

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**NAIROBI CITY COUNCIL
MINISTRY OF LOCAL AUTHORITIES
THE REPUBLIC OF KENYA**

**THE STUDY ON
SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN THE REPUBLIC OF KENYA**

FINAL REPORT

VOLUME 4

SUPPORTING REPORT

AUGUST 1998

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**CTI ENGINEERING CO., LTD.
ENVIRONMENTAL TECHNOLOGY CONSULTANTS CO., LTD.**

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All the Kenyan shilling amounts including the project costs shown in this report are indicated in 1997 price unless otherwise indicated. Those amount are estimated partly based on the foreign prices by applying mean 1997 currency exchange rates; namely, US\$1 = Kshs. 58.8 = 121.76 Japanese Yen.

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SECTION A
WASTE GENERATION AND
COMPOSITION ANALYSIS

**THE STUDY ON
SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN THE REPUBLIC OF KENYA**

FINAL REPORT

SECTION A

WASTE GENERATION AND COMPOSITION ANALYSIS

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SECTION A

WASTE GENERATION AND COMPOSITION ANALYSIS

1. SURVEY METHODOLOGY AND INSTRUCTIONS

1.1 General

Basic information such as quantity of solid waste generated in the Study Area and the population covered by collection services is essential for a successful and workable solid waste management plan. The first stage in planning and designing of solid waste management (SWM) facilities depends on the availability of reliable data on solid waste generation, apparent specific gravity, composition and so on.

The generation rate of solid waste varies significantly from dwelling to dwelling within an area and within a city. Waste generation further differs even within a household on different days of a week and month of a year. Thus, it is difficult to assess the per capita generation rate of solid waste. On the other hand, calculating the accurate generation rate is very important for planning and designing of an effective solid waste collection and disposal system of the area.

Waste generation and composition survey was executed by a local consultant under the supervision of the JICA Study Team to collect quantitative data for grasping present and projecting future conditions of solid waste amounts and characteristics classified by generation source. The survey was conducted by the same local consultant in the same way two times in two different seasons to decrease the fluctuation of analysis due to climatic conditions such as rainfall and humidity.

1.2 Solid Waste Sampling

The sampling for waste generation and composition was conducted in a residential area, residential/commercial mixed area, markets and roads to get a true and representative picture of Nairobi City. Taking into account housing types and different socioeconomic groups living in the city, the residential area was further subdivided into high income, middle income, low income and surrounding areas, including the slums and squatter settlements, each house and flat. Besides, one compost sample was taken for chemical analysis to evaluate the quality of compost. Number of samples and locations of sampling households are as shown in Table A.1-1 and Figure A.1-1, respectively.

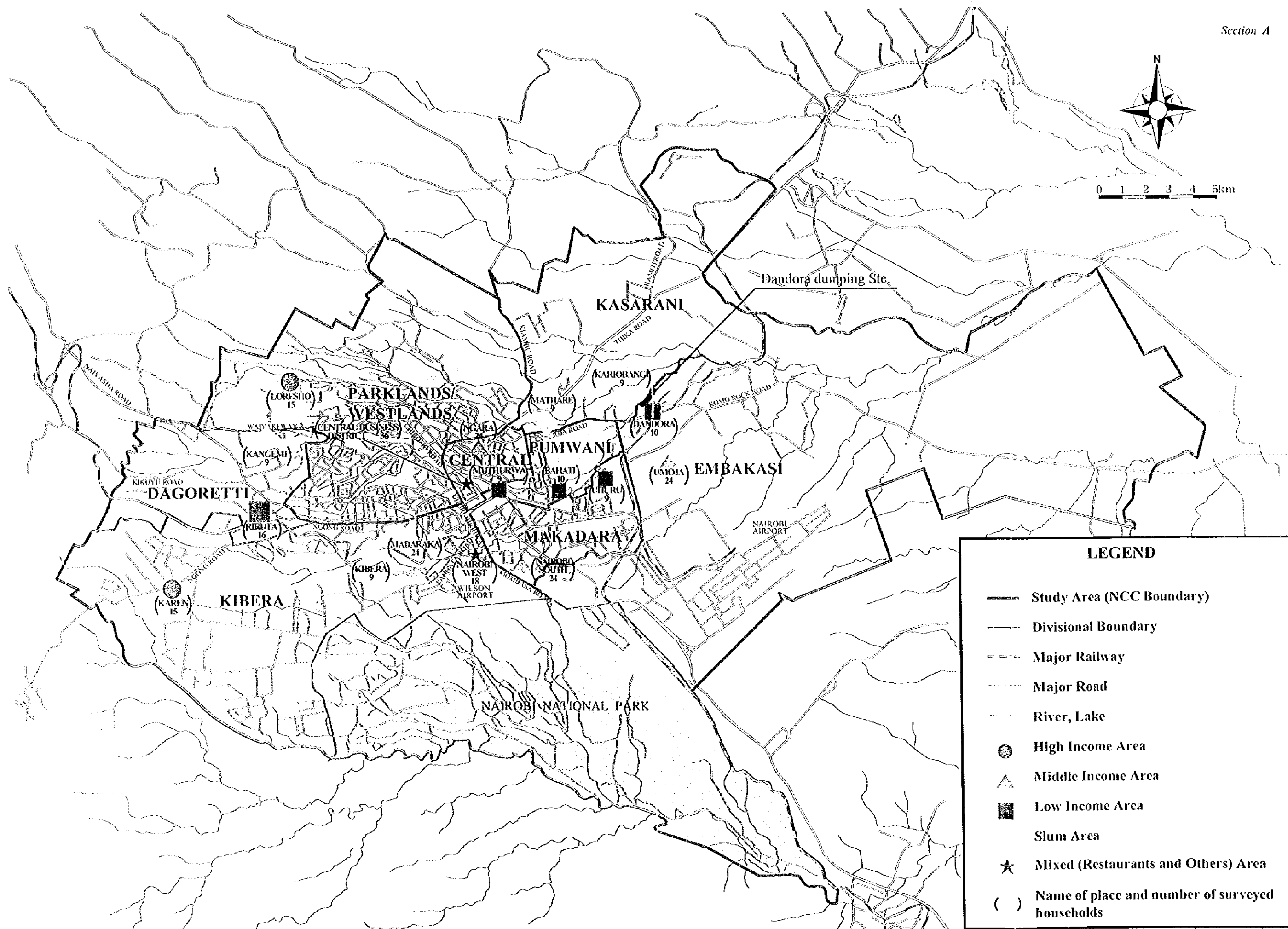


Figure A.1-1 Locations of Sampling Households for Waste Generation and Composition Survey

Table A.1-1 Number of Waste Generation Samples and Composition Survey

Generation source		Number			Characteristics	
	House type	Samples per day	Survey days	Total samples	Physical Composition	Chemical Composition
Mixed	restaurant	36	7	252	252	1&3*
	others	18	7	126	126	1&3
High income	house	21	7	147	147	1&3
	flat	9	7	63	63	
Middle/high income	house	24	7	168	168	1&3
	flat	24	7	168	168	
Middle/low income	house	24	7	168	168	
	flat	24	7	168	168	
Low/high income	house	18	7	126	126	1&3
	flat	18	7	126	126	
Low/low income	flat	18	7	126	126	
Surrounding area	house	18	7	126	126	1&3
	flat	18	7	126	126	
Markets		3	7	21	21	1&3
Roads		7	7	49	49	0
Compost		0	0	0	0	1&3
Total		280		1960	1960	8&24

* One sample in the first survey and 3 samples in the second survey

The sampling methodology for the collection and analysis of waste samples was as follows:

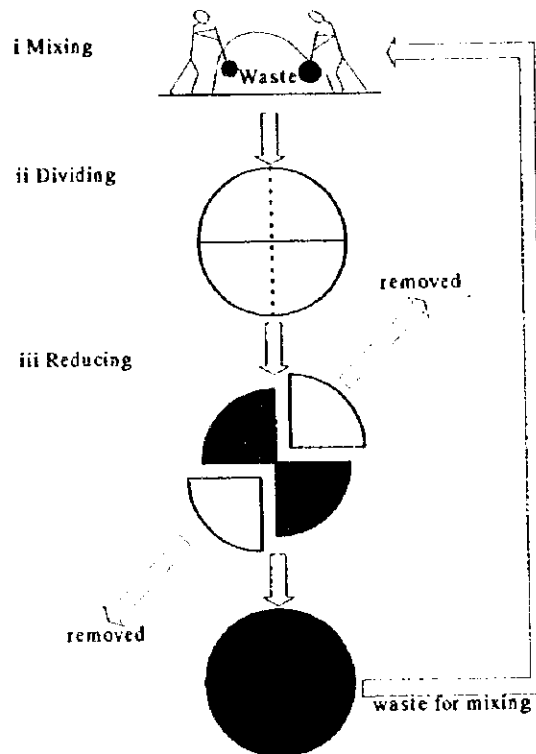
- (a) Taking the daily fluctuation of generated solid waste into consideration, the sampling and physical analysis were conducted continuously for 8 days from May 2 to May 9, 1997 in the First Survey, and from November 5 to November 11 in the Second Survey. The data collected on the first survey day were for reference only and the results were disregarded for reporting purposes.
- (b) Two survey teams were organised, that is, one team was to collect the samples and the other team was to analyse the solid waste. Several sampling teams consisting of 3 to 4 members collected samples all over the city. The teams moved between target areas and the sorting place. Six analysis teams also consisting of 3 to 4 members each waited for the samples and sorted them rapidly upon arrival at the sorting place.
- (c) The survey teams were briefed on the objectives of the project and the sampling and work methodology in advance.
- (d) NCC provided a measuring place and a depot for analysing the collected samples for 8 days.
- (e) The consultant prepared the tools, equipment, furniture, stationery, etc., required for sampling and analysing of solid waste. Plastic bags for collection, plastic sheets, plastic buckets, brushes, gloves, and balances for sorting were also acquired as project requirement. A label was put on

Section A

every plastic bag clearly identifying the survey date, generation sources, and house number.

- (f) The households sampled were questioned in advance as to household number and their agreement to participate in the data collection and sampling process to avoid any interruption of the collection and analysis during the survey period.
- (g) On the day before the first day of survey, the sampling teams were divided suitably to reach the target areas. The households were informed of the objective of the survey, and houses in selected locations were chosen at random. Furthermore, 0.75m × 0.95m black plastic bags for waste collection were distributed in advance. On the first day, two bags were distributed so as to avoid any mishap or not getting the sampling bag back the following day.
- (h) In market and commercial areas, the supervisor of the market, shop or road, who was responsible for the collection of waste samples, was informed of the survey in the same way as the households.
- (i) In the morning of the following day, the samples were collected from the selected households and areas. The samples were then sealed, marked and kept in a safe condition.
- (j) The samples collected in plastic bags from the areas except markets were transported immediately by the sampling team to the depot at Dandora for measurement. Volumes were measured, and the physical composition of each sample was analysed by the analysis team.
- (k) The samples from markets were at first transported by NCC vehicle to the weight bridge for the measurement of weight and volume, then to the depot at Dandora where the physical composition of each sample was analysed. Since the volume from markets was too large, the waste was reduced to 20-50 litres by mixing and dividing it into approximate quarters, removing 2 blocks, then continuing the above method, as illustrated in **Figure A.1-2**.
- (l) The houses from where the samples were collected in the morning were provided by the sampling team with another set of plastic bags in the afternoon for waste generated the following day.
- (m) Chemical analysis was carried out for the representative sample from each generation source except the road sample in the middle of each survey period (6th of May and 10th of November). The compost sample was also subjected to chemical analysis. One sample from each generation source was analysed in the first survey while 3 samples were analyzed in the second survey.

Responsibilities and the survey chart are as shown in **Table A.1-2** and **Figure A.1-3**, respectively.



- i Mixing : In case that large size waste (e.g., cardboard, textile, etc.) is contained in the waste, those big size waste should be cut and made small, then mixed again.
- ii Dividing : Waste should be divided into four blocks of almost the same volume.
- iii Reducing : The diagonal two blocks of waste divided into four should be removed.

