, already started in shanty areas of Kibera to the other low-income areas. This will supplement the efforts of the NCC staff.

6.2.3 Proposals for further investigations

This review has been based on reports or studies done in Nairobi's low-income areas in past years. There is need to update the information through a comprehensive data collection exercise. From existing information it appears that it is the sanitation services that require critical attention. It is therefore proposed that several activities should be undertaken:

- Conduct seminars at educational centres and prepare technical advice on latrine technology and utilization. A consultant engaged on this activity could plan and carry out a communication/information support programme that cannot only educate, but also motivate communities to make better use of on-site sanitation.
- Investigate possibilities of manufacture of pre-fabricated latrine slabs perhaps through some support funding. The slabs could be sold at subsidised rates to plot owners.
- Investigate methods of minimizing pit latrine flooding and sullage disposal difficulties following prolonged heavy rains.
- Investigate feasibility of promoting labour based methods of drainage construction and maintenance in keeping with the self-help spirit in the low-income areas.

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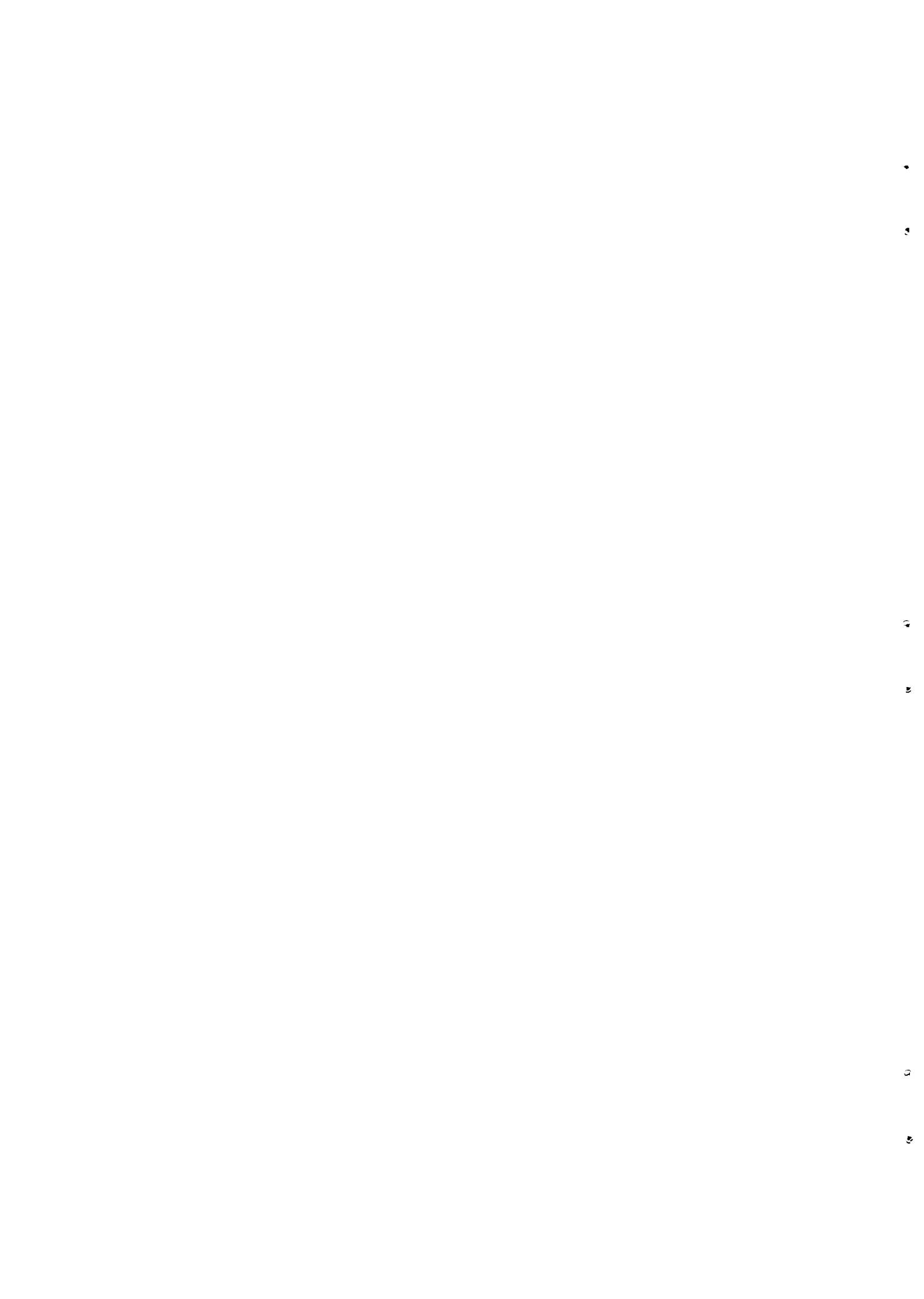
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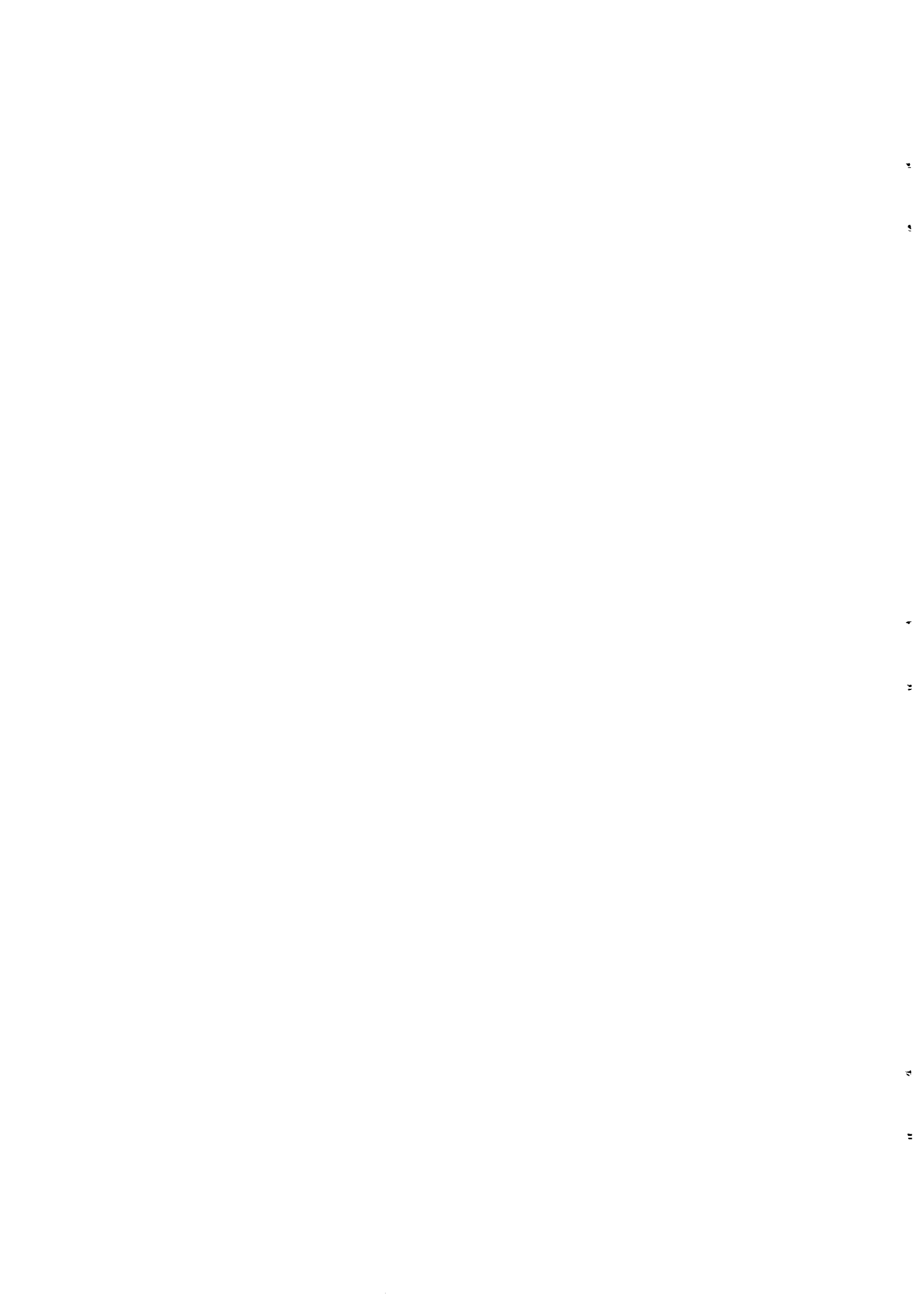
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Part III: WATER AND SANITATION SERVICES IN LOW-INCOME AREAS IN TANZANIA



WATER AND SANITATION SERVICES IN URBAN LOW-INCOME AREAS IN TANZANIA

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ABSTRACT

Urbanisation is brought by human development which needs certain resources (labour, infrastructure and materials). It is natural that these human development activities (industries, commercial enterprises, etc.) will bring about urbanisation. These human settlements may grow from simple villages (of a few thousand people) to gigantic cities of million plus people. The developing world has about 30 % of their population in the urban centres at present. The growth rates in these cities is so high that in some cases the population will increase by a factor of two in ten years time.

With such high growth rates it is inevitable that slums will crop up to cater for the urban poor who cannot afford the official housing facilities. The slums are characterized by inadequate water supply, poor sanitation and poor or no roads. In Tanzania these areas accommodate up to half the urban population – a substantial amount of people. If the situation has to improve we need to have concerted efforts on the upgrading of these areas.

This report is a review of the present situation on the urban slums in Tanzania. The service status of water supply, sanitation, refuse collection, urban drainage and access roads is assessed in view of possible improvements. The report covers some selected towns namely Arusha, Dar es Salaam, Mbeya, Morogoro, Mwanza, Tabora and Tanga. These centres were selected as they were already earmarked for upgrading programmes sometimes back.

Design criteria and standards are also reviewed as to their suitability to the local needs. An example of Tindiga settlement, a slum area in Arusha town, is detailed to illustrate the upgrading process.