Figure A.1-2 Waste Reduction Method

Table A.1-2 Responsibility for the Waste Generation and Composition Survey

		Mixed	Residential	Market	Road	Compost
Discharge		Owner	Housekeeper	NCC	NCC	-
Collection		Consultant		NCC	Consultant	-
Container		Plastic bag		Truck	Plastic bag	-
Measure	Weight	Consultant		NCC	Consultant	-
	Volume	Consultant				-
Analysis	Physical composition	Consultant				-
	Chemical composition	Nairobi University				-

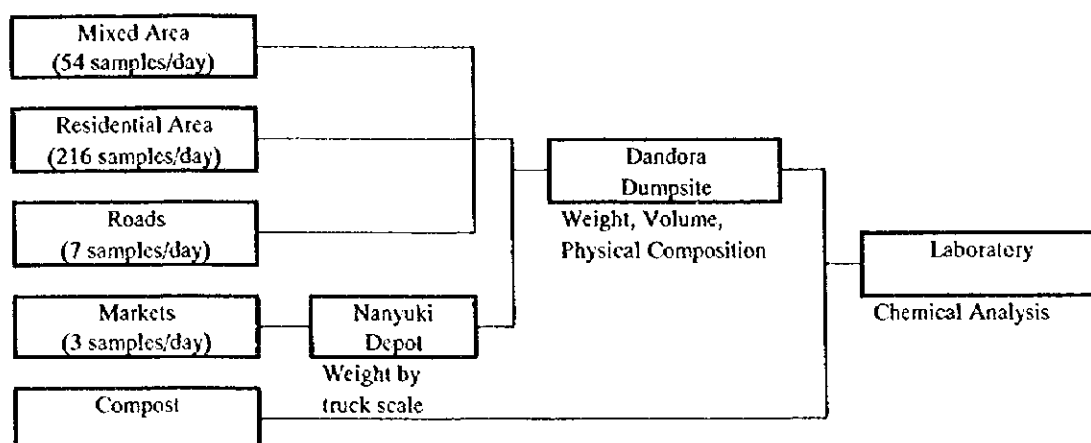


Figure A.1-3 Survey Chart of Waste Generation and Composition

1.3 Characteristics of Each Generation Source

(1) Mixed Area

Mixed areas were categorised into restaurants and others.

Wastes from mixed areas are mainly generated from commercial centers, shopping areas, and facilities like hotels and restaurants where food is served to the general public. Thirty-six (36) restaurants in the city where food and drinks including lunch, dinner and snacks are served for low, middle and high income customers during the day and night were chosen. Sampling bags were distributed by the sampling teams for restaurants to store the generated solid waste.

The 'others' category include solid waste from apparel shops, drugstores, chemist shops, groceries, hardware stores, and other miscellaneous retail trade establishments. Eighteen (18) of such enterprises as hardware, chemist and print shops which cater for general products and household items were chosen.

(2) Residential Area

Residential areas consist of high, middle/high, middle/low, low/high and low/low income households, including the slum and squatter settlements in surrounding areas from the socioeconomic point of view.

(3) Market Waste

Like other cities and provincial capitals of the country, Nairobi has also many markets. The markets are either in clusters or scattered in residential areas. The information and data from established markets such as number of stalls, revenue, location, etc., were collected to select the target market. In the first survey, the City Market, the Wakulima Market and the Sharimoya Market were selected on account of their multi-disciplinary commercial activities and different sizes, and because they are the main central markets of the city. In the

second survey, Westlands Market and Kaliokor Market were selected because wastes from City Market and Wakulima Market were being collected by Kenya Refuse Handlers Limited, a private company contracted by the NCC starting in September 1997 due to the privatisation of waste collection in the Central Business District.

(4) Road Sweepings

The waste from road sweepings consist of dirt, muck, stones and debris which are littered or discarded by people. To assess the quantity of road sweepings, the same seven roads were chosen due to their prime location and strategic importance for serving the nearby commercial centers. The traffic load on these roads are also higher as compared to other roads. The information about surveyed roads such as name, width and survey length are shown in Table 1.1-1 of Data Book (1).

1.4 Apparent Specific Gravity

The Apparent Specific Gravity (ASG) of solid waste is an important tool to assess the total mass and volume of waste. ASG is calculated by the following formula:

$$ASG = \text{weight of waste (kg)} / \text{volume of waste (litre)}$$

Volume of waste is measured as follows:

After weighing, the waste is thrown into a polyethylene bucket placed on a sheet and measured by visually inspecting the upper line of the waste inside the bucket after tapping it two or three times off the ground at the height of 30 cm. Any waste in excess of the capacity of a bucket after tapping is removed onto the sheet and then loaded into the next bucket, tapped in the same way, and the volume measured.

1.5 Physical Composition

Solid wastes within a city vary considerably with respect to quantity and composition. Information and data on physical composition of solid wastes are important in the selection and operation of equipment and facilities, disposal strategy, processing, and so on. Components that make up typically most of the municipal solid wastes are organic waste, garden waste, animal manure, night soil, paper and cardboard, textile, glass, plastics and polyethylene, ceramics and stone, metals, leather and rubber, wood, etc. The components can vary from place to place.

In view of the heterogeneous nature of solid waste, the determination of waste composition was not an easy task. Strict statistical procedures were found difficult to follow, even if it was not impossible to implement. For this reason, a more generalised and commonly followed standard procedure was adopted for determining the waste composition based on common sense and random sampling techniques.

For every sample collected from each generation source the physical composition of solid waste was measured in wet base. Samples were divided into the following

Section A

10 constituents and weighed. The results of physical composition analysis are then shown in percent.

- (a) Food Waste
- (b) Paper (recyclable and others)
- (c) Textile
- (d) Plastic (container and others)
- (e) Grass/wood
- (f) Leather
- (g) Rubber
- (h) Glass (container and others)
- (i) Metal (container and others)
- (j) Any others

The procedure of physical and chemical composition analysis is as shown in **Figure A.1-4**.

1.6 Chemical Analysis

Information on chemical composition of solid waste is important in evaluating the alternative processing and options such as incineration, composting and energy recovery. Typically, the solid waste is a combination of semi-moist, combustible and incombustible materials. To assess the use of solid waste as fuel, the important chemical properties to be calculated are three: moisture, ash and combustible contents. Other aspects are ultimate analysis of six elements (carbon, hydrogen, oxygen, nitrogen, sulfur and chlorine) and low calorific value. The number of samples for chemical analysis from each generation source including compost was from one to three due to decreasing errors of analysis.

One average and typical sample in the first survey and three samples in the second survey were selected from each generation source except roads in the middle of the survey period (6th of May and 10th of November) and delivered to the laboratory.

The sample for compost was obtained from the City Park Market in the First Survey, and from Dandola Kuku Women's Compost Project and the City Garbage Recyclers in Maringo Estate in addition to the City Park Market in the Second Survey. The compost product was made of leftovers of food waste.

The selected samples were mixed and kept in a plastic bag again after measuring physical composition, and then transported to the chemical laboratory. The analysis for the two surveys was executed under Doctor Oluka at the chemical laboratory of the Nairobi University, in Chiromo campus.

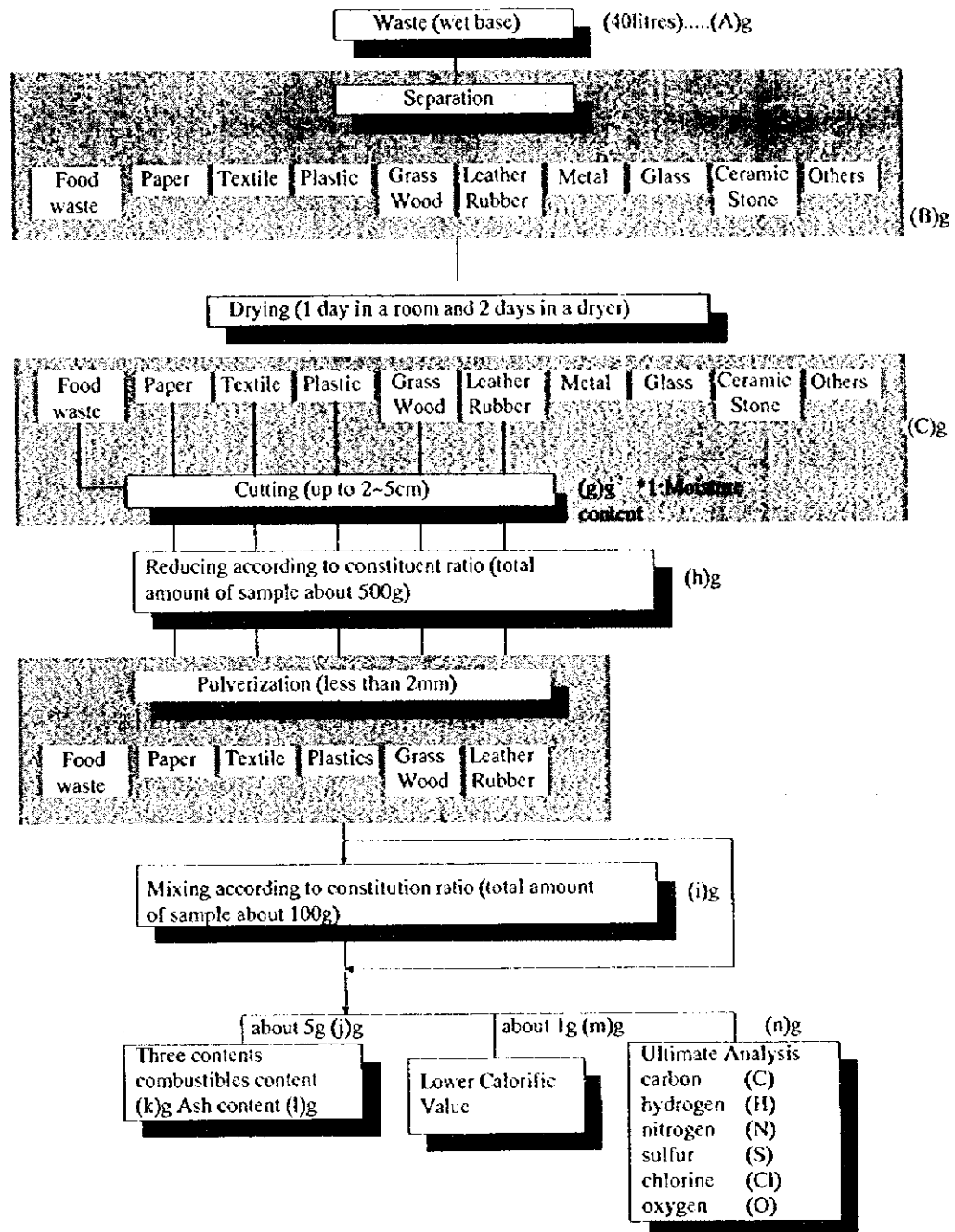


Figure A.1-4 Procedure of Waste Composition Analysis

1.6.1 Three Contents

(I) Moisture Content

The moisture content of solid waste is usually expressed in weight of moisture per unit weight of wet material. To calculate the moisture content, the solid waste sample was dried in a room for 1 day and in a drier at 105°C for more than 2 days until the weight was constant. This temperature and time were used to dehydrate the material completely and to limit the vaporisation of

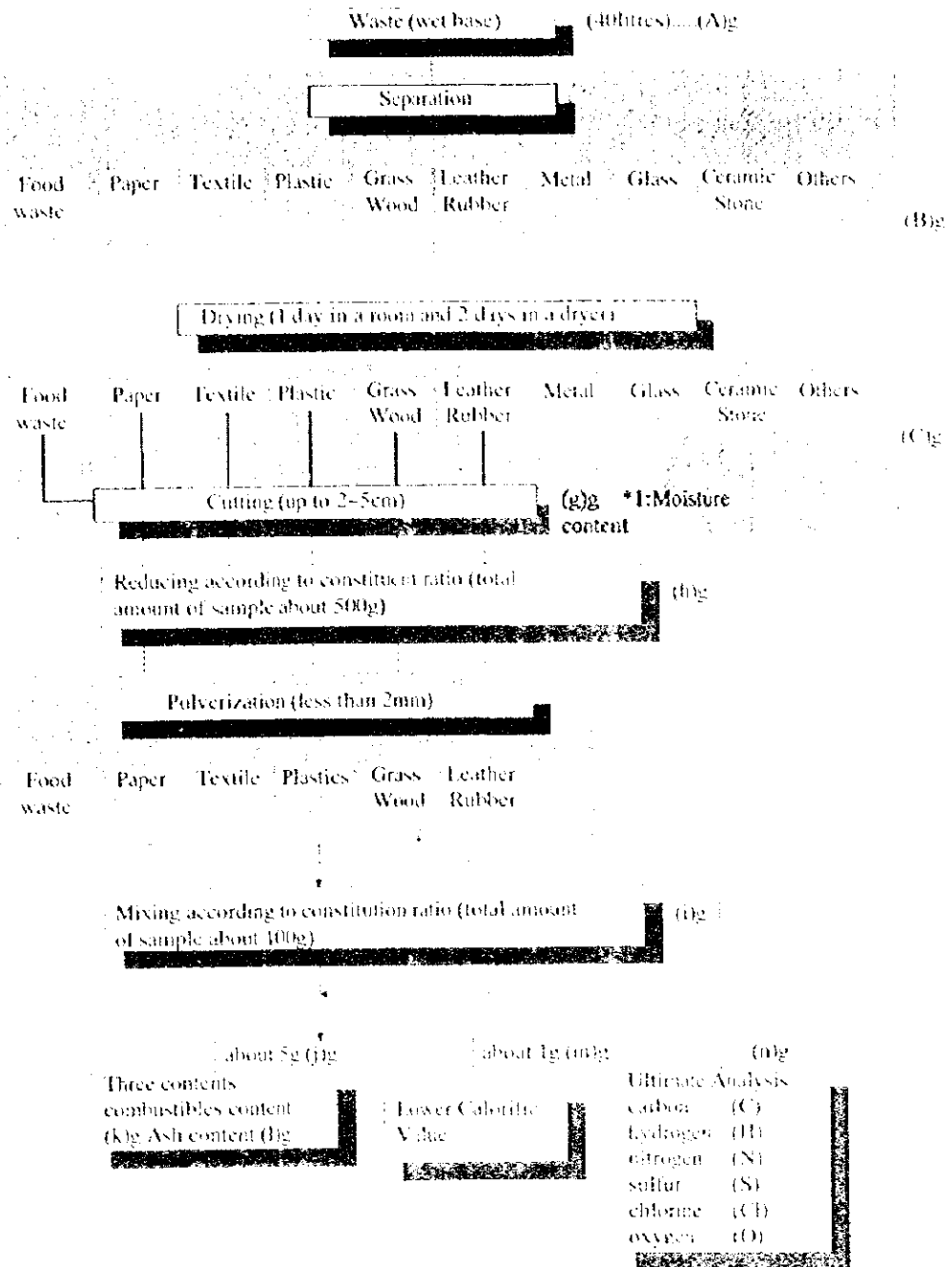


Figure A.1-4 Procedure of Waste Composition Analysis

1.6.1 Three Contents

(1) Moisture Content

The moisture content of solid waste is usually expressed in weight of moisture per unit weight of wet material. To calculate the moisture content, the solid waste sample was dried in a room for 1 day and in a drier at 105°C for more than 2 days until the weight was constant. This temperature and time were used to dehydrate the material completely and to limit the vaporisation of

volatile materials. The moisture content was obtained by subtracting the weight of the dried mass sample from that of the wet mass sample and taking out the percentage.

Moisture Content is calculated by the following formula:

$$\text{MoistureContent}(\%) = \frac{(B - C)}{A} \times 100$$

(2) Ash Content

Combustible samples, i.e., the following 6 constituents were taken after drying:

- (a) Food Waste
- (b) Paper
- (c) Textile
- (d) Plastic
- (e) Grass/wood
- (f) Leather
- (g) Rubber

Each combustible sample was cut into 2 to 5 cm. The sample was reduced up to totally 500 grams in accordance with each constituent ratio. Then each combustible sample was pulverised into fractions of less than 2 mm in size by the cutting mill. After pulverisation, the samples were mixed together again and subjected to heating at 800°C for two hours in an electric furnace. Ash content in this study includes ash after the combustion of combustible matters and the following incombustible items:

- (a) Metal
- (b) Glass
- (c) Ceramics and stone
- (d) Others

Ash Content is calculated by the following formula:

$$\text{AshContent}(\%) = \frac{(l \times \frac{g}{j}) + (e - g)}{A} \times 100$$

(3) Combustible Content

Combustible content is calculated by subtracting the weight of combustion ash from the weight of combustible matters, as follows:

$$\text{Combustible Content}(\%) = 100 - \text{Moisture Content} - \text{Ash Content}$$

1.6.2 Ultimate Analysis

The ultimate analysis of waste component typically involves the determination of Carbon (C), Hydrogen (H), Nitrogen (N), Sulfur (S), Chlorine (Cl) and Oxygen (O). The results of ultimate analysis are used to characterise the chemical composition of organic matter in municipal solid waste. They are also used to define the proper mix of waste materials to achieve suitable C/N ratios for the biological conversion process.

1.6.3 Lower Calorific Value

The calorific data on solid waste can be utilised for evaluating the facilities such as incineration, composting and energy recovery. Lower calorific value was obtained by combustion in a calorimeter bomb and measuring water temperature increase in a calorimetric vessel which surrounded the bomb.

2. ANALYSIS OF THE PRESENT WASTE GENERATION AND COMPOSITION

2.1 General

The survey was conducted two times in different seasons to decrease the fluctuation of analysis. The waste generation of the first survey was higher than that of the second survey in every generation source. The reason is assumed to be high moisture content due to rain during the survey period. The result of the first survey, the second survey and the average of the two surveys are as described below.

2.2 Solid Waste Generation from Each Generation Source

The total waste generated by a household was divided by the number of household members to get the average per capita generation rate. The number of members in households surveyed in the two surveys are shown in Table A.2-1 and Tables 1.1-2 and 1.1-3 of Data Book (I). Household sizes were also investigated in the public awareness survey. The results are 5.5, 6.3 and 4.8 in high, middle and low income households, respectively. These values were nearly the same as that of this survey.

Table A.2-1 Number of Households Surveyed

Residential Area	First Survey	Second Survey
High income	6.4	5.7
Middle income	6.1	5.1
Low income	5.0	4.6
Surrounding Area	6.2	5.4

The weight of each generation source is shown in Table A.2-2 and the weight per capita in residential area is shown in Table A.2-3 and Figure A.2-1. The data of each generation source during the survey period are shown in Tables 1.1-4 and 1.1-5 of Data Book (I).

Table A.2-2 Weight of Each Generation Source
(Unit: kg/day)

Generation Source		1 st Survey	2 nd Survey	Average
Mixed (restaurant)	shop	4.90	8.68	6.79
Mixed (others)	shop	1.39	1.39	1.39
High income	household	4.55	3.13	3.84
Middle income	household	4.00	2.67	3.34
Low income	household	3.07	2.37	2.72
Surrounding area	household	3.39	2.75	3.07
Markets	market	2609	2240	2,425
Roads	1 km	43.9	52.6	48.3

Table A.2-3 Weight Per Capita in Residential Area
(Unit: kg/day)

Residential Area		1 st Survey	2 nd Survey	Average
High income	capita	0.759	0.549	0.654
Middle income	capita	0.666	0.523	0.595
Low income	capita	0.614	0.515	0.565
Surrounding area	capita	0.565	0.509	0.537

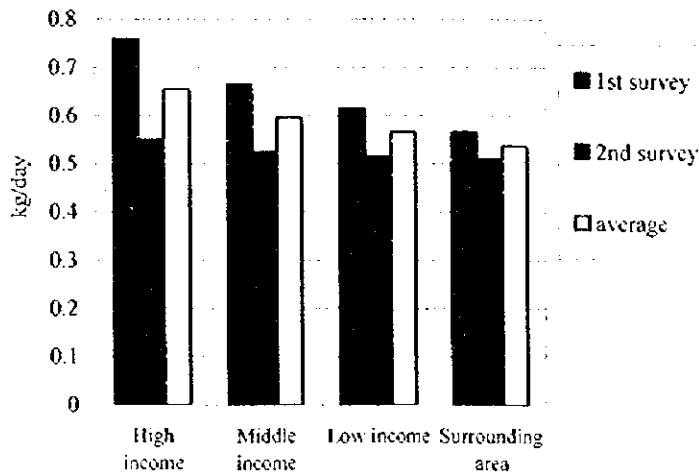


Figure A.2-1 Weight per Capita in Residential Area

The characteristics of each generation source are as described below.

(1) Mixed Area

The quantity for restaurants and others in mixed area were 6.8 kg/shop/day and 1.4 kg/shop/day, respectively.

(2) Residential Area

The average generation rate per capita in high, middle, low income areas and surrounding area was found to be 0.65 kg, 0.60 kg and 0.57 kg and 0.54 kg,

respectively. The generation ratio of solid waste per capita is in proportion to the income.

(3) Market Waste

Solid wastes of 2.4 ton/day were collected by the collection vehicle from each market.

(4) Road Sweepings

The generation ratio of road waste per km was 48.3 kg.

2.3 Total Amount of Solid Waste on Roads

The generation of solid waste per generation source was obtained as above. Therefore, the total amount of solid waste generated in Nairobi City was calculated based on the data furnished by NCC on the following assumptions (basic data was provided by NCC.).

(1) Households

The population in Nairobi City is 2,191,000 in 1997.

The population ratio of high, middle and low income (including surrounding area) is 23.3%, 26.7% and 50.0%, respectively. (Source: *Development Solution for Africa Ltd.: "A Strategic Health Plan for the Nairobi Area", 1992*)

(2) Shops

The total number of shops except restaurants is 39,900. The number of restaurants is 5,600.

(3) Markets

The number of markets is 34 at present in Nairobi City.

(4) Roads

The total length to be swept all over the city is 1,430 km.

Under the assumptions mentioned above, the total amount of waste generation in the first and second surveys and the average of the two surveys are as shown in Tables A.2-4, A.2-5 and A.2-6, respectively.

Table A.2-4 Total Waste Generation Amount in the First Survey

Generation Source	weight per unit (kg)			total number			total weight (t)			
	capita	shops	1 km	person (10 ³)	shops	length (km)	house	shops	road	total
Mixed (rest.)		4.90			5,600			27		27
Mixed (others)		1.39			39,900			55		55
High income	0.76			511			388			388
Middle income	0.67			585			389			389
Low income*	0.59			1,095			645			645
Markets		2,600			34			88		88
Roads			43.9			1,430			63	63
Total				2,191			1,422	170	63	1,656

* Low income includes surrounding area.

Table A.2-5 Total Waste Generation Amount in the Second Survey

Generation Source	weight per unit (kg)			total number			total weight (t)			
	capita	shops	1 km	person (10 ³)	shops	length (km)	house	shops	road	total
Mixed (rest.)		8.68			5,600			49		49
Mixed (others)		1.39			39,900			55		55
High income	0.55			511			281			281
Middle income	0.52			585			306			306
Low income*	0.51			1,095			561			561
Markets		2,240			34			76		76
Roads			52.6			1,430			75	75
Total				2,191			1,148	180	75	1,402

* Low income includes surrounding area.

Table A.2-6 Average of Total Waste Generation Amounts, First and Second Surveys

Generation Source	weight per unit (kg/day)			total number			total weight (t/day)			
	person	shops	1 km	person (10 ³)	shops	length	house	shops	road	total
Mixed (rest.)		6.8			5,600			38		38
Mixed (others)		1.4			39,900			55		55
High income	0.65			511			334			334
Middle income	0.60			585			348			348
Low income*	0.55			1,095			603			603
Markets			48.3		34				69	69
Roads		2,400				1,430		82		82
Total				2,191			1,285	175	69	1,530

* Low income includes surrounding area.

2.4 Apparent Specific Gravity

The results of ASG are shown in Table A.2-7 and Figure A.2-2. The data of each generation source during the survey period are shown in Tables 1.1-6 and 1.1-7 of Data Book (I). The weighted ASG of total waste generated in Nairobi City is also shown in Table A.2-7.

The characteristics of each generation source are as described below.

(1) Mixed Area

The ASG of mixed waste from restaurants and others were found to be 0.28 and 0.26, respectively. There was little difference between the two areas.

(2) Residential Area

The average values obtained for the areas mentioned above were found to be very similar at the values of 0.30, 0.26, 0.28 and 0.27, respectively.

(3) Market Waste

The ASG of market waste was 0.38, the highest among the eight generation sources in both surveys.

(4) Road Sweepings

The ASG of road sweepings was 0.23, the lowest among the eight generation sources in both surveys.