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1 INTRODUCTION

Most of the people in Tanzania live in rural areas, only about 10 % of the total population are urban dwellers. This does not mean Tanzania is not suffering the urbanisation disease that has created havoc in most of the urban centres in developing countries. The urban areas in Tanzania are experiencing shortage of housing, poor water supply and sanitation as well as inadequate infrastructures such as roads, electricity and health facilities. Dar es Salaam, which is the commercial port city and the capital of the country, is no exception to this phenomenon.

This trend of affairs has led to urban degradation manifested by mushrooming unplanned estates. The figures are staggering, but it can be said that up to half the urban population lives in these fringes of towns or cities. It is logical for any administration to consider improvement of such areas to reduce the human suffering of the urban poor. This paper will dwell on the institutional arrangements planned for such areas and the inherent problems and possible solutions.

The city of Dar es Salaam has about 1.5 million inhabitants according to the 1988 census. Most of the infrastructure without maintenance and expansion dates back to the 1950s. As such these facilities have outlived their economic lives more than once resulting in poor level of services due to ageing and wear and tear. It is partially due to this reason that the urban areas are now facing the problem of squatter settlement.

Life in the urban fringes is characterized by undesirable accommodation due to poor houses and the inhabitable conditions of roads, water supply and sanitation. The conditions are even further compounded by the unacceptability of these settlements by the government. The stories of forceful evictions from the areas are not totally untrue.

Dar es Salaam is mainly a workers' town. Due to historical reasons most of the industries are based there and with that a substantial workforce is required. The city is also a sea port and commercial centre of the country which inherently demands more people to service it. Small holder fishermen are abundant since fishing is a prominent industry along the coast and fish is common diet of the people.

Along with these businessmen are plentiful as the city is the hub of commerce in the country. The unemployed, self-employed and the part-timers form the bulk of the low-income group that is forced to live in the urban fringes. It is this group and its environs we are going to deal with in this report.

The slum conditions of Dar es Salaam and other urban centres are dealt with in this report. A case study of the Tindiga slum area in Arusha is discussed as a typical example of squatter upgrading exercise in Tanzania.

2 COUNTRY'S POLICY ON URBAN DEVELOPMENT

2.1 General

The Government of Tanzania has had several policies in to develop urban centres. Among others the policies had to accommodate the improvement of unplanned areas or squatters. The following example illustrates this. In the 1967/68 year this development included cleaning of the city's slums by complete demolition of any unplanned structures. The Government promised to construct new buildings for the displaced people. The promise was easier said than implemented.

An estimated 15 000 units were demolished in Buguruni area in Dar es Salaam displacing about 22 000 people. With the help from the then Federal Republic of Germany some 2 800 units were constructed to rehouse about 11 000 of the displaced people leaving the rest to fend for themselves. This marked the first failure of the policy to upgrade the slum areas. There are untold stories of human suffering as a result of these government decisions.

2.2 Upgrading phases in Tanzania

Since the first unsuccessful sites and services the Government sought a new policy and financial and technical aid from donors. The International Development Agency (IDA) of the World Bank agreed to give the required help to develop the infrastructure of the low-income urban areas. From the beginning the programme has been dependent on external aid. The development policy had the following phases:

Phase One (1973 to 1976):

The original idea was to develop about 11 000 sites in three towns. These were 7 450 plots in Dar es Salaam (Kijitonyama, Sinza and Mikochehi), 850 plots in Mbeya (Mwanjelwa) and 2 300 plots in Mwanza (Nyakato). In addition the programme was to upgrade some of the existing slums e.g. Manzese A and B in Dar es Salaam and Mwanjelwa in Mbeya. These additional settlement represented approximately 9 000 units. The work included detailed engineering designs of the infrastructures (roads, health centres and schools) for the areas.

Phase Two (1976 to 1981):

The phase was a result of the first one using the experiences gained so far. The main objective was to give the necessary technical and financial aid needed for the implementation of the work during the period.

The phase encompassed the following towns: Dar es Salaam (Mtoni, Tandika, Hanna Nassif and Kinondoni), Tanga (Nguvumali, Gofu Juu and Mwakizaro), and Iringa slums. The upgrading programme included water supply, drainage and roads for about 16 000 houses in total. Small scale industries were encouraged in the areas to sustain development.

Phase Three (1981 -):

The phase was an amended one based on the experience from the previous phase. In this phase Morogoro town was chosen as an example for upgrading. By the time the World Bank had pulled out of the project and the Ardhi Ministry was the sole entity to carry out the duties of upgrading the squatters.

In broad terms the squatter upgrading meant the following:

- supply of clean and wholesome water in adequate quantities
- improved sanitary facilities and conditions
- proper drainage of the areas
- provision of community facilities e.g. schools, hospitals, recreation centres, etc.
- improved transport system both for vehicles and pedestrians
- improved electricity supply and street lighting.

The goals for upgrading were not different from those of the urban ones. Having in mind the worsening situation in the towns/cities it would be imaginary to think that these targets could be met in the slums. Especially that these plans are handed over to the people without their involvement.

3 CURRENT SITUATION IN URBAN LOW-INCOME AREAS

3.1 General

The rate of urbanisation in Tanzania is perhaps not one of the highest in the world, but the problems are evident in most the big towns. According to 1978 data 40 – 70 % of the urban population actually lives in unplanned squatters. Table 1 shows the situation in 1978.

Table 1. Urban population living in unplanned areas.

Town	% population in slums
Dar es Salaam	70
Iringa	44
Mbeya	70
Morogoro	58
Mwanza	60
Tabora	60
Tanga	65

Squatters are typically characterized by insufficient or lack of basic amenities like water, electricity, drainage, sanitation and street lighting. In 1969 only 25 % of the households in Dar es Salaam had piped water supply and house connections, 38 % had access to stand posts and the rest depended on unreliable water supply from traditional wells or from vendors. By 1968 about 73 % had no electricity supply. Nowadays the services are better in urban areas, but not in the slums, where the situation is unbearable.

3.2 Water supply

Water supply is essential for the very existence of the human beings. It is amazing to note how the people have managed to secure water for their daily needs in the slums. Generally there are four possibilities:

1. no piped water supply in the area except from neighbouring communities through public taps or wells
2. existence of shallow wells in the areas
3. water tap in the backyard of the house or outside the house, but less than 100 m away
4. water available at a tap that is 100 m or more from the house.

It is logical that for the people in the first category water is collected only for very essential purposes. These include drinking, cooking and minimum washing (especially that of utensils). The amounts collected are minimum: it does not sustain improved sanitation and personal hygiene. According to the records in local health centres, water washed diseases are endemic in these areas.

Kihesa B, a slum in Iringa town, has no reliable water supply in its vicinity. As result water is collected from unprotected wells, and diarrhoea is common in all age groups. Situation is the same in other urban unplanned areas with similar conditions. Water is often collected from hand dug wells in Dar es Salaam slum areas. These sources are shallow and often close to pit latrines leading to water borne diseases. With such conditions it is almost impossible to prevent the spread of diseases.

The third and the fourth categories could be said to be the absolute minimum service levels for a community. If such arrangement could be sustained at least hygiene could be maintained and thereby promote a healthy population. Table 2 shows the status of water supply in selected towns in Tanzania.

It is very inconvenient to fetch water from the kiosks due to distance and queues. Wherever possible stand posts in the house yards are preferred. On the other hand there is always a possibility of contamination during transport or storage of water. Studies in Brazil and Lesotho have shown that provision of clean water without protection during carriage and storing does not necessarily improve the health of the people. These lessons are quite relevant to the situation in Tanzania.

Table 2. Existing water supply in some selected squatter areas.

Town Population (Houses)	Squatter areas (Year)	Public tap/ Kiosk	Private connection	Status
Dar es Salaam	All	Few	7 %	Either broken/ insufficient supply
Iringa 2 000	Kihesa B (1985)	2	Very few	Undependable supply or lack
Iringa 4 000 (800)	Mwangata (1978)	2	Very few	Standposts are dry most of the time
Mbeya 1 600	Mwanjelwa (1978)	50	9	Kiosks dry vandalised (200)
Tabora 11 800 (1 700)	Ng'ambo (1979)	4	very few	No water Long walking distances
Tabora 6 500 (900)	Tambuka- Reli/ Mbugani (1979)	2	26	Broken kiosks, polluted well sources
Tanga	Usagara Gofu Juu	50 % are within 100 m distance	6 %	60 % have acceptable water supply

3.3 Sanitation

Sanitation must complement the provision of good quality water, otherwise the exercise would not be fruitful. In most cases excreta is disposed off through pit latrines which are simple hand dug holes with slabs on top and an enclosure to conceal the user from the public. The enclosure may have or may not have a roof whose quality may vary from grass thatching to corrugated iron sheets. The pits can be lined or unlined depending on the economic status of owner and the quality of the soil in the area. Table 3 gives a picture of the situation in selected squatter areas in Tanzania.

Table 3 shows that over 70 % of all pit latrines are shallow unlined holes. The biggest problems are caused by high ground water table that forces the residents to either shallow holes or raise structures, the later being impractical in most cases. Collapse of pit walls is more frequent with high ground water. This is common phenomenon in slums

where pits are not emptied regularly.

Table 3. Sanitary conditions in some selected areas.

Squatter areas	Pit latrines		Others	
	Lined	Unlined	Shallow holes	None
	%	%	%	%
Manzese, Dar es Salaam	46	32	-	22
Mbugani, Tabora	35	51	14	-
Mwanjelwa, Mbeya	-	100	-	-
Ngámbo, Tabora	40	40	20	-
Tambuka-Reli, Tabora	9	63	28	-

The problem of high water table has been experienced in Manzese and Mikoroshoni (Dar es Salaam) and Tindiga in Arusha among others. In Kihesa B (Iringa) over 720 % of pit latrines are unlined forming breeding places for insects such as flies, cockroaches and mosquitoes. These insects are vectors to a host of diseases. In any case about 92 % in Kihesa B had pit latrines which can be a good indicator of adequate sanitation.

Common problems of pit latrines are:

- **Mosquito breeding**

Stagnant water in pit latrines is a very excellent breeding place for mosquitoes e.g. the anopheles responsible for malaria and the culex responsible for filariasis. This is a draw back on the system especially when the water table is high throughout the year. The problem can be solved partly through installing a vent pipe to remove the foul gases. Other mitigation methods to prevent the spread of diseases are treated separately.