Table A.2-7 Apparent Specific Gravity of Each Generation Source

Generation Source	First Survey	Second Survey	Average
Mixed (restaurants)	0.235	0.317	0.28
Mixed (others)	0.257	0.256	0.26
High income	0.291	0.305	0.30
Middle income	0.281	0.242	0.26
Low income	0.317	0.232	0.28
Surrounding area	0.262	0.269	0.27
Markets	0.419	0.267	0.38
Roads	0.223	0.243	0.23
Weighted ASG	0.291	0.267	0.28

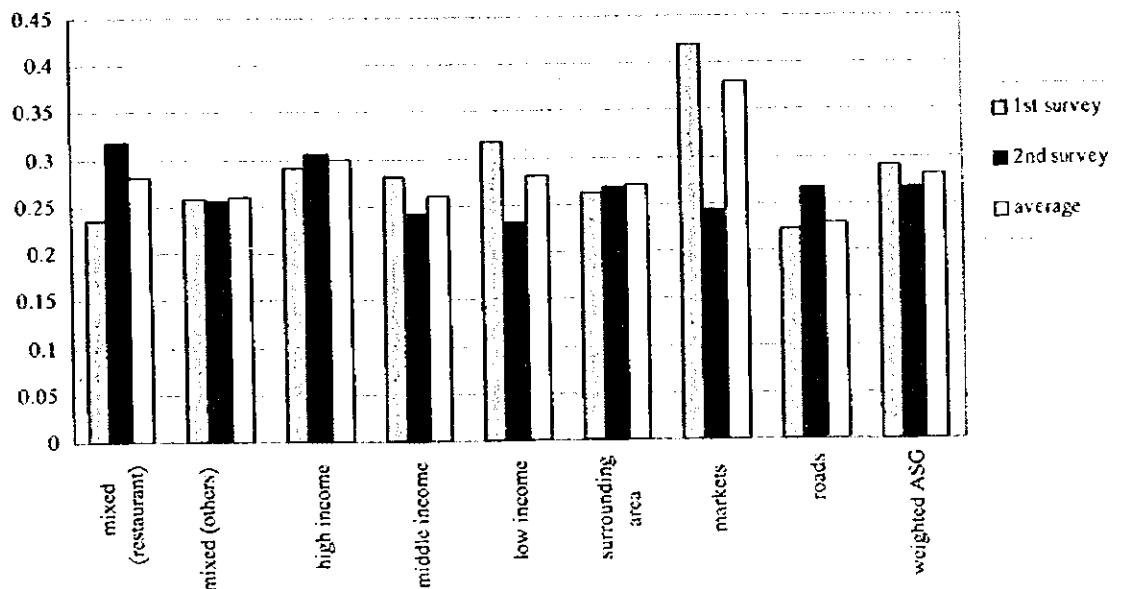


Figure A.2-2 Apparent Specific Gravity of Each Generation Source

2.5 Physical Composition

The physical composition of each generation source in the first and second surveys and the average of the two surveys are shown in Tables A.2-8, A.2-9 and A.2-10 and Figures A.2-3, A.2-4 and A.2-5, respectively. The data of each generation source during each survey period are shown in Tables 1.1-8 to 1.1-23 of Data Book (1).

The following components are the highest according to the results of the two surveys:

- (a) Food waste in mixed restaurants
- (b) Paper, glass and metals in mixed-others
- (c) Textile, Grass/wood and any others in roads
- (d) Plastics in high income area
- (e) Leather in markets

Table A.2-8 Waste Composition in the First Survey

Generation Source		Mixed (rest)	Mixed (others)	High income	Middle income	Low income	Surrounding area	Markets	Roads
Food Waste		41.61%	40.41%	48.57%	51.87%	55.75%	49.45%	49.22%	38.87%
Paper	Recyclable	18.98%	21.58%	18.08%	11.00%	17.15%	18.63%	9.58%	7.40%
	Others	10.75%	0.59%	0.49%	5.70%	0.61%	0.51%	2.51%	12.93%
	Total	29.73%	22.17%	18.57%	16.70%	17.76%	19.14%	12.09%	20.33%
Textile		1.92%	2.36%	2.78%	3.43%	3.18%	3.40%	4.88%	4.22%
Plastic	Container	3.45%	3.81%	5.94%	6.30%	5.23%	4.69%	1.99%	4.93%
	Others	11.23%	10.34%	10.12%	9.03%	8.71%	9.20%	10.73%	9.14%
	Total	14.68%	14.15%	16.06%	15.33%	13.94%	13.89%	12.72%	14.07%
Grass/Wood		2.31%	2.53%	4.75%	4.57%	1.31%	3.73%	16.25%	5.46%
Leather		3.61%	0.42%	0.84%	0.69%	0.50%	0.33%	1.48%	0.43%
Rubber		0.64%	0.45%	0.48%	1.30%	2.50%	1.98%	0.00%	0.76%
Glass	Container	0.59%	7.05%	1.32%	1.54%	0.94%	1.13%	0.85%	0.40%
	Others	0.32%	1.46%	0.48%	0.45%	0.66%	0.35%	0.85%	0.45%
	Total	0.91%	8.51%	1.80%	1.99%	1.60%	1.48%	1.70%	0.85%
Metal	Container	1.92%	4.57%	3.07%	1.41%	1.34%	1.27%	0.21%	2.49%
	Others	0.86%	0.87%	0.88%	0.71%	0.24%	2.08%	0.19%	0.64%
	Total	2.78%	5.44%	3.95%	2.12%	1.58%	3.35%	0.40%	3.13%
Any others		1.81%	3.56%	2.20%	2.00%	1.88%	3.25%	1.27%	11.88%

Table A.2-9 Waste Composition in the Second Survey

Generation Source		Mixed (rest)	Mixed (others)	High income	Middle income	Low income	Surrounding area	Markets	Roads
Food Waste		70.50%	9.64%	53.73%	55.90%	59.31%	67.03%	21.42%	14.71%
Paper	Recyclable	10.04%	68.27%	13.57%	12.04%	13.41%	10.17%	12.29%	11.47%
	Others	5.68%	1.87%	0.37%	6.25%	0.47%	0.28%	3.22%	20.05%
	Total	15.72%	70.14%	13.94%	18.29%	13.88%	10.45%	15.51%	31.52%
Textile		0.21%	0.85%	2.93%	1.49%	0.02%	0.69%	1.25%	8.27%
Plastic	Container	0.62%	1.72%	4.40%	4.74%	5.52%	2.26%	3.64%	3.47%
	Others	1.80%	6.37%	3.00%	4.39%	4.37%	1.82%	6.76%	4.87%
	Total	2.42%	8.09%	7.40%	9.13%	9.89%	4.08%	10.40%	8.34%
Grass/Wood		9.88%	3.65%	14.92%	4.93%	4.17%	10.91%	17.76%	31.52%
Leather		0.04%	0.93%	0.72%	0.71%	0.93%	1.16%	5.94%	1.19%
Rubber		0.09%	0.00%	1.00%	0.57%	1.19%	0.41%	13.97%	1.42%
Glass	Container	0.64%	2.93%	3.37%	1.83%	1.32%	0.41%	1.97%	0.89%
	Others	0.05%	0.64%	0.40%	0.41%	1.27%	1.31%	0.87%	0.28%
	Total	0.69%	3.57%	3.77%	2.24%	2.59%	1.72%	2.84%	1.17%
Metal	Container	0.19%	2.59%	0.84%	2.90%	0.82%	1.28%	2.49%	0.61%
	Others	0.04%	0.47%	0.67%	1.32%	0.52%	1.53%	1.50%	0.54%
	Total	0.23%	3.06%	1.51%	4.22%	1.34%	2.81%	3.99%	1.15%
Any others		0.22%	0.08%	0.08%	2.52%	6.68%	0.75%	6.93%	0.73%

Table A.2-10 Average of Waste Composition, First and Second Surveys

Generation Source		Mixed (res.)	Mixed (others)	High income	Middle income	Low income	Surrounding area	Markets	Roads
Food Waste		55.92%	36.04%	50.00%	53.52%	57.17%	57.74%	36.55%	24.68%
Paper	Recyclable	13.44%	25.22%	16.81%	11.42%	15.65%	14.64%	10.85%	9.79%
	Others	7.60%	0.69%	0.46%	5.93%	0.55%	0.40%	2.84%	17.11%
	Total	21.04%	25.91%	17.27%	17.35%	16.20%	15.04%	13.68%	26.90%
Textile		4.45%	2.14%	2.82%	2.64%	1.91%	2.13%	3.23%	6.60%
Plastic	Container	1.89%	3.47%	5.51%	5.66%	5.35%	3.54%	2.75%	4.08%
	Others	5.89%	9.59%	8.13%	7.13%	6.98%	5.72%	8.93%	6.63%
	Total	7.78%	13.06%	13.64%	12.79%	12.33%	9.26%	11.68%	10.71%
Grass/Wood		6.11%	2.55%	7.60%	4.72%	2.46%	7.12%	16.98%	20.76%
Leather		1.39%	0.45%	0.81%	0.70%	0.68%	0.72%	3.53%	0.88%
Rubber		0.30%	0.39%	0.62%	1.00%	1.98%	1.24%	6.42%	1.14%
Glass	Container	0.84%	6.41%	1.90%	1.66%	1.09%	0.79%	1.36%	0.69%
	Others	0.15%	4.95%	0.46%	0.43%	0.90%	0.80%	0.86%	0.35%
	Total	0.99%	11.36%	2.36%	2.09%	1.99%	1.59%	2.22%	1.04%
Metal	Container	0.87%	4.21%	2.44%	2.02%	1.13%	1.28%	1.15%	1.39%
	Others	0.35%	0.80%	0.82%	0.96%	0.35%	1.82%	0.69%	0.58%
	Total	1.22%	5.01%	3.26%	2.98%	1.48%	3.10%	1.84%	1.97%
Any others		0.81%	3.10%	1.61%	2.21%	3.80%	2.07%	3.87%	5.33%