As a result malaria is endemic in most slums e.g. in Kihesa B in Iringa almost 50 % of the people were malaria positive. Urban Bancroftian filariasis infection can easily reach 60 % of the population in some coastal areas. A number of mitigation methods have been tried, but each case must be dealt separately.

- **Collapse of pit slab:**

Slabs are relatively stable structures especially when they are made of reinforced concrete e.g. ferrocement. In some cases wooden slabs are used. These are prone to rotting due to the dumpy conditions in the pit. Wooden slabs can also be attacked by insects e.g. ants thereby raising the risk of structural collapse. In any case slabs should be constructed so that cleaning of the floors can be done easily.

- **Collapse of pit walls:**

Unlined walls are more likely to collapse than others. Soil type is a major factor in the collapse of walls; sands, clay and loam are prone to caving even during construction of the pits. Collapse of walls is more frequent during rainy seasons when the soils are saturated with water and there are flows of water into the pits. This phenomenon has been noticed in a number of places e.g. Kihesa B in Iringa town.

Usually collapse of the walls is followed by that of the super structure which endangers the users of the latrine. It is therefore of utmost importance to protect the walls against collapse.

- **Flooding of pit latrines:**

Surface run off during rainfalls is bound to flood pit latrines. The flooding is due to improper drainage of the streets and roads as well as the wrong siting of pit latrines. Excreta that flushes out from latrines may contaminate the whole area causing further deterioration of sanitary conditions. The situation may very easily spread pathogenic micro-organism to human beings especially through ground water and foodstuffs.

3.4 Storm water drainage and disposal

Naturally there are no adequate storm water drainage and disposal facilities in the squatter areas. Often downpours create pools, which are breeding grounds for some disease vectors. The following lists deficiencies due to poor drainage systems:

- Pools formed after rains are a cause of foul smells, breeding ground for some vectors and generally are eye sore. Examples are Kihesa B in Iringa and Tambuka-Reli in Tabora where the landscape is such that floods can easily damage houses and pools are formed immediately during rains. These areas are water logged which means that even the pit latrines cannot work properly leading to spread of diseases.
- If drainage trenches are provided they are either blocked due to poor maintenance or faulty designs, which form dead ends. They maybe not working due to unremoved debris, garbage, etc.
- Soil erosion can also be a problem in cases where cultivation is practised causing further problems to the drainage system.
- Due to poor drainage damage caused to houses by floods is also possible leading to loss of property and in some cases life. Such sad stories are not uncommon in Kihesa B and Tambuka-Reli areas. The damage may be more severe to mud houses than for more stable structures.

3.5 Solid waste management

Like the other services solid waste collection and disposal is a problem in slum areas. The planned areas of towns face this problem, too, but it is even more severe to the

slums because of their illegal existence. Table 4 shows the solid waste management in Kihesa B in Iringa.

Table 4. Solid waste management in Kihesa B in Iringa.

Means of disposal	%
Open land, haphazardly	18
Open pits	15
Burning	37
Burying	30

Over 30 % of the 2000 residents in Kihesa B do not have proper solid waste disposal system. Another study done in 1985 at Mbugani and Tambuka–Reli areas in Tabora had similar findings. The situation in Tanga squatter areas was:

- about 10 % is collected in dustbins
- 67 % is burnt
- a mere 10 % is through open pits.

A study in Dar es Salaam shows that over 80 % of the squatter population do not have dustbins and that most people burn their wastes.

It is obvious that the people in squatter areas suffer most from improper handling of solid wastes. The burning of refuse can cause fires and smoke nuisance to the residents. The uncollected heaps of solid wastes are conducive homes to certain disease vectors compounding hygienic problems. To prevent diseases from spreading it is therefore important to arrange proper solid waste management.

The uncollected solid waste may impair other services such as roads and drainages.

3.6 Transportation system

Roads, footpaths or simply ways of reaching one point from another are important means of communications. Unfortunately these facilities are either missing or in bad conditions in the squatter areas. Since the areas are not planned in the first place then these infrastructures are not expected from the same institutions that consider them illegal. But this does not remove the responsibility of the Government to provide roads to schools, hospitals and places of work.

Due to the very reason of their creation the squatters are out of the town centres making them far from any institutional facility. The dwellers are forced to walk or bike long distances to obtain services. Table 5 indicates the situation in Tanga and Tabora squatters.

For both cases the major means of transport seems to be by walking. Second to that is bicycling followed by some type of public transport , i.e. bus. Since public transport is

often not working, slum people have to walk to and from their places of work, schools, etc. Because roads are full of pot holes and the vehicles are in bad shape it is not worth bus riding or even worse cycling in these areas.

A number of residents would like to use bicycles whose prices they can hardly afford any more. The majority of the people use up to one third of their incomes on transport leading to even poorer diets for the families.

Table 5. Means of transportation in Tanga and Tabora squatter areas.

Squatter areas	Walking %	Bicycle %	Motor-cycle %	Bus %	Car %
Usagara/ Gofu Juu (Tanga)	62	28	2	8	–
Tambuka–Reli Mbugani (Tabora)	69	25		6	–

In most squatters roads, collector streets as well as access paths are in poor state of disrepair. Most of the roads are gravel surfaced making them impassable during the rainy seasons. Even the tarmac roads are eroded beyond repair. As there are no planned accesses some of them lead to dead ends or are very inconvenient to use by any means of transport.

Due to poor or non-existence of access roads it is difficult to arrange water supply or electricity to the areas. It is also almost impossible to have fire fighting equipment to the areas in case of fires. Refuse collection is impaired by the same reasons. All in all life in the slums is very insecure and every thing is just against the people living there.

3.7 Electric power supply

Electricity for household use and street lighting is essential and it also enhances the security of private and public facilities of an area. Lack of electricity promotes robberies, mugging and any other unworthy habits prone to the dark alleys of the inner cities.

Usually power supply to squatter areas is either missing or is inadequate making the areas heaven for criminals. In many countries authorities have tried to demolish squatters on the pretext of cleaning the criminals from cities.

Over 95 % of the Dar es Salaam squatters had no electricity in 1973. The situation has improved since then through a series of site and service programmes. It is worth mentioning that electricity has been given high priority in the squatter areas of Mwanjelwa in Mbeya and Usagara Gofu Juu in Tanga.

4 DESIGN CRITERIA FOR THE INFRASTRUCTURE ON SITE AND SERVICES PROJECTS

4.1 General

Quite often design criteria are acquired from abroad and have very little or nothing to do with local situations. The state of affairs is brought about by the experts from other countries who bring in their home criteria. Also the locals trained abroad tend to introduce standards they have learnt in foreign institutions.

Almost without exception these standards apply to all sectors i.e. water supply, sanitation, transportation and power supply. The main problem in Tanzania is the lack of national standards in these sectors. To accomplish the assigned works, which ever standard can be applied. The situation is even worse in the unplanned or slum areas where the same standards are supposed to be applied.

4.2 Water supply

Water supply connections to all houses is the main target in the long run. As an initial step water is supplied through kiosks located at about 150 m walking distances. Usually kiosks planned for 50 or more houses are provided with 12 taps. These services are planned in phases as shown in Table 6.

4.3 Sanitation

Point disposal of excreta is more common than centralised system. Ventilated improved pit latrines (VIP) are to be constructed by the owners. Depending on the ground water table levels a specific design is adopted. For example in Morogoro town where the water table is never above a 2 m limit a special VIP is anticipated to be used. In more wet areas built-up or double vault composting toilet would be more appropriate.

For the upgraded areas of Hanna Nassif, Mtoni, Tandika, Mbagala A and B in Dar es Salaam normal pit latrines are suitable. They are recommended to be built and used by the owners. The long term objective is to connect all residents to a waterborne central sewerage. This is to cater for an increased water consumption and growth in the population.

Both traditional pit latrines and aqua privies with soakaways have been recommended for use. The living examples are the Mikocheni and Sinza areas in Dar es Salaam. Furthermore aqua privies connected to a central sewerage system have been recommended, too.

4.4 Storm water drainage and disposal

The drainage system is designed to carry only the stormwater resulting from rainfall run off. The spill overs from latrines were not supposed to overburden the system. Usually the system is of earthen channels and culverts at road crossings. The channels can also be stone or concrete lined depending on the soil condition, slopes and any other abrupt change of direction which would be erosion prone. Drains usually follow roads and

cascades with the general landscape of the area. Special structures e.g. outfall drains are also incorporated wherever needed.

Table 6. Water service levels in peri-urban areas.

Type of service	Proposed standards	Phase One	Phase Two
Standpipes	1(4 taps) unit per 100 plots and max walking distance of 100 m		1(4) taps per 350 plots and max walking distance of 800 m
General plots	1(2 taps) unit per 25 plots, max walking distance 100 m		1(4 taps) unit per 50 plots, max walk 150 m
Upgrading schemes	1(2 taps) unit per 25 plots	as in new sites	as in phase one
Individual connections initially	30-40%	nil where no sewer or 100 % where sewer	nil
Growth in connections	50% in ten years	nil	30% in 10 years
Water Consumption in l/c/d			
New service sites	140	150	-
Upgrading sites	140	150	100
Public stand-posts	140	150	no change
Fire hydrants intervals	300 m	125 m	300 m

4.5 Refuse collection and disposal

There are no design data for refuse collection, storage and final disposal. This meant that the authorities used their common sense to work out these figures. It was assumed that so long as access roads were provided, refuse collection and eventual disposal would be possible and practised. As for now it is up to the intuitive capabilities of the planners to come out with design standards.

This is a dangerous situation giving way to any design standard being used, which may not necessarily be applicable to the local conditions.

4.6 Transportation system

It is important to provide access roads to and from settlements and also for internal articulation in the areas. The traffic, however, must be kept at a level that is not a nuisance to the residents in terms of noise or fume pollution. The roads should serve as convenient passages for the residents within their compounds. For upgrading purposes three road categories are given in Table 7.

Table 7. Classes of roads in the squatters.

Class of road	Phase one	Phase two	Phase three	Function	Surface materials
A					
Road reserve	33 m	36 m	30 m	Main access and link to urban network	Treated dry macadam on stabilised gravel bed
Formation width	15 m	15 m	13 m		
Side slope	1.5:1	1.5:1	1.5:1		
B					
Road reserve	20 m	24 m	20 m	Main vehicular access to site	Rolled gravel single lane
Formation width	4.5 m	4.5 m	4.5 m		
Side slope inclined ditches					
C					
Road reserve	10 m	12 m	15 m	Minor vehicular access to residential areas	Gravel or compacted access
Formation width	5.5 m	5.0 m	5.5 m		
Side inclined ditches as in class A					
D					
Road reserve	6 m	6 m	6 m	Access to dwellings on foot	Earth

4.7 Electricity supply

Power supply is mainly for lighting and normal domestic use. As such the power transmission and all switch gears are designed for these duties. These may include street lighting, too. According to the standards only class A and B roads or streets could be lighted. In some cases class C roads have been upgraded to include this facility.

This has improved the security situation of the area very much. Through sites and services the following service levels have been proposed for use in the squatter areas:

- street lighting at 50 m intervals
- dwellings served in 0.6 kW/plot (0.3 diversity factor)
- community facilities and local industries for each facility depending on scale 2.5 kW.

In some upgraded areas in Dar es Salaam, e.g. Hanna Nassif, Mtoni Tandika as well as Mbagala A and B, some service levels have been adapted. These include upgraded street lighting which has been at 50 m intervals in class B roads. There has been also direct power supply to community facilities and articulate distribution system that allows for future individual house connections (Table 8).

Table 8. Electric power supply service levels.

Type of facility in community	Unit	Power supply service level
Dwelling plots	kW/plot	0.6
Market place	kW	5
School	kW	5
Dispensary	kW	2-3
Street lighting	W	80
Urban health centres	kW	5

5 DEFICIENCIES IN CRITERIA AND STANDARDS FOR UPGRADING THE INFRASTRUCTURE IN URBAN LOW-INCOME AREAS

5.1 General

Upgrading of squatter areas is faced with numerous problems including those of setting of design standards. The difficulties involved in setting standards in a poor economy like the one in Africa are real. This is true in general and particularly in peri-urban areas. This report will, however, confine to the urban poor in Tanzania. The question of affordability for example is difficult to figure out due to the extended family system and the dual income arrangements. The dual income is mainly from small holder farms, petty business, second jobs as well as help from relatives.

In the Mwanjelwa squatter area the ability to pay for services was grossly under-estimated based on the existing physical infrastructure. In this particular case it was further found out that the dwellers had some considerable farming activities in the neighbourhood. These activities generated substantive amounts of money that could be ploughed into upgrading the area.

A better approach would have been to interview the recipients on their capabilities to pay for the services and what services and at what levels would they prefer. In this way we would bound to achieve good results, because the people are involved themselves.

It is unfortunate that in Tanzania this has never been the case. Consequently the upgrading exercise has had not much impact on the very targeted people. As if this was not enough trouble the sites were chosen without due consideration of the ground water table, the soil conditions, access, topography and drainage possibilities. As a result of this some sites are water-logged and inaccessible most of the time.

Some comments are hereby directed at the deficiencies in the standards concerning water supply, sanitation, storm water drainage, solid waste management, transportation and electricity supply.

5.2 Water supply

Among the improvements in the squatters water comes on top of the list. Its importance is not to be underestimated. The criterion shown in Table 6 does not insist on this importance. Water kiosks with two taps are proposed for each block of 25 plots, which is a very low service level.

Additionally the local authorities are neither prepared financially or manpower wise to deal with such infrastructures. Simple maintenance and repair cannot be carried out by the local councils. The case of Mwanjelwa squatter in Mbeya is good example. The dwellers have had to go without clean water because their kiosks were broken down and the council could not repair them. As a result people do collect their water from traditional sources which are polluted leading to high incidences of water related diseases.

The supply of water to the peri-urban areas is the responsibility of the government. As such the local governments must maintain, repair and operate the systems. Since these governments are not in a position to do this due to financial, administrative and

maintenance constrains the schemes are inoperative in most cases giving rise to human suffering in these areas.

For the same reasons shortage of water is persistent in the urban areas and squatters are most hit. This is due to the fact that the system was under designed anyway. In any case squatter area service level is characterized by the lowest possible one.

In some cases low quality water has been supplied to the squatters. Examples are Kihesa El in Iringa, Msamvu in Morogoro and some parts of Dar es Salaam. This is contrary to the basic human needs.

It would be fair to note that standards have left out some important issues. These are:

- provision of clean water supply (chemically, bacteriologically and physically)
- adequate quantities (to the basic human needs)
- there are not reliable water sources whether articulated or point ones
- the design capacities are underestimated and therefore lower service levels.

There are two possibilities to provide water to the people in squatters; either build a completely new water supply scheme or rehabilitate existing schemes. Both have advantages and disadvantages in their implementation and service levels. Rehabilitation of existing schemes must be carefully planned so that sufficient quantities of good quality water are supplied to the people. Apparently this solution seems to be the cheapest and most practical.

The second solution is also used whereby new designs and constructions are done in order to upgrade squatter areas as whole or in part. Usually this is more expensive, but it should be considered to be more reliable and in some cases the only way to safer water supply.

The whole design concept must be looked afresh in view of deficiencies of the ones in force now. For example the future population should be used in the design of infrastructures unlike now that the present is used. If the present demands are used for the future needs it is obvious that the schemes wont meet them, leading to poor service levels.

The peak factors (daily and hourly) should be considered when making the designs. Due consideration must be given to expansions in schools, industries, health services and community facilities. In any case the future water demand should be used in designing water schemes.

New water sources should be considered where the existing ones are not sufficient or are not giving good quality water. It is recommended to provide a water tap for each plot. By providing plot taps, operation and maintenance will be carried out by the owners and at least vandalism will be minimized.

5.3 Sanitary facilities

The problem is not only that of low cost sanitation but that of appropriate technology to suit both the soil conditions of an area and the existing socio-cultural environment. The possibilities are aqua privies connected to central sewerage system, or soakaways and

pit latrines. Pit latrines are most popular in the upgrading of on-site sanitation of squatter areas. This is quite common in Msamvu (Morogoro) and Mwanjelwa in Mbeya.

Most of the standard plots are 12 x 24 m making them too small to have sanitation system that may include a soakaway pit. Worse still some of these sites do have high ground water table. Thus potential ground water contamination and therefore health hazard is real. The shallow wells dug to supplement the town water supply are the main ways of getting the contaminated water to the residents. The problem could be solved through provision of reliable water supply and appropriate sanitation. The social fabric of the community, especially the sanitation, should be considered.

At present there are no consideration of plot sizes vis-a-vis the level of sanitation to be provided or the location. The location may dictate the type of sanitation to be provided. For an example in high water table areas either the elevated ventilated pit latrines (EVIP) or the double-vault composting toilet could be most appropriate. It could be convenient to improve the existing system rather than import something new and inappropriate to the areas.

The improvement could be achieved by:

- lining pit latrine walls to avoid wall collapse
- include vent pipes to remove odours from pit latrines
- improve pit cover structure to sustain higher loads
- strengthen the superstructure of pit latrines
- avoid turning pit latrines into breeding grounds for mosquitoes and flies which are known disease vectors.

As regards to costs and appropriateness the VIPs are very suitable. The double pit version of the VIPs is also gaining popularity among the users. This is possibly because the latrine can be used efficiently by rotating from one vault to another. After the first pit is filled-up the second is put into use while the first one is being emptied. The materials from the first pit can be used as soil conditioning or as fertilisers.

The permanent improved pit latrines (PIP), as they are popularly referred to, are very appropriate to small plot sizes as is common in the squatter areas. The use of the PIPs should fit the other areas without centralised sewerage systems, too.

5.4 Storm water drainage and disposal

Drainage of a settled area is beneficial to both the residents and the infrastructure. Proper drainage system is therefore important to the development of an area and its people. The standard criteria for surface drainage and run off collection demands for unlined earth channels. These designs do not consider the rainfall intensity or frequency for an area; thereby they are inadequate in handling the resulting runoff.

In Mwanjelwa slums in Mbeya the drainage system was unlined as a result it was most of the time damaged through erosion. While erosion is the main culprit uncollected garbage is also a problem to reckon with. In this particular occasion garbage blocked drainage system caused further deterioration in the sanitary conditions of the said slum. The uncollected refuse may undermine the accessibility of an area leading to further uncomfortable living to the residents.

The drainage problem of the Msamvu squatter in Morogoro emanated from improperly designed runoff collection system. The area is water-logged by water from the roads, nearby hills and a draining canal passing through the settlement. To have a suitable drainage of the area the amount of water being drained must be estimated and taken into account in the design of the drainage system.

If the problem is not solved right from the beginning the foundations for houses, latrines and for other infrastructures will be eroded or damaged. As the water table rises the possibility of pollution becomes increasingly high, too. The intermittent supply of water is forcing the residents to depend on point sources, e.g. shallow wells.

5.5 Solid waste disposal

Collection of refuse, as one step towards solid waste management, is important and should be planned well in advance. Placing of waste collection bins or chambers at certain points is not only desirable but a must for a properly managed refuse collection system. The actual collection of the rubbish and its final disposal is another issue. In any case the two are interrelated as if one is not done properly it is bound to impair the other.

It is now a common feature to see heaps of refuse at street corners in urban areas in Tanzania. This is a result of unavailability of dust bins or containers and in some cases the inoperative collection system. There are far too few refuse collection trucks and those available are mostly misused or are not working. It is not a secret that most the local councils are faced with financial and technical constrains. As such they cannot cope with the buying of fuel and spares for the refuse trucks among others. Moreover, refuse collection is not their priority.

One possibility could be the use manual drawn carts or animal based hauling systems. The second method has been tried in Dar es Salaam and failed totally due to unplanned implementation procedure. In any case it could be executed in many urban centres with high degree of success if properly planned.

The other approach could be to coordinate the recipients to collect, store and dispose their refuse. This could be achieved through community participation in all sectors, e.g. water supply, sanitation, roads, drainage as well as solid waste management. Handcarts (mikokoteni) equipped with five or more bins could serve 200 – 300 households per day. The refuse so collected could be stored in bigger containers which can be emptied appropriately by tractor with trailer or animal drawn carts.