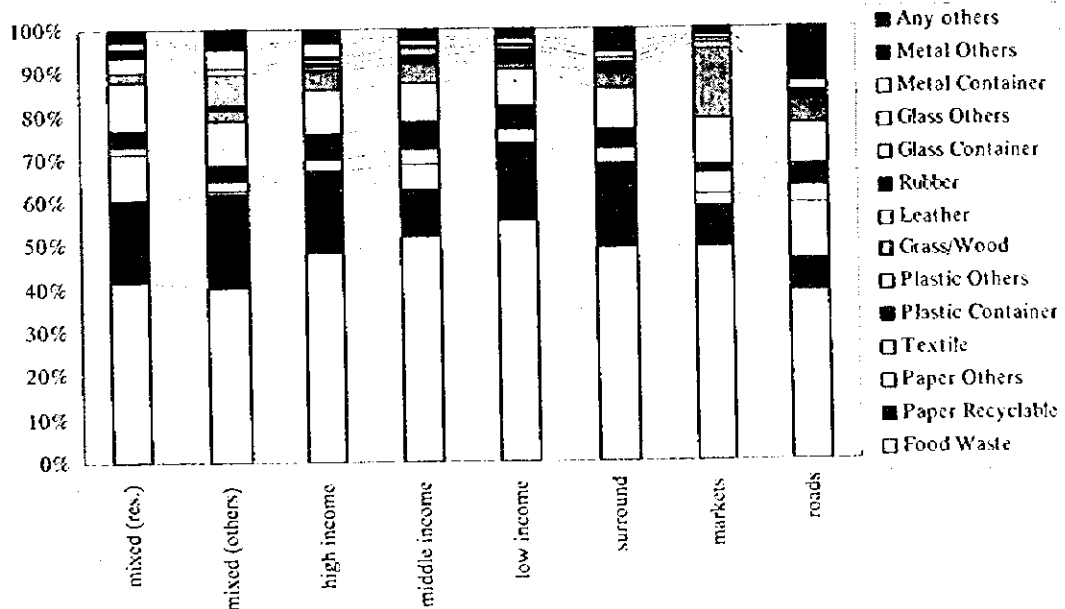


Figure A.2-3 Waste Composition in the First Survey

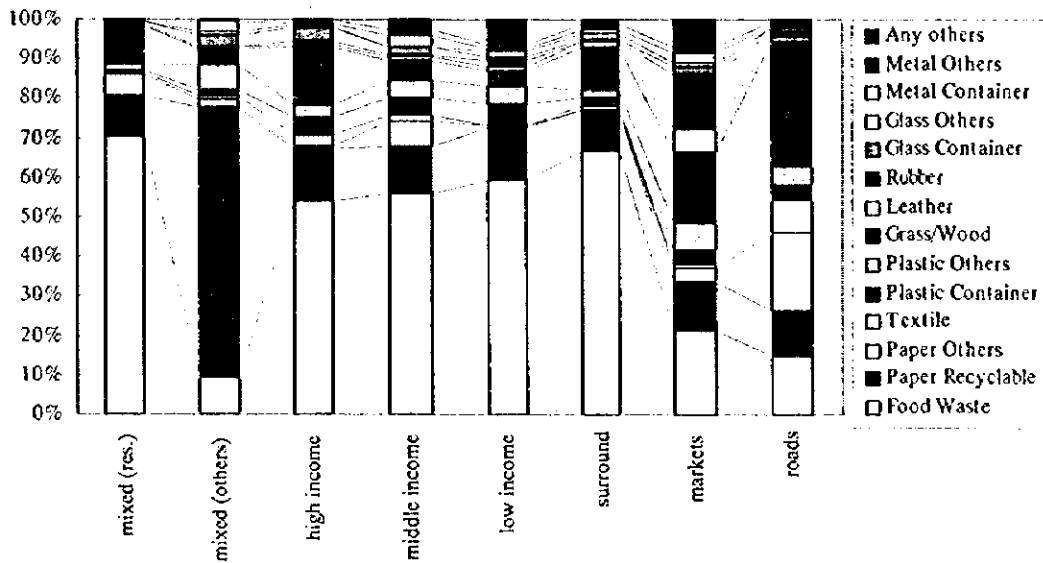


Figure A.2-4 Waste Composition in the Second Survey

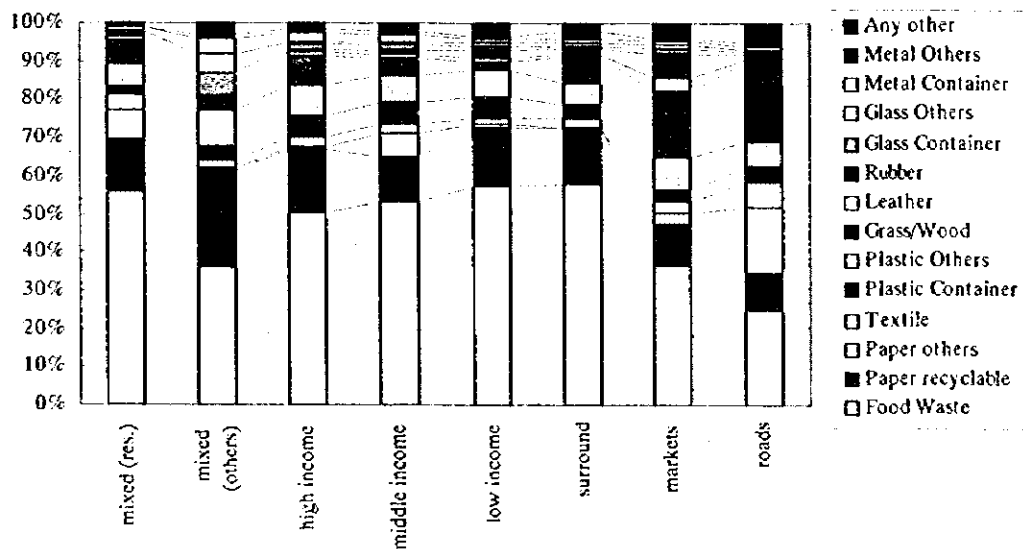


Figure A.2-5 Average of Waste Composition, First and Second Surveys

The weight and weighted rate of each constituent based on the two surveys are shown in Table A.2-11 and Figure A.2-6. The rates of the first and second surveys are nearly of the same value and food waste is around half of the waste amount, followed by paper. The total ratio of recyclable materials from paper, plastics, glass and metals is 22.6% on the average. On the other hand, the ratio of non-combustible materials is 7.6% on the average.

Table A.2-11 Weight of Each Constituent of Total Waste

Constituent	First Survey		Second Survey		Average		
	(t/day)	(%)	(t/day)	(%)	(t/day)	(%)	
Food Waste	830.9	50.4	743.3	53.5	785.2	51.7	
Paper	Recyclable	258.7	15.7	200.2	14.4	220.7	14.5
	Others	39.6	2.4	41.4	3.0	40.9	2.7
Textile	53.7	3.3	21.7	1.6	40.1	2.6	
Plastic	Container	87.2	5.3	54.5	3.9	72.3	4.8
	Others	155.2	9.4	51.5	3.7	109.1	7.2
Grass/Wood	71.1	4.3	140.5	10.1	100.0	6.6	
Leather	11.4	0.7	15.9	1.1	13.5	0.9	
Rubber	22.4	1.4	20.6	1.5	21.6	1.4	
Combustibles	1,530.2	92.9	1,289.6	92.7	1403.4	92.4	
Glass	Container	22.8	1.4	21.5	1.5	23.2	1.5
	Others	8.9	0.5	10.9	0.8	11.9	0.8
Metal	Container	28.8	1.7	21.0	1.5	26.8	1.8
	Others	14.2	0.9	13.6	1.0	14.0	0.9
Any others	42.3	2.6	33.9	2.4	39.2	2.6	
Non-combustibles	117.0	7.1	100.9	7.3	115.1	7.6	
Total	1,645.0	100.0	1,391.0	100.0	1,518.0	100.0	

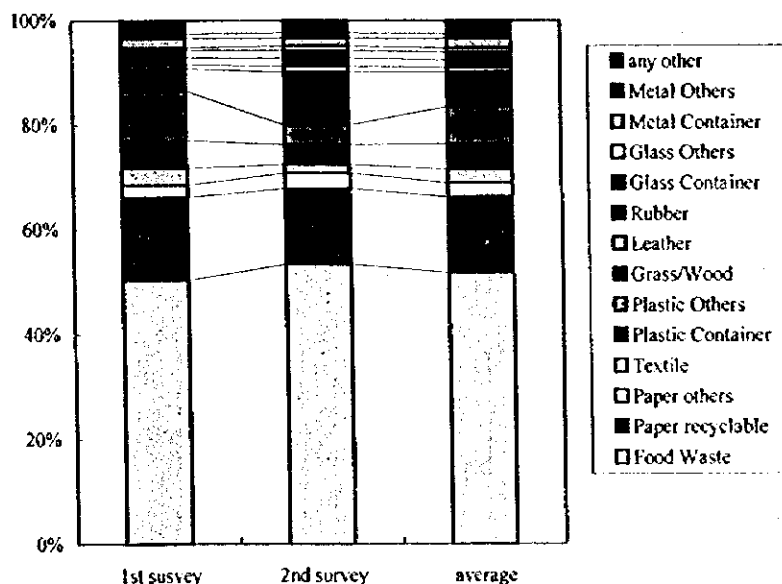


Figure A.2-6 Weighted Rate of Each Constituent of Total Waste

2.6 Chemical Analysis

2.6.1 Three Contents

The results of the three contents analysis are shown in Table A.2-12 and Figures A.2-7, A.2-8 and A.2-9. The data on the 3 samples of each generation source in the second survey are shown in Table 1.1-24 of Data Book (1).

Table A.2-12 Average of Three Contents, First and Second Surveys

	First Survey			Second Survey			Average		
	moisture	ash	combustible	moisture	ash	combustible	moisture	ash	combustible
Mixed (rest.)	60.82%	17.50%	21.68%	52.93%	6.24%	40.82%	56.88%	11.87%	31.25%
Mixed (others)	57.51%	22.68%	19.81%	14.40%	6.08%	79.52%	35.96%	14.38%	49.67%
High income	72.94%	5.61%	21.45%	50.41%	7.87%	41.72%	61.68%	6.74%	31.59%
Middle income	58.60%	7.45%	33.95%	61.72%	7.15%	31.13%	60.16%	7.30%	32.54%
Low income	78.34%	8.90%	12.76%	64.03%	13.44%	22.53%	71.19%	11.17%	17.65%
Surrounding area	80.55%	2.70%	16.75%	65.17%	16.12%	18.71%	72.86%	9.41%	17.73%
Market	64.73%	8.86%	26.41%	53.29%	8.14%	38.57%	59.01%	8.50%	32.49%
Compost	23.75%	54.89%	21.36%	23.76%	55.26%	20.99%	23.76%	55.08%	21.16%

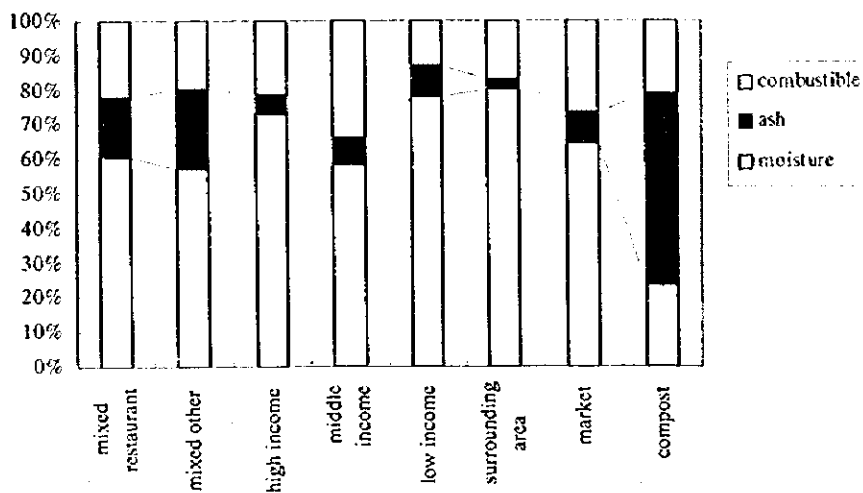


Figure A.2-7 Three Contents in the First Survey

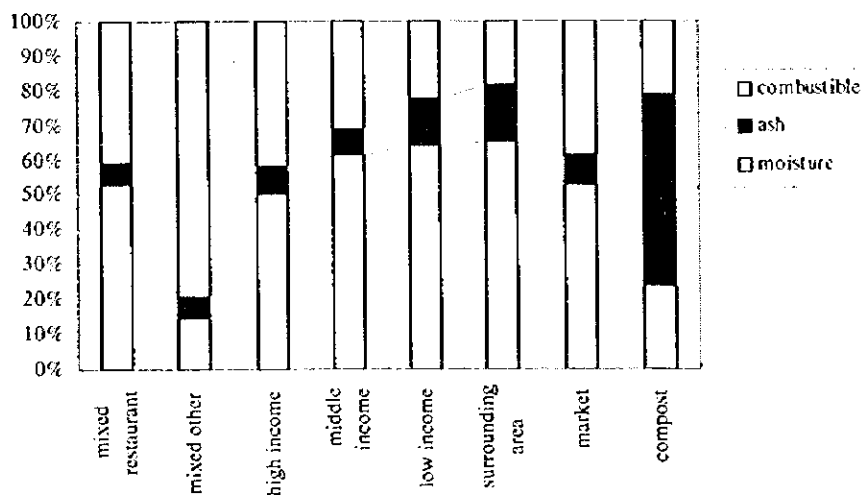


Figure A.2-8 Three Contents in the Second Survey

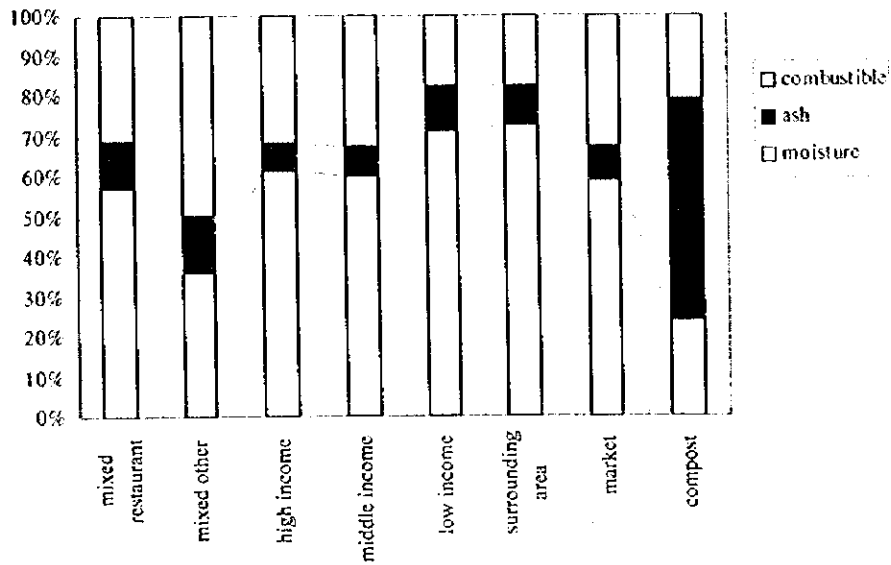


Figure A.2-9 Average of Three Contents, First and Second Surveys

The following components are the highest according to the results of two surveys:

- (a) Moisture in mixed-restaurants
- (b) Ash in compost
- (c) Combustible in mixed-others

The weight ratios of the three contents of total waste generated in Nairobi City are shown in Table A.2-13 and Figure A.2-10. The reason why the ratio of moisture is high in the first survey is assumed to be rain during the survey period.

Table A.2-13 Three Contents of Total Waste

	First Survey	Second Survey	Average
Moisture	70.87%	57.76%	64.34%
Ash	7.12%	10.50%	8.86%
Combustible	22.02%	31.73%	26.80%
Total	100.00%	100.00%	100.00%

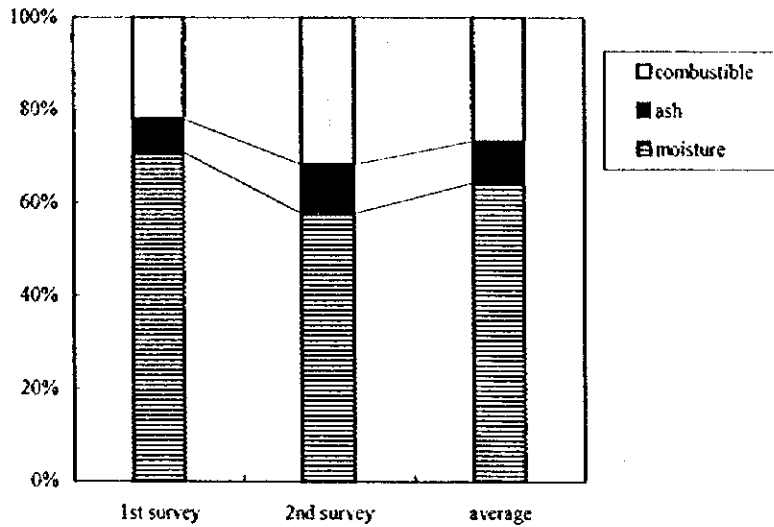


Figure A.2-10 Three Contents of Total Waste

2.6.2 Ultimate Analysis

The results of ultimate analysis are shown in Tables A.2-14, 2-15 and A.2-16 and Figures A.2-11, A.2-12 and A.2-13. The data on the 3 samples of each generation source in the second survey are shown in Table 1.1-25 of Data Book (1).

Regarding ultimate analysis, the following parameters with highest values were found in the areas as tabulated below:

- (a) Carbon and Hydrogen in high income areas
- (b) Nitrogen and Sulfur in compost
- (c) Chlorine in mixed-restaurants
- (d) Oxygen in surrounding area

Table A.2-14 Ultimate Analysis in the First Survey

	carbon	hydrogen	nitrogen	sulfur	chlorine	oxygen
Mixed (rest.)	48.10%	5.90%	1.26%	0.11%	0.38%	44.28%
Mixed (others)	58.27%	4.13%	0.84%	0.12%	0.05%	36.64%
High income	55.91%	3.75%	0.84%	0.07%	0.07%	39.38%
Middle income	49.25%	4.52%	0.57%	0.02%	0.02%	45.64%
Low income	50.17%	6.83%	1.13%	0.08%	0.13%	41.72%
Surround. area	41.61%	3.32%	0.87%	0.09%	0.23%	53.92%
Markets	43.88%	3.46%	0.96%	0.15%	0.63%	50.96%
Compost	36.23%	7.97%	2.29%	0.27%	0.19%	53.20%

Table A.2-15 Ultimate Analysis in the Second Survey

	carbon	hydrogen	nitrogen	sulfur	chlorine	oxygen
Mixed(rest.)	61.60%	7.41%	1.49%	0.16%	1.80%	27.54%
Mixed (others)	50.03%	6.12%	0.10%	0.20%	0.23%	43.32%
High income	49.40%	6.54%	0.89%	0.22%	0.39%	42.56%
Middle income	43.69%	5.64%	1.88%	0.23%	0.14%	48.42%
Low income	50.61%	6.19%	1.74%	0.20%	0.32%	40.95%
Surround. area	46.87%	7.45%	3.79%	0.11%	0.12%	41.66%
Markets	54.77%	6.88%	0.97%	0.30%	0.11%	36.97%
Compost	37.61%	4.67%	5.06%	0.61%	0.18%	51.89%

Table A.2-16 Average of Ultimate Analysis, First and Second Surveys

	carbon	hydrogen	nitrogen	sulfur	chlorine	oxygen
Mixed(rest.)	54.78%	6.64%	1.38%	0.14%	1.08%	36.00%
Mixed (others)	53.63%	5.25%	0.42%	0.17%	0.15%	40.40%
High income	52.74%	5.11%	0.87%	0.14%	0.23%	40.92%
Middle income	46.54%	5.06%	1.21%	0.12%	0.08%	46.99%
Low income	50.41%	6.48%	1.46%	0.14%	0.23%	41.30%
Surround. area	43.96%	5.16%	2.17%	0.10%	0.19%	48.44%
Markets	49.58%	5.25%	0.97%	0.23%	0.35%	43.64%
Compost	36.94%	6.26%	3.72%	0.44%	0.18%	52.52%

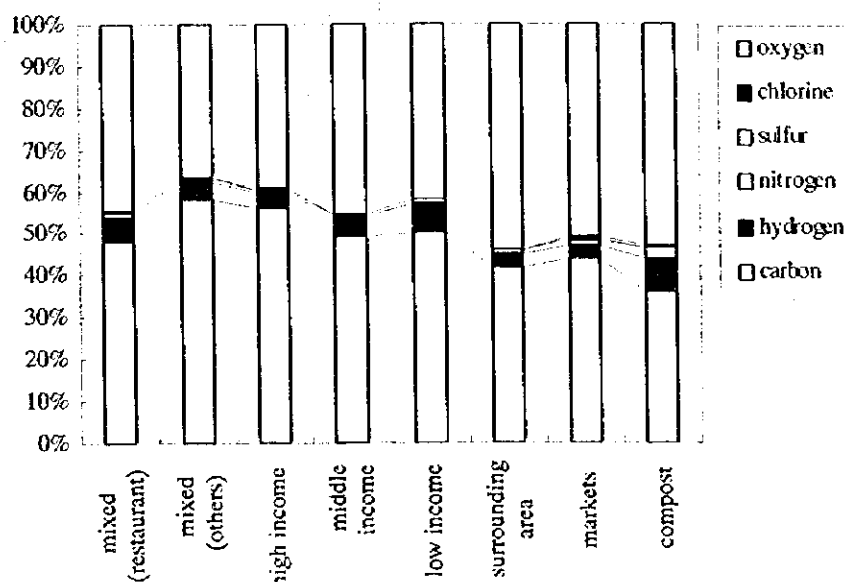


Figure A.2-11 Ultimate Analysis in the First Survey

Section A

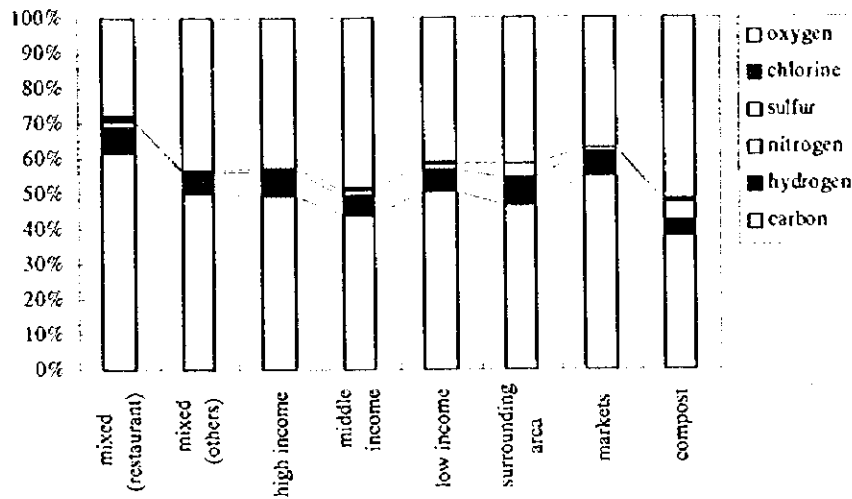


Figure A.2-12 Ultimate Analysis in the Second Survey

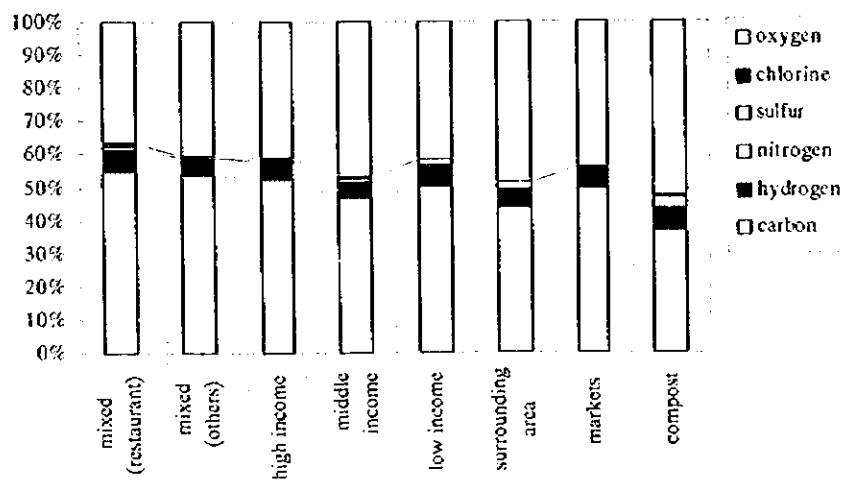


Figure A.2-13 Average of Ultimate Analysis, First and Second Surveys

The weighted ratio of ultimate analysis of total waste generated in Nairobi City are shown in Table A.2-17 and Figure A.2-14. Carbon and oxygen are the main elements and the sum of carbon and oxygen is more than 90%.

Table A.2-17 Ultimate Analysis of Total Waste

	carbon	hydrogen	nitrogen	sulfur	chlorine	oxygen
First Survey	49.65%	4.36%	0.79%	0.06%	0.12%	45.01%
Second Survey	48.99%	6.42%	1.55%	0.21%	0.32%	42.51%
Average	49.33%	5.35%	1.22%	0.14%	0.21%	43.75%

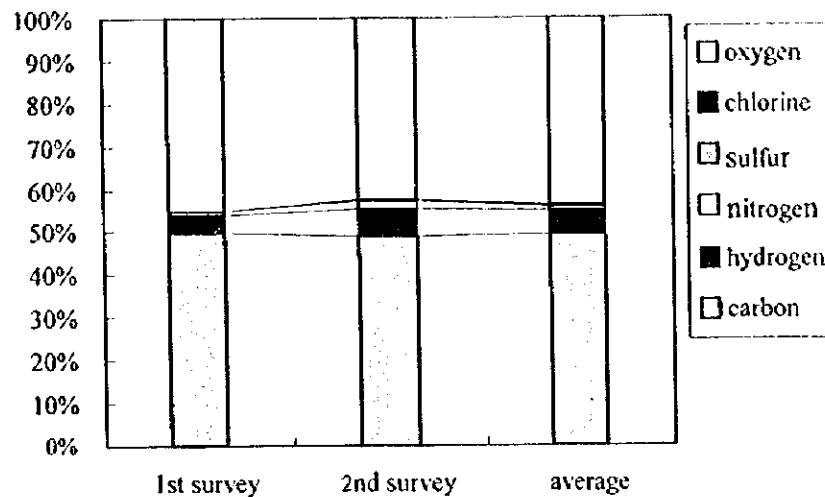


Figure A.2-14 Ultimate Analysis of Total Waste

2.6.3 Lower Calorific Value

The results of lower calorific value are shown in Table A.2-18 and Figure-A.2-15. The data on the 3 samples of each generation source in the second survey are shown in Table 1.1-26 of Data Book (I).

Table A.2-18 Lower Calorific Value
(unit: cal/g)

	First Survey	Second Survey	Average
Mixed (restaurant)	916	2,344	1,630
Mixed (others)	703	2,681	1,692
High income	1,070	1,396	1,233
Middle income	1,537	1,161	1,349
Low income	385	803	594
Surrounding area	756	614	685
Market	1,077	1,777	1,427
Compost	279	113	196

Section A

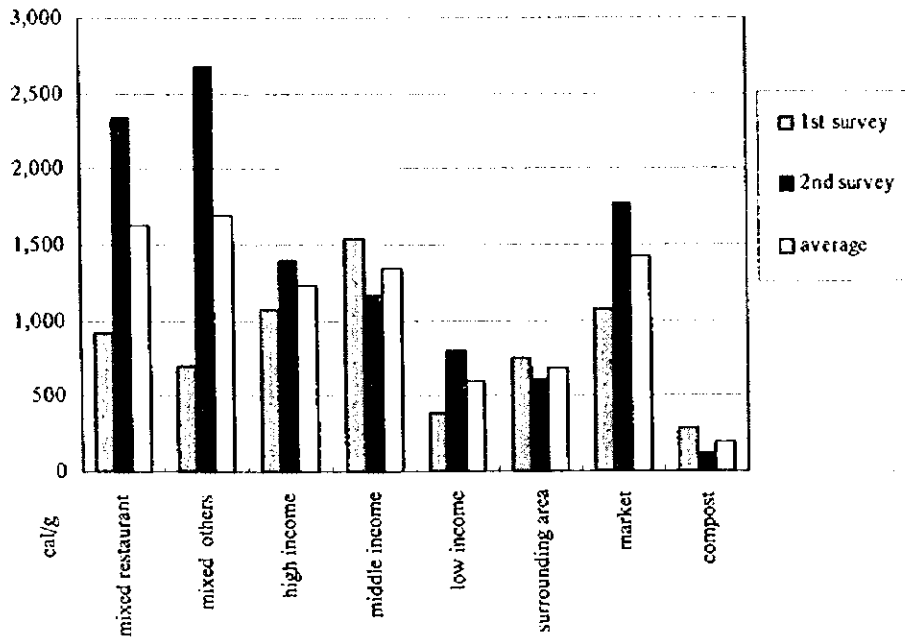


Figure A.2-15 Lower Calorific Value

The weighted low calorific value of total waste generated in Nairobi City is shown in Figure A.2-16. The average value is a little more than 1,000 cal/g.