The collection of domestic refuse should be carried out soonest as it contains a lot of biodegradables. Failure to do so will create unbecoming smells and unsightly pockets in the areas. As shown before uncollected refuse can block roads and drainage system causing more harm to the delicate situation. The collected garbage should be safely disposed off either through sanitary landfills, re-circulation or incineration, etc. depending on the local situation.

5.6 Roads

A comparison is drawn between the road design criteria for Malawi, Tanzania and Zambia (Table 9).

Table 9. Road reserve in Malawi, Tanzania and Zambia.

Class of road	Road reserve in		
	Malawi m	Tanzania m	Zambia m
Class A	18	33	18
Class B	12	20	12
Class C	9	10	9
Foot paths	6	5	5

Table 9 indicates that in most cases the design criteria adopted in Tanzania is unnecessarily too high for squatter upgrading in the region. To implement such a programme means demolishing existing structures such as houses, etc. to give way to roads. This is very expensive to the owners and to the government as well. It would have been more economical and therefore practical to adopt realistic standards for designs.

In a place that is highly densely populated like the Tindiga area in Arusha it would mean very high investments. The roads will need constant maintenance and repair which the local governments cannot afford. Lack of coordination between the implementing agency and the ministry in charge is yet another negative factor in the poor state of the roads.

Since there is no cost recovery or cost sharing with the recipients, the roads will deteriorate due to the lack of preventive maintenance. In some cases the poor drainage system adds to further damage to the roads and impend any development in the area. The most hit are the class C earth roads, which are more prone to erosion and flooding.

The case of water logged roads in Mwanjelwa squatter in Mbeya is a vivid example.

5.7 Electricity supply

The supply of electricity is gaining popularity among the squatters as it gives the owner a sense of security. The security is through lighted streets and power supply in individuals' homes. Small scale industries are bound to mushroom in the areas if there is electricity. This trend could propel further development in the squatter areas.

The upgrading process is however tricky as the Ardhi ministry must pay for the services before TANESCO (the national electric supply company) can take any action. This is necessary as the equipment required is very expensive and in most cases must be paid for in foreign currency.

In some cases it is a matter of a step-down transformer to a service line in an area but in other instances long (and expensive) lines must be erected. Electricity supply to the Msamvu upgraded areas in Morogoro has not been effected due to shortage of funds. About one thirds of the population in Msamvu do consider electricity as an important factor in their development and comfort. It is therefore a pity that the same people are deprived of the service.

6 CASE STUDY OF URBAN UPGRADING: THE TINDIGA CASE IN ARUSHA

6.1 General

Tindiga squatter area in Arusha is a typical slum in northern Tanzania. It is characterized by poor access roads, inadequate water supply and incoherent solid waste collection system. In many ways it represents the other squatters in Tanzania. This report is a summary of the problems of upgrading infrastructures in the area and solutions proposed.

Location: The Tindiga slum is in Arusha town in the north-east side of Tanzania. The area is bounded by the Arusha-Dodoma road on one side, coffee plantation on the other side and banana farm on yet another side. The area covers about 0,53 km² in total. A secondary road links the area with the Moshi-Nairobi highway (Figure 1).

Topography: The area is characterized by continuous rise from south to north towards Topography Mount Meru which is at about 4500 m above sea level. The area is bounded on both eastern and western sides by rivers which form natural boundaries. The soil around the area is mainly sandy-clay, though the soil along the river banks is typically uniform sand.

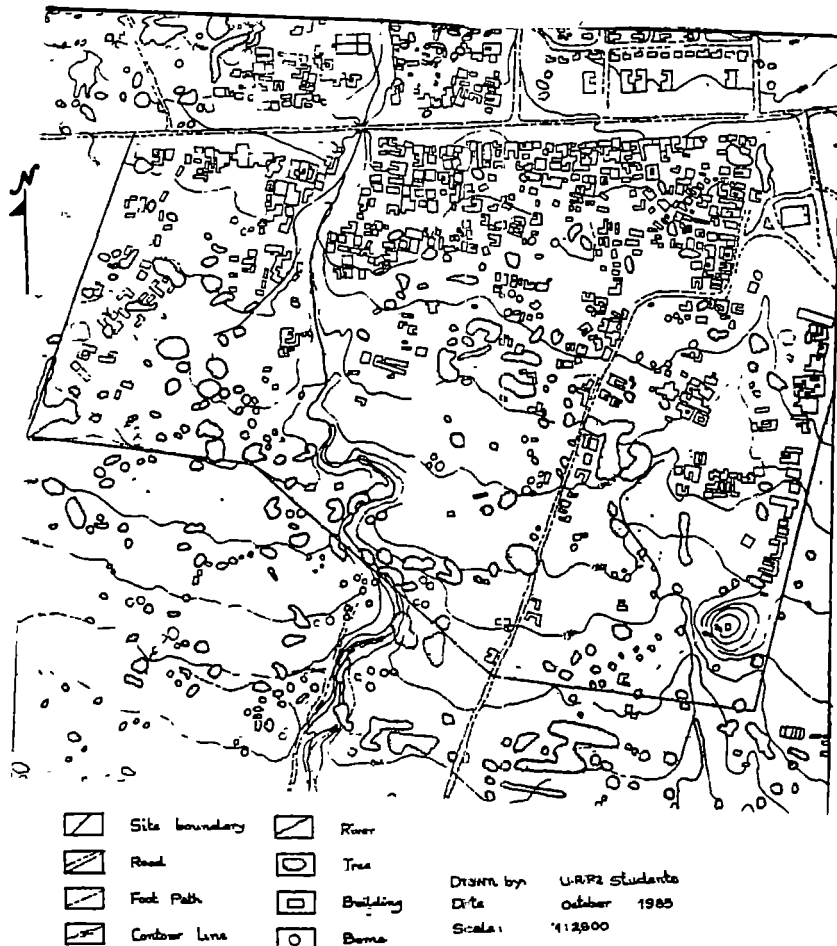


Figure 1. Base map for Tindiga squatter area in Arusha municipality.

6.2 Present situation

6.2.1 Water supply

The people in the squatter fetch their water from a neighbourhood kiosk or from a public tap in the vicinity. They also get water from the nearby river when the kiosk is out of order (Table 10).

Table 10. Means of getting water in Tindiga.

Type of water source	% users
Kiosks	77
Plot tap	11
House connection	9
Shallow wells	3

There is a good blend between the water sources available in the area. During breakdowns of the municipal water works people have to resort to the river water, although they might be polluted. The well sources are quite practical as the water table is hardly 4 m below ground level.

The per capita water consumption was 100 – 120 l/d, which is a high figure especially in a squatter area. The figure is to be used in the design of the water scheme to meet the future needs of the population.

The distribution of kiosks in the area is uneven and some people have to walk long distances to get water. Worse still is that on the average one tap serves about 1100 people in a day. This invariably creates queues at the kiosks amounting to waste of valuable time of the people. The walking distance to a water point is sometimes more than 500 m which is both uncomfortable and laborious to people.

6.2.2 Sanitation

The sanitation condition of the area is very good as about 98 % of the population has pit latrines. About 35 % of the latrines are used for the disposal of both excreta and solid waste. As the average volume of pit latrine is about 6 m³ it takes maximum two–three years to be filled up. This means new pits must be constructed to replace the old ones as soon as they are filled up. The process may be hindered due to plot size constrains. Table 11 gives a summary of the types of pit latrines in the area.

Half of the pit latrines are of temporary status as they are built of mud and poles structure or from iron sheets which are semi–temporary. The latrines can easily be washed away during rain seasons due to the cheap building materials. Since the drainage system is not well planned in many cases surface runoff can damage the

latrines, too.

The latrines can be a health hazard as they are usually very close to the living quarters. Disease vectors, such as flies and mosquitoes, are also a potential health hazard to the people. Due the close proximity of the latrines to houses offensive smells are a common feature in the area.

Table 11. Condition of pit latrines in Tindiga area.

Structure	Materials	%	Remarks
Walls	Mud and poles	50	Not permanent
	Cement blocks	7	Permanent
	Iron sheets	24	Semi-permanent
Permanent	Others	19	Not permanent
Floor	Concrete	44	Permanent
	Mud	24	Not permanent
	Wood	27	Semi-permanent
	Others	5	Not permanent
Roof and door	Neither	35	No privacy, not weather proof
	Roof only	9	No privacy, rain, etc.
	Door only	2	Not permanent, rain, etc.
	Both	54	Privacy and weather proof

6.2.3 Solid waste

There are no organised ways to collect, store and dispose off solid wastes in the area. A lot of refuse is left in disorderly manner that create environmental pollution or other nuisance. Some residents burn their refuse while some do bury them in shallow open pits. A survey has shown that about 41 % of the population do burn their refuse while up to 25 % bury it.

The semi-buried refuse is bound to be wind blown to the discomfort of the people. Usually the buried rubbish is covered by soil layers after the pits are filled up. In any case it could be said that the disorganised solid waste management creates an aesthetics problem. Two main problems face the municipality of Arusha in as far as refuse collection is concerned are:

- there is shortage of trucks to collect the refuse
- there are no roads for internal circulation in the area.

The second point is very valid for the case, because even if the municipality had vehicles refuse could not be collected. It also means that for any proper upgrading of any squatter all services (roads, water supply, sanitation, etc.) must be considered as an integrated programme.

6.2.4 Storm water drainage

Due the very nature of the construction of slums there are no proper drainages to remove the surface runoffs. This has lead to poor environmental features of the area. The average slopes are 2–3 % south wards leading to very high surface overflows during downpours. The area has no surface drainages nor ditches to collect and transport the resultant flows.

As a result the area is flooded after rainfall creating breeding grounds for a host of insects. It is stinking due to the rotting of some of the floating rubbish in the stagnant waters. The drainage system has to be improved in order to upgrade the area.

6.2.5 Roads

Practically there are no roads in the area. The few access ways in the area are either dead–end or lead to no where. The main link with the rest of Arusha town is either through the Arusha–Dodoma road or the secondary road to the Unga limited industrial area. The area has a number of foot paths to and out of the area which can be used also with bikes.