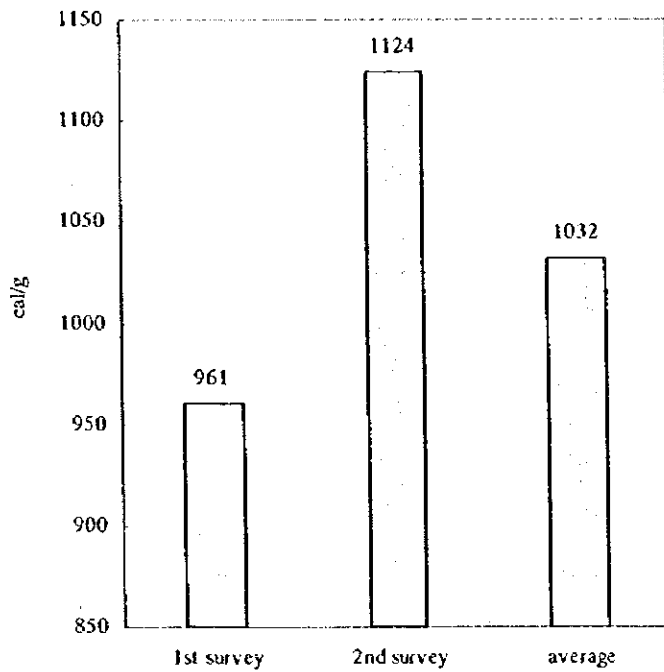


Figure A.2-16 Lower Calorific Value of Total Waste

3. ANALYSIS OF THE FUTURE WASTE GENERATION AND COMPOSITION

3.1 General

This section describes the estimation of future solid waste amount and composition around the year 2008. The forecast model will include interim estimates for the year 1998, 2000, 2004 and 2008. Generally, it is difficult to conduct forecast on future waste amount and composition due to lack of previous data about them. The result obtained in the field survey is therefore the basis of forecasting the future amount and composition.

Social welfare and the financial capacity of single consumers/families as well as the import of goods will have influence on the future waste amount and its composition. From the financial viewpoint, i.e., the Gross Domestic Product (GDP), the waste generated in Nairobi City would be categorised into that of developing countries.

3.2 Forecast on Future Population

The most direct influence on waste amount is the change in population. As described in Subsection 4.2.1 of the Main Report, Master Plan Study, the estimated annual population growth in Nairobi City for the planning period are as tabulated in Table A.3-1 and shown in Figure A.3-1.

Table A.3-1 Forecast on Future Population in Nairobi
(Unit: 1,000 person)

	1997	1998	2000	2004	2008
High income	511	532	574	703	862
Middle income	585	614	674	820	992
Low income	1,095	1,147	1,252	1,489	1,776
Total	2,191	2,294	2,500	3,012	3,630

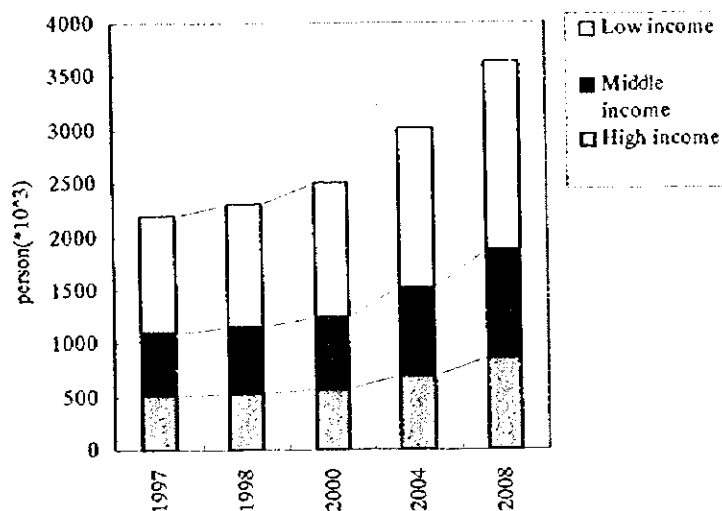


Figure A.3-1 Forecast on Future Population in Nairobi

3.3 Relationship between GDP and Waste Generation

The increased amount of welfare is taken into account in order to determine the relationship between GDP and the waste discharge amount. Statistical data on waste discharge amount in the developing economy of a developed country are very important to forecast the future waste amount.

Growth rate in GDP is expected to have a larger impact on the waste discharge amount in developing countries than in developed countries. Also, growth rate in GDP will remarkably result in changes in the composition of waste at a certain welfare level.

The Tokyo Metropolitan Area has fine statistics allowing for analysis of the relationship between GDP and waste discharge amount in a developing economy. The increase rate of discharge amount/capita and growth rate in GDP/capita between 1956 and 1968 were as follows (GDP/capita in 1956 in Japan was about US\$350, which is nearly 1.3 times as much as that of Kenya in 1997):

- (a) Average increase rate of discharge amount/capita: 7.2% per year
- (b) Average growth rate in GDP/capita: 14.2% per year

The waste discharge flexibility is defined as the ratio of increase rate of discharge amount per capita to growth rate in GDP per capita in percent. Based on these figures, it is assumed that the waste discharge flexibility is as follows:

Flexibility: 0.51 of GDP per capita change in percent

Another study in Bangkok between 1990 and 1995 also shows the same relationship as follows:

- (a) Average increase rate of discharge amount/capita: 4.3% per year
- (b) Average growth rate in GDP/capita: 8.3% per year

Based on these figures, it is assumed that the waste discharge flexibility is as follows:

Flexibility: 0.52 of GDP per capita change in percent

Considering the above two results, the waste discharge flexibility in this study is assumed at 0.5 of growth rate in GDP per capita in percent.

3.4 Methodology for Selecting the Forecast Model

The forecast of total waste amount will require a study on the relation between GDP and the generation of waste. For the type of wastes to be forecast, the conditions of the estimation are as set out below.

(1) Commercial Waste (restaurant, others)

Commercial waste generation are forecast based on the number of shops which will increase in accordance with the increase in population.

The commercial waste of each location is based on the number of shops in each location at present. The rate of this number is shown in **Table 1.2-1 of Data Book (1)**. The population at daytime is higher than that at night due to commercial activity. The increase of waste by the increase of business people who work in the city at daytime is counted as commercial waste.

(2) Household Waste

The data on waste generation amount per capita was obtained in the field survey. Waste discharge amount was calculated by subtracting self-disposal amount from waste generation amount.

The self-disposal amount per capita was calculated by the result of a socioeconomic and public awareness survey on households in Nairobi City in May 1997. This survey covered 504 households consisting of high income (49 samples), middle income (100 samples), low income (197 samples) and slum areas (158 samples). This survey shows that 15, 14, 1, and 4 households in high, middle, low and slum area, respectively, utilise food waste for Mulch or Compost. In addition, garden waste is heaped, burnt or composted by 22, 41, 64, and 11 households in high, middle, low and slum areas, respectively. The self-disposal ratio in the residential area is assumed to be constant.

Waste discharge amount was calculated by multiplying the discharge amount per capita by the population of each income level, i.e., high, middle and low income. As previously described, the waste discharge amount per capita was assumed to increase according to 0.5 of GDP per capita in percent.

The future waste generation, self-disposal and discharge is shown in **Table A.3-2** and in **Table 1.2-2 of Data Book (1)**.

(3) Market Waste

Market waste generation is also forecast based on the number of shops in the market which will increase in accordance with the increase in population.

(4) Road Sweepings

Waste generation ratio regarding road waste will not change and it is projected based on the length of road for sweeping service which will increase in accordance with GDP growth. Therefore, road waste generation will increase in accordance with GDP growth.

3.5 Forecast on Waste Amount

Based on the above-mentioned assumptions, the results of the forecast are shown in **Table A.3-3** and **Figure A.3-2**. The detailed data from 1997 to 2008 are shown in **Table 1.2-3 of Data Book (1)**. The data subdivided into each district are also shown in **Table 1.2-4 of Data Book (1)**.

**Table A.3-2 Forecast on Household Waste Amount in Nairobi
(Unit: t/day)**

	1997	1998	2000	2004	2008
Generation	1,285	1,361	1,522	1,943	2,488
Self-Disposal	104	110	123	159	205
Discharge	1,181	1,251	1,399	1,784	2,283

**Table A.3-3 Forecast on Waste Amount in Nairobi
(Unit: t/day)**

	1997	1998	2000	2004	2008
Household	1,181.1	1,251.1	1,398.9	1,784.1	2,283.3
Commerce	93.5	97.9	106.7	128.5	154.9
Market	82.5	86.3	94.1	113.4	136.6
Road	69.0	73.9	84.8	114.4	155.3
Total	1,426	1,509	1,684	2,140	2,730

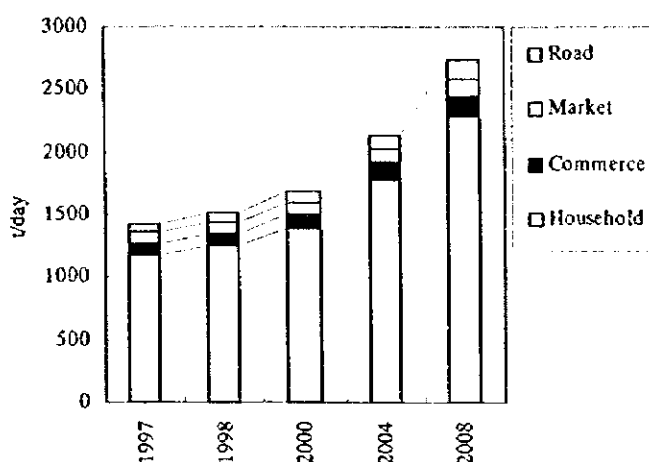


Figure A.3-2 Forecast on Total Waste Amount in Nairobi

3.6 Forecast on Future Waste Composition

A change in the composition of waste is expected due to the following changes in the study area:

- (a) Manufacturing of new products and expansion of industrial activities
- (b) A different consumption pattern and the improvement of standard of living and change in lifestyle
- (c) Rapid urbanisation
- (d) Change from independent houses to aggregate houses
- (e) Increase in income

Regarding the above, there are no data available in the Study area. The analysis, therefore, focused on the comparison of data provided by the results of the field study on waste characteristic.

Table A.3-3 shows the forecast on waste composition. With reference to this table, the frame of the waste composition in 2008 is set as follows:

- (a) Combustibles ratio is decreasing to 85%, and non-combustibles ratio is increasing to 15%.
- (b) Each composition ratio in combustibles (food waste, paper, textile, etc.) and non-combustibles (glass, metals, any others) is constant.