As mentioned before the lack of internal circulation is hindrance to vehicular refuse collection. It is also a serious handicap to shopkeepers, school goers and to other services that might be needed by the people in the area. The problem is a snag to safety of the people and their property in case of fires as fire fighting equipment cannot be brought into the area.

6.2.6 Electricity supply

Electricity just like any other service is poorly supplied to the area. A survey shows that only 17 % of all the houses were connected to electric power system. The main area which is connected to the grid is the one that runs parallel to the Arusha–Dodoma road. Even in this case mainly bars, shops, small scale industries and restaurants are getting electricity.

The connections are not done due to the low–income levels of the residents and the inferior house standards abound in the area. Perhaps the construction standards of TANESCO (the national electric supply company) are not appropriate for this type of settlements.

The area is invested by muggers, robbers and thieves due to insufficient street lighting during the night. This has impaired the safety of life and property in the area.

6.3 Design criteria and standards

The design criteria can be defined as the systematic choosing of various physical infrastructural elements in relation to both its function and capacity. On the other hand planning standards are the guidelines to attain the set goals or targets. In reality it may be necessary to compromise the standards or criteria to meet the objectives of a given environmental set-up. There are cases where this is a healthy situation and therefore encouraged.

In the Tindiga case some standards had to be lowered so that the residents could afford the services in terms of both capital and recurrent costs. In general this could be done in the following manner:

- Some saving in capital costs could be achieved through minimizing the total lengths of roads and that of storm water drainages. These facilities are by far the most expensive in comparison with the others. In any case this should be planned carefully so as not compromise too much on the lives of the people.
- Since the provision of water and sanitation are closely related it would be advantageous to plan them together as a package to minimize costs. The cuts in costs may not be as high as in the first case, but in any case it should be done.
- Costs can also be reduced in supplying electricity and street lighting by optimising on both. An optimised layout would decrease the costs considerably without compromising security of the people.
- Most of these strategies are effective in cutting down the capital costs but not the operation and maintenance costs. It should be noted that the capital costs are far more than the recurrent ones so any saving in them would make the services cheaper.

The afore mentioned strategies were used in the case of the Tindiga squatter taking into consideration its soil condition, water table, topography, etc.

6.4 Physical plans for Tindiga upgrading

Water supply:

Water supply is through public taps or water kiosks located within a walking distance of 100 – 150 m. Provision for house connection at a later stage must be planned. The other criterion was that a kiosk with three taps served, on the average, 50 households or 350 population equivalent. The adopted consumption rate was that of Maji Arusha master plan of 1984 (Table 12).

Sanitation:

To determine the type of sanitation required or best suitable for the area there are number of factors to be considered. These factors include the soil type, water table levels, availability of water supply in the area, the plot sizes and the cultural behaviour of the people. In Tindiga area the water table is very high, 2 – 4 m below the ground level. This means a very high potential for ground water contamination through pit latrines or soakways. It is recommended to use elevated ventilated pit latrines (EVPL) in the area.

Table 12. Consumption rates adopted from Maji Arusha.

Type of service	Unit	Consumption
Public kiosk	l/c/d	100
Individual connection	l/c/d	250
Schools	l/c/d	25
Community facilities	l/ha/d	30 000
Daily peak factors		1.4
Hourly peak factor		1.3

Solid waste management:

The area should be provided with large containers or bins at strategic points. Individuals can then haul their refuse to these points which must be emptied regularly by the town council. Hand operated push carts or animal drawn type can be used in the area as internal vehicular circulation is difficult. There is a tradition in Arusha to use animals for carrying loads so them can easily be utilised them for garbage collection.

Storm water drainage:

This is an important aspect to upgrade the area. Most drains can be unlined especially where slopes are not too steep. Otherwise lined drains are necessary in order to avoid erosion. Practically all main roads and some secondary ones would need to be covered with some type of drainages. The surface runoff from streets and roads must be collected through a system of drains and disposed off in a manner that would ensure that the land is not flood in any way.

Roads and foot paths:

Access to the area and within the area is very vital to the people and their property. As such a minimum level should be maintained to assure an effective vehicular circulation in the area. To upgrade the Tindiga area road categories shown in Table 13 are proposed. These are classified in way that there is minimum demolition of houses while at the same time limiting excessive through traffic. In the upgrading exercise footpaths should also be improved and included in the programme. Car parks should be arranged for all public premises, e.g. community halls, schools, health centres and shopping malls. To some extent the road type will depend on the soil conditions and also the traffic needs. On the average one parking stall should be provided for every five households.

Electricity supply:

Electricity is scarce in the area. Only about 17 % of the whole area is connected to the electricity network. Only bars, restaurants, shops and garages around the area have electricity. Due to the poor houses in the area and the very low incomes of the people, TANESCO cannot connect them to the supply. As a result of poor street lighting burglary and criminality is common in the area. Provision must be made for future power supply connection to individual houses.

Table 13. Roads and footpaths categories.

Road/foot path type	Road reserve carriageway	Construction
Primary distributor (Existing)	30 m/7 m	
District distributor	20 m/5.5 m	Compacted gravel 20–30 cm (surface material)
Local distributor	15 m/5.5 m	Earth surfaced road such as vehicular and footpath to individual houses
Local roads	10 m/5 m	Earth surface
Access path	6 m	Earth surface
Foot path	2–4 m	Earth surface

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

1. There are squatters in Tanzania especially in the urban centres housing more than half the urban population.
2. The facilities for good water supply, proper sanitation and solid waste management are missing in these areas. This state of affairs brings about poor health conditions in the slums.
3. Storm water collection and drainage as well as access roads are either missing or are inadequate. This compounds further the problem of sanitation.
4. Electricity supply in the slums is scarce thereby impeding development, e.g. small scale industries, making the place insecure and providing breeding grounds for criminality.
5. Efforts to upgrade these areas have failed more often than not due to dependence on foreign donors (technical and financial) and inadequate local infrastructure.
6. Design criteria and standards are set inappropriately for the areas and thus not meeting the needs of the people.
7. The recipients of these upgrading programmes are taken for a ride since they are not involved/consulted before the said plans are effected.

7.2 Recommendations

1. The government must recognise the existence of slums in the country and design programmes to uplift them.
2. The upgrading programmes must include provision of water, good sanitation, urban drainage, solid waste management, access roads and electricity supply.
3. The government must utilise the locally available resources (labour, materials and technology), to realise plans to improve these areas.
4. The design criteria and standards must be streamlined to take into account the local situation and conditions.
5. The targeted people must be involved in any plans to change their life styles either by way of implementing new facilities or improving on the existing ones. It would be more appropriate to build on the existing facilities rather than demolishing and starting anew.
6. Community mobilisation through certain groups, e.g. women ought to be encouraged to enhance upgrading of services in the urban fringes.

7. In any case the people should choose a technology (e.g. animal drawn carts, VIP or PIP, shallow wells, etc.) that they themselves are ready to pay for and can afford.
8. There is a serious need to make a thorough survey of these slums to see how the areas can be developed for the betterment of the human lives. This report has only shown the existing problems of which solutions have to be formulated.

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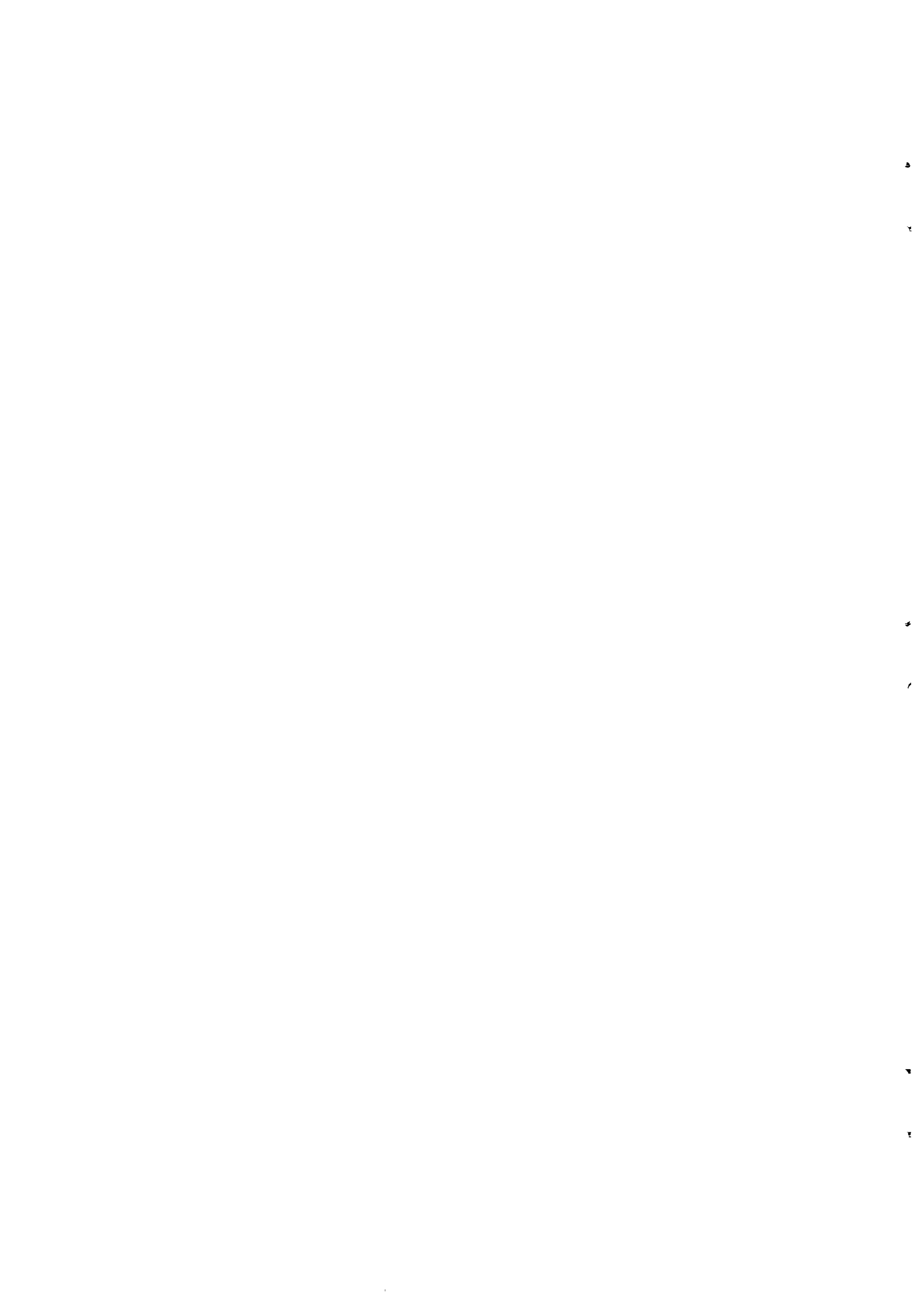
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Part IV: URBAN WATER SUPPLY IN FRENCH-SPEAKING AFRICA



URBAN WATER SUPPLY IN FRENCH-SPEAKING AFRICA

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1 INTRODUCTION

Cities are growing very fast, too fast to provide modern services to all new inhabitants. If the majority of human beings still live in rural areas, whether as peasants or in small towns, the number of those who live in big cities cannot be ignored.

This part will present a few elements of the history of urban way of living in Africa. History is an essential dimension to describe any infrastructure of a city. It is through history that the instant picture becomes meaningful to the outsider. The history of a city should be taken at two levels: human actors with their perception of their city and physical items with their interconnections.

A few institutions of the sector of environment will be described, to show different ways to formalise the ideas. Finally a few "technical" details will be discussed which present some of the ideas of the professionals in charge of direct operation of the services.

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2 GENERAL FEATURES OF URBAN DEVELOPMENT IN FRENCH SPEAKING AFRICA

2.1 Urban areas

In 1950, ten years before the independence process of most of these countries, only 10 % of the population of the whole area was living in towns bigger than 5000 inhabitants. Europe, without Russia, was in a similar situation during the 16th century. The growth of the African urban population is though, nowadays, much faster than it has ever been in Europe, and this must be related to the natural growth rate of the African population which is also very exceptional.

"French speaking" urban dwellers were 8,2 millions in 1960, but already 30,8 millions in 1980, thus a mean annual growth rate of 6,8 %, while in Europe it was around 2 % (except Helsinki) (Venard 1986). Another peculiarity of French speaking cities is their recent development: in the 1950s, none of the big African city was in the French speaking area. In 1955, three cities had over 200 000 inhabitants, three between 100 and 200 000 and six between 50 and 100 thousand. For this aspect too the situation was similar in Europe during the 16th century. (Venard 1986)

Considering the geographical position of all major cities, it can be said that they have all been allocated according to the strategy of colonial countries: harbour or major cross-road in direction of a harbour, making the genesis of the urban phenomenon an exogene factor for this area.

Comparison with European cities of the classical time is, though, difficult if not hazardous. Bairoch has shown that at this time in Europe most of urban growth consisted only into the migration of rural population while in modern Africa the natural growth of urban population is very consequent. Another difference presented by Bairoch is worth to underline: the rural African population is still growing, while in Europe it was not any more because the European peasants were migrating as much to America and other colonies as to their own country cities.

The growth of population affects the level of equipment of cities. It is clear that it is accompanied with rapid construction rates which need, to be somehow controlled, huge investments in infrastructure and planning. We will see that the social structures of the African cities are not necessarily prepared for this.

2.2 Succession of urban policies

The urban growth is a constraint which is not to favour the implementation of well defined, strong and sufficient infrastructures. An important factor is the question of land ownership: a good part of city extensions are done more or less legally.

A way to contain the change of cities is planning, and the international organisations are seemingly impatient to see this growth limited and orientated. The French tradition has been to draw the city in the long term and fix this view into documents accepted by all actors. This approach is, according to Arnaud (1993), quite different from the Anglo-saxon tradition. The global planning is, though, on the decrease and, instead, the sectoral planning is being favoured. Which on its turn might turn inefficient, says Arnaud, if nothing is done to co-ordinate nor to see the long term. This policy is though more connected to the reality than previous plans aimed at control of land. He

concludes that planning however cannot be too dogmatic or normative, it should be adapted to the planning tradition of each city and try to allow more small scale experiments.

3 TWO EXAMPLES OF URBAN WATER SUPPLY INSTITUTIONS

In this difficult context the minimum services are to be delivered. Among these important services is water supply. In most African cities co-exist piped water supply systems with water vendors (Metaferia 1993). This co-existence should in theory bring competition and decrease prices for consumers. However Metaferia shows that on the contrary poor families pay often more for their water than better-off families which have had the opportunity to be connected to the collective piped water supply.

I will present in this report some of the innovations that water suppliers in French speaking Africa have introduced. This presentation will rely mainly on the reports, presentations, comments and visits gathered by at the 5th Congress of the Union of African water suppliers held in February 1990 in Abidjan.

But before these innovations can be presented, some information on the institutional background is needed. I shall therefore present in more details two major piped water suppliers of French speaking Africa: SODECI and SONESS.

3.1 SODECI (Ivory Coast)

The main water supplier of Ivory Coast, SODECI, plays an important role in the development of the water sector of Africa. His director, Mr Marcel Zadi Kessy has founded the Union of African Water Suppliers to build links between the African professionals. SODECI plays an important role and it is interesting to see its developments.

In Ivory Coast the SODECI, which supplies the water to urban users, is a private company. This company, created in 1960 by the French SAUR corporation (Bouygues Group), is owned by private persons (half by Ivorians and half by French) and is linked to the Government by a strict contract called "concession". Most of its activities are concerned by the production and distribution of water (67 % in 1989), and only marginally by sewerage and pipe-building. The concession contract means that the SODECI is the operator of the infrastructure, the owner remaining the State and the cities. Only new pipes and constructions financed by the company are belonging to the SODECI and this for only a determined period of time. This system of concession comes directly from France where it is widely used (Morange 1993).

SODECI produces 100 million m³ and sells 85 millions m³ of water in 370 cities and towns, where live its 225 000 customers. It operates and maintains the pipe networks, measures the water and collects the bills. The main activity takes place in Abidjan, a two million inhabitant harbour city.

The bills consist of a consumption fee as well as fees to finance older pipes and a tax to finance a national fund for water supply in poor areas, rehabilitation of existing pipes and extension of the networks. The fund is under the Ministry of public works. The mean price was 263 francs CFA/m³ in 1989 (50 Fcfa = 1FRF), half of it remaining to the SODECI.

The SODECI is controlled by the Water Agency for distribution and by the Ministry of Public Works for construction and research activities.

Organisation

SODECI employs 330 persons (99 % African) in 10 regional centers (2 are in Abidjan). The regionalisation of its structure has been possible thanks to computerisation (billing, management, book keeping). The regional centers are now profit centers.

The personnel is integrated in the management (by objectives). The continuing education is partly produced by the SODECI itself whose education center is used by water suppliers of other countries, too. The dynamic staff management includes participation to the capital, health insurance fund, special access to credit for housing, etc. Periodical meetings at all levels give the needed information to everyone, so that anybody can be replaced easily, even the director.

The productivity is measured by several indicators such as

- * 64 000 m³ sold per agent
- * 13 million FCFA per agent
- * 170 customer per agent
- * 8 junctions per day per plumber
- * 1500 customers per meter-reader

The SODECI is a peculiar organisation. Apart that it is a private company, it might be among the only African Water supplier able to recover 99 % of its bills and making profit. This amazingly high rate is due to, according to Mr Zadi, the quality of the personnel in charge of recovery, which are exclusively women. After the price of water was decreased in 1985, a drastic restructure of the company was undertaken. 160 persons were taken out, but one year later 67 were taken in, since the company started to make profit. The profit is still increasing (500 million FCFA in 1989).

Part of the restructure was the regionalization, which turned the regional centers into profit centers. The personnel of each center receives financial incentives proportional to the profits.

3.2 SONESS (Senegal)

SONESS is the state owned water company of Senegal. It operates both drinking water and sewer systems. Since 1984 it owns the water distribution networks.

Almost half of the Senegalese population is urban, concentrated mostly (80 %) in the capital city of Dakar. The difficulties are augmented by the growth rate of cities (6 % in Dakar, 8 % in Mbour).

Water supply

The problem of water resources is acute in this coastal city built on a sandy peninsula. The first deep well of Thioraye (1952) is now included in the urban area and is contaminated. The water of the lake Guiers, the only large fresh water resource in the area is situated 300 km from Dakar, has been used since 1970 for small amounts (40000 m³/d). The other wells in the area see their salinity increase slowly, and the last drilled in 1980 was already situated 45 km from the city center.

In water supply the role of public standposts is essential as these equipments supply the water to half of the urban population. However, their operation and maintenance is

difficult and endangered because the operator, the SONESS, has difficulties to be paid for the service which should be financed by the municipalities. The SONESS thus plans to move towards both increase of private "social" connections coupled with suppression of existing public standposts, and the installation of kiosks where users should pay directly to the employee in charge of the kiosk. This person will be under contract; the water shall be sold at a definite price (5 FCFA the bucket of 25 litres) and the water consumed will be charged at a lower price (130 FCFA/m³ compared to 200 FCFA).

Wastewater

Modern sewers exist in only five cities of Senegal, and reach only 20 % of the inhabitants. The population relies mostly on private latrines or nothing, i.e. forest, free places and public spaces. This causes problems of health in the low areas which are submitted to floods. When I visited Dakar, a large area of houses, most of them being made out of concrete, was under one meter of water. This situation lasted for already a couple of month and was expected to continue for at least the same. A lot of garbage was floating on the surface and the smell was of course horrible. Flooded houses were of course empty, but the surroundings were inhabited by several tens of thousands of people.

Sewage is treated in lagoons, in Dakar exists also an activated sludge treatment system.

The extension of the sewer is planned for only the areas with high consumption of water, since the minimal flow rate in the sewer must be secured to transport the matters away. In the other areas the plans concern individual and small scale collective systems of infiltration of wastewater into the ground. The existence of these latrines is not sufficient, they should then be emptied regularly and their walls repaired when necessary. In Dakar however several informants reported that the price to empty them is too high for many. The consequence has been the contamination of the oldest deep well of Dakar.