Table A.3-4 Estimated Future Waste Composition in Nairobi

Constituent	1997		2008		
	total (t/day)	rate (%)	total (t/day)	rate (%)	
Food Waste	734	51.5	1,293	47.4	
Paper	Recyclable	206	14.5	363	13.3
	Others	41	2.8	71	2.6
Textile	38	2.7	67	2.5	
Plastics	Container	67	4.7	118	4.3
	Others	102	7.1	179	6.6
Grass/Wood	96	6.7	168	6.2	
Leather	13	0.9	23	0.8	
Rubber	21	1.5	37	1.3	
Combustibles Sub-total	1,317	92.4	2,321	85.0	
Glass	Container	21	1.5	81	3.0
	Others	11	0.8	43	1.6
Metal	Container	25	1.7	93	3.4
	Others	13	0.9	49	1.8
Any others	38	2.7	143	5.2	
Non-combustibles Sub-total	109	7.6	410	15.0	
Total	1,426	100.0	2,780	100.0	

Section A

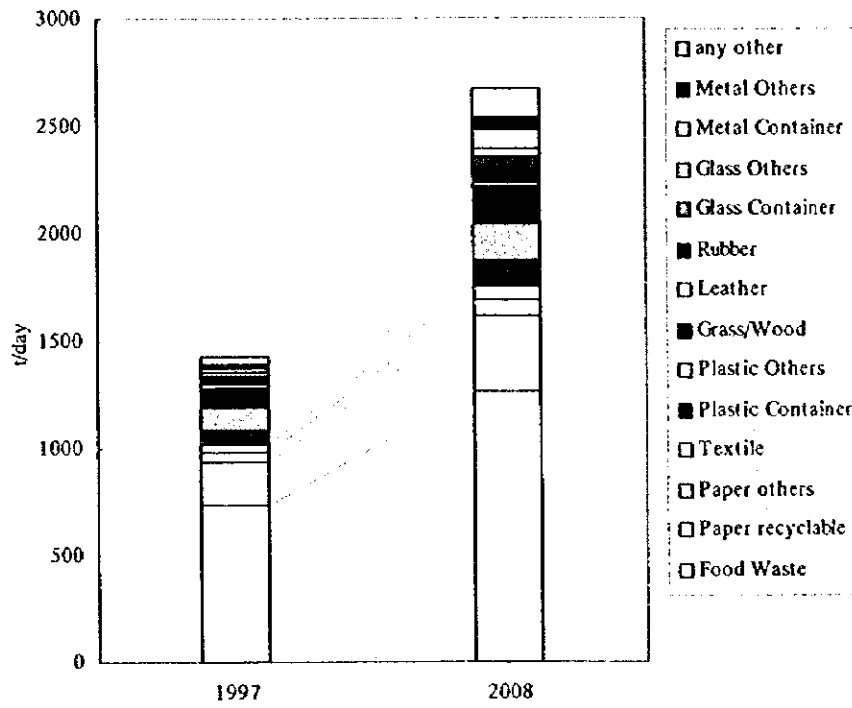
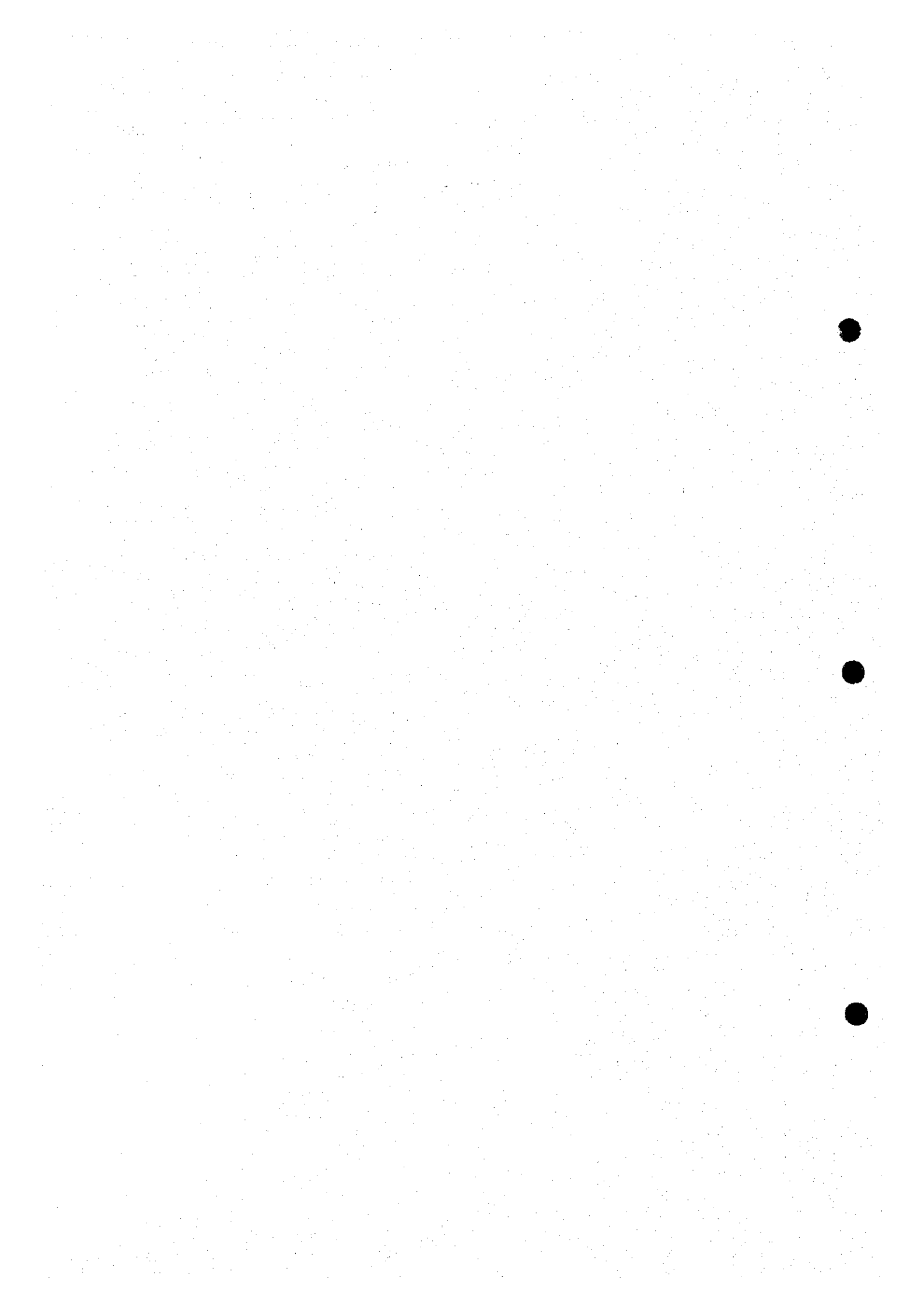


Figure A.3-3 Forecast on Waste Composition in Nairobi

SECTION B
INSTITUTIONAL AND
ORGANISATIONAL STUDY



**THE STUDY ON
SOLID WASTE MANAGEMENT
IN NAIROBI CITY
IN THE REPUBLIC OF KENYA**

FINAL REPORT

SECTION B

INSTITUTIONAL AND ORGANISATIONAL STUDY

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SECTION B

INSTITUTIONAL AND ORGANISATIONAL STUDY

1. INTRODUCTION

1.1. Scope of the Institutional and Organisational Study

The institutional and organisational study for the Study on Solid Waste Management for Nairobi City considers the arrangement of solid waste management (SWM) from a number of institutional perspectives. These are the:

- (a) national responsibilities for SWM, in **Section 1.2**;
- (b) Nairobi City Council's organisation and management, in **Section 1.3**;
- (c) organisation and management of SWM in Nairobi City Council, in **Section 1.4**; and
- (d) management of human resources in SWM in Nairobi City Council, in **Section 1.5**.

A description and evaluation of legal arrangements for the regulation and management of solid waste at both national and local levels are presented in **Supporting Report Section C**.

1.2 Overview of the Main Institutional Issues

Although there are a number of substantial deficiencies in the institutional and organisational arrangements for SWM in Nairobi City there are, nevertheless, opportunities for real reform and capacity building for the Department of Environment and also NCC.

There is now a clear consensus among both the senior officers at NCC, the Ministry of Local Government (MOLG) and in the Government of Kenya (GOK) that the current institutional problems at NCC should not continue. The Presidential Commission on Local Government, the "Omamo Commission" which was set up in 1995 has clearly recognised these problems. The Commission key recommendations cover:

- (a) revenue sharing between central government and NCC of, e.g., the fuel levy, income tax and licence fees;
- (b) political and operational decentralisation of NCC into five boroughs councils and five administrations. This will be shortly considered by NCC; and
- (c) the complete amendment of the Local Government Act.

MOLG has also just implemented a substantial Capacity Building Program (CBP) for Nairobi City Council in collaboration with the UNDP under a UNDP Programme Support Implementation Arrangement (PSIA). The PSIA is based on the UNDP's Programme Support Document (PSD) on the Enhanced Public Administration and Participatory Development (EPAPD) agreed between the UNDP and the Government of Kenya.

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The overall objective of the CBP is to develop and strengthen the management capability of NCC focusing on the key areas of organisational governance, organisational restructuring, human resource development, financial management and revenue generation. A key component of the program will be the rationalisation of staffing needs and numbers.

There has been a positive consensus towards the CBP amongst senior officers in NCC and all parties involved in the program. The CBP comprises eight Program Components and started in January 1998 and will continue for two years until 31 December 1999.

It should be noted that NCC is capable of initiating some organisational changes without external assistance. And it should not be forgotten that not so very long ago good SWM services were effectively delivered to the citizens of Nairobi. There is real hope and vision for a much better future for SWM in Nairobi.

2. DESCRIPTION AND EVALUATION OF CURRENT INSTITUTIONAL AND ORGANISATIONAL ARRANGEMENTS FOR SWM

2.1 Institutional Framework and Responsibilities for SWM at the National Level

The main responsibilities for SWM at national level lie with the Ministry of Local Government (MOLG) and the recently restructured Ministry of the Environment and Natural Resources (MENR).

Other ministries and GOK bodies play minor roles in SWM. These include, amongst others the Ministry of Health (MOH) and the Ministry of Industry and Commerce (MOIC).

2.2 National Overview

The evaluation at the national level considers the fragmentation, overlap, omission and deficiencies in SWM responsibilities amongst national institutions. A preliminary evaluation of the institutional framework shows that there are a number of responsibilities at national level and in Nairobi that are not being performed.

Table B.2-1 below is the national Institutional Responsibility Matrix for solid waste management (SWM) in Kenya. It shows the main SWM responsibilities and which institutions undertake them.

Table B.2.1 Institutional Responsibility Matrix for SWM

	MOLG	MIENR	MOK	MOH	NCC	Private Sector	NGOs
Institutional Responsibilities							
Policy and planning	None, but approves NCC's policies by formal approval of Council resolutions	Only draft policy awaiting formalisation. No planning.	None for industrial waste	None for hospital waste	Environmental Committee sets policy. No planning.	None	None
Legislation	Scattered through Local Government Act and its By-laws	None, but currently formulating an Environmental Bill	None for industrial waste	None for hospital waste. Public Health Act gives general conditions for SWM	Scattered through Local Government Act and its By-laws		
Setting standards, formulating regulations & issuing guidelines	None	None	None for industrial waste	None for hospital waste	None		
Issuing licenses and permits for SWM activities	None	None	None for industrial waste	None. Hospital/clinic set up licence only covers need for pathogenic waste treatment facilities.	None		
Monitoring SWM activities & enforcement	None	None	None for industrial waste	None for hospital waste	Very little. City Inspectorate is responsible for enforcement. Some self monitoring.		
Regulation of private sector involvement:	None. No guidelines produced.	None. No guidelines produced.	None for industrial waste	None for hospital waste	None		
- procurement							
- monitoring							
- enforcement							
Provision of SWM services:	Local Authorities are responsible under the Public Health Act. Local Government Act empowers LAs to provide services.	None	None	None	Collection and transportation. All disposal. All street cleansing. Responsible for all types of waste.	Only collection & transportation.	Some primary collection
- collection & transportation							NCC has no involvement or coordination with them.
- treatment & disposal							
- street cleansing							
Planning & financing capital expenditure	None	None	None	None	All capital investment in SWM	About 60 companies	
Financing operating expenditure	None	None	None	None	Waste charges and tipping fees levied. Mostly financed through "general taxation"		
Research & development	None	None	None for industrial waste	None for hospital waste	None		

Section B

The roles played by NCC, NGOs and Community Groups and the Private Sector are also added to complete the matrix. The responsibilities considered cover:

- (a) policy and planning;
- (b) legislation;
- (c) setting standards and formulating regulations;
- (d) issuing licenses and permits;
- (e) monitoring SWM activities and enforcement;
- (f) regulation of private sector involvement in SWM;
- (g) provision of SWM services;
- (h) planning and financing capital investment in SWM;
- (i) financing operational and capital expenditures; and
- (j) research and development.

Regulation of Private Sector Involvement (PSI) in SWM includes all aspects of PSI, i.e.:

- (a) policy and planning;
- (b) issuing PSI guidelines to local government;
- (c) the contracting process;
- (d) monitoring and enforcement of contracts; and
- (e) central government's monitoring of local government's management of PSI, i.e., a national watchdog role.

2.3 Evaluation of SWM Responsibilities at the National Level

The following issues were identified:

(1) Policy and Planning

Formulation of policy and planning for SWM is almost completely lacking at both the national and local level.

No central government Ministry or body has been assigned with responsibility for SWM policy, planning or the preparation of national standards and guidelines.

The Ministry of Environment and Natural Resources (MENR) should have overall responsibility for all types of solid waste but it has no formal policies and has not formulated any standards or guidelines on SWM yet.

However, MENR is in the process of formulating preliminary SWM