Two different organisations are taking care of drainage: the SONESS for wastewater evacuation, the municipal technical division for rain water. The director of Soness (Diouf 1991) considers this as a problem. He also considers that the financial effort of the budget in favour of sewerage should be developed according to the size of the problem: less than one (1) percent of the budget for water is attributed to wastewater, while nearly half goes to the supply of drinking water. The water budget represented 15 % of the public investments over the period 1989/92.

The operation and the maintenance of the existing sewers is financed by a tax paid together with the drinking water in areas where sewers exist. An increase of this tax could in theory help to finance the extensions of sewers but Diouf considers that the price of water is already high and that an increase of the price would just hamper the drinking water policy.

4 SOME STRATEGIES FOR IMPROVEMENTS AND EXTENSIONS OF SERVICES

4.1 Drinking water

Despite financial difficulties, most of the African water suppliers try to comply with the extension of the urban population. It leads them to use the almost official phrases of the Water Decade of the United Nations: "water for all", meaning piped water for all. I shall present now a few strategies to extend existing networks.

Several alternatives exist in order to increase the number of beneficiaries of the piped water. Whether the number of individual connections is increased, or the amount of standposts and fountains or even improving the service delivered by the water merchants and small vendors can be improved. In their congress in Abidjan the water suppliers seemed to be more interested by the first alternative, although it is capital consuming.

But no absolute answer can actually cover the situation which is varying drastically between city areas. As far as extension is concerned, three types of areas of the African city shall be discriminated (Peterschmitt):

Area A: Streets already equipped with a pipe

- part of the inhabitants are not yet connected
- some of them would like to join
- > this is the problem of the water supplier: client relationship, capacity to find adequate contracts, commercial action

Area B: Streets without any pipe network

- potential clients exist
- > the problem belongs more to the owners of the pipe network than to the operator, the solutions are very different

Area C: Population living in non-plotted spontaneous residential areas

- no network, difficult to install
- problem which does not belong to the water department
- > belongs to the Ministry of cities, urban planning

The water suppliers propose to limit to areas type C the installation of standposts.

4.2 Extension of individual connections to networks

The strategies to develop individual connections received a lot of interest during the congress of Abidjan, where it was the subject of the first technical session. This kind of service gives the best service to the customers, and should also theoretically permit to increase the revenues of the suppliers.

The synthesis of a questionnaire presented by Mr Mouiri (of SEEG, Gabon) and Mr Peterschmitt (of SAUR- Africa) was very interesting since it presented the answers given by the managers of distributing companies and ministry officers responsible for water affairs.

The survey showed that water networks suffer recurrently from weak connection rates. The two assessors disagreed on the conclusions. For Mr Mouiri, two main reasons

explain this situation:

- the network density is too low (as length of pipe per km²)
- connection costs are too high.

He concludes that the water resources are not the limiting factor (except in Burkina Faso). Mr Peterschmitt considers these explanations too global. In a city the situation varies a lot from street to street (see areas A, B, C), and a high connection rate in a small density piped area does not imply a good service for the overall population although it might improve the financial health of the water company. He considers that the water supplier has to conciliate benefits with his mission of public service, which should apply even for the very poor. Therefore he considers as the supplier's duty to imagine technic to convince consumers to buy a connection, which not only good ideas but also a good commercial division.

Extensions in already equipped streets

Mouiri finds in the questionnaire several technical strategies to reduce the costs. They consist of low price materials, smaller water meters, grouping of connection building, collective connections (several alternatives) and customers' participation in the work.

Peterschmitt was rather pessimistic concerning these strategies because "they often weaken too much the equipment, leading to leakages, etc. and impede the construction rhythm". The only technical modifications giving advantage are according to him the suppression of the key-valve and the semi-industrial fabrication of valve-meter box systems. He also objected the idea of collective connections. For Peterschmitt a connection should be reserved to one family only. Anyhow the contract policy has a rather limited effect, only in streets already equipped (area A).

The financial strategies

For streets already equipped (areas A) the strategy consists in many countries in densifying the connections. Several countries have chosen for this objective the creation of a special fund to subsidize new connections (Senegal, Zaire, Ivory Coast, Marokko). In reference to Europe the connections receiving subsidies are then called "social connections" although the receivers are not necessarily the poorest of the city.

These funds are financed via tariffs: a portion of the water bill is allocated to this "social fund". According to Mouini good results have been achieved in Abidjan and Dakar. Criteria to attribute this aid are varying from countries. They generally take into account the revenues of the applicant, the size of the meter installed and the number of taps in the house (4 being symbol of wealth). This policy has reached 15 000 connections in Ivory Coast and 5 550 in Senegal.

It must be highlighted that such policy is thus financed by other users. It might be an advantage, but criteria for attribution must be very clear and accepted as objective, otherwise abuse might occur and it becomes difficult to collect the water bills.

It has been shown by the researcher Morel à l'Huissier that the term of "social connections" used to cover these policies does not mean that the poor families are reached. His surveys show that in many cities exist enough middle class families who wish to join the network and are really able to pay the bills. At the same time he notices that as many connection are terminated as new are contracted. He concludes that poor families attracted by these policies of free or almost free connections have to revoke,

quite certainly because of the billing policy which forces generally to save over period of three months, which is difficult for families having only daily or sporadic incomes.

Loans and payment facilities

An experiment in Gabon related by Mouini has given the opportunity to new customers to pay their connection fee over 12, 24 or 36 months. The experiment was reported to be conclusive.

In Cameroon and Congo it is the banks which seem to offer loans. The question remains to know which kind of guaranty banks require (monthly salary, etc.). In Marokko a large credit program has been initiated by the World Bank and the Communal Investment Fund. This fund has already allowed 180 000 families to join a piped water supply between 1982 and 1985. The good return rate of the program allows continuation.

It shall be noticed that the following up such payment facilities is rather complicated and costly, it thus needs a strong, already well established organisation, and limits therefore the countries. Similar assertion is valid for all subsidised connections.

In addition crucial consequences of the increase of the fast increase of low price connections have to remain in mind:

- increases overall water consumption, thus might lead to production difficulties,
- needs a lot of staff for installation, billing, control and ... closing!
- decreases the average consumption of private connections, thus the marginal profit of the supplier diminishes.

The last remark is already a reality in Abidjan: Peterschmitt compares the mean yearly cost per connection to be FCFA 9210 with the low income water bill 8400. He reveals that in the same city the water consumption increased only 3 times between 1965 and 85 while customers multiplied by 9. The nominal water consumption is thus decreasing continuously, and this trend will continue. He remarks that it brings with itself a heavier commercial staff, necessary because the water supplier has a public service duty. He comments that part of the increased costs can be compensated if addressed early enough by use of e.g. computer technology. This technology however is easy to implement in large corporations such as the SAUR, but should not be considered as an absolute safeguard.

Strategies to extend distribution networks in areas B

Controversial discussions concern the opportunity and the suitability of densifying of water networks in areas where proper streets exist and where urbanisation is regulated (area B). Some actors consider that it is a must to obtain full capacity of the investments. Others reply that the cases of cities like Dakar or Rabat are rather special in Africa where vertical construction is quite seldom.

Densification implies also increase of water consumption and it shall be sure that water resources and production facilities are sufficient. Simultaneously the increase of consumption implies unavoidably the apparition of wastewater problems.

However, densification of existing networks is an objective proposed by several suppliers. It permits, in certain conditions, to improve the utilisation rate of the

production facilities.

The installation of new pipes in areas where proper streets exist and where urbanisation is regulated (area B) require special financial arrangements. In such areas exist generally a demand for piped water but it is advisable to check the solidity of the demand before action.

Several countries (Senegal, Ivory Coast) are collecting from the water consumers a special fund to finance the extensions of the networks.

However this solution is not possible in all cases, the political bodies might consider that the effort shall be supported by all the community and only the users of the existing facility. In this case communities use the international banking system. These institutions enable to implement large projects at a time. Antagonists to this idea allege that the danger lays in this case with the implementation of programs on an areal basis, which easily leads to equip streets with few or no candidate to join the water service. Another handicap of this solution is the low frequency of such programs which obliges families to wait for several years. Densification funds collected continuously from own users permit on the contrary to act quickly and exactly were the demand lies. This is possible only if the fund manager knows well the conditions in the field, many suggest that it could be the water supplier himself, but as good solutions exist certainly.

In any case the European system of financing in advance the infrastructures by fees collected from constructors and builders was rejected as too far from the African traditions.

How to reach the peri-urban population?

In peri-urban areas, the population has built, spontaneously or not, houses before any collective service has been organised. In these areas it is specially difficult to build water pipes because the population density is often rather low: cheap housing does not permit vertical extensions, the size of the plots might be also bigger. The low density means higher price per capita of linear pipe in areas which are otherwise poorer.

The few economic resources of these areas are not actually attracting the African water suppliers (Mouiri). Peterschmitt considers these areas as belonging to the Ministry of Housing or similar public bodies in charge of basic infrastructure. Since something has to be done immediately, he estimates that all what the water suppliers can do is erect standpoints managed by private contractors. The easiest is thus to raise the standpoints at the limit between planned and unplanned areas, so to limit initial investments of the water supplier.

ABIDJAN

Such a strategy has been implemented in Abidjan since 1990. It takes advantage of the newly developed semiautomatic "Yacoli" standpost. The introduction of a 10 FCFA coin in the machine by the appointed keeper of the kiosk (or his worker) opens the 25 litre whose content is poured into the bucket of the client. This machinery permits a precise delivery and is fast, and thus attracts contractors. It is produced in Abidjan by a subsidiary of the SODECI.

Before such a kiosk is introduced the illegal water resellers taping the water from their own private connections are identified and closed up to a distance of 300 meters. Immediately after offers are made to contractors and the kiosks are installed.

In the area that I visited it was visible that the kiosks were very useful, queues were huge. At the same time it was obvious that water vendors were still existing, but not in the very neighbourhood of the kiosk.

5 CONCLUSION

It can be seen that a lot is being done in African cities to maintain and even improve the services. A lot is still to be done. The efforts for experiments are to be continued. Education in international context is also to be continued in order to increase exchange of ideas and develop operative communication networks between African engineers. The work of the UAWS, now member of the IWSA is an example and shall be followed with attention.

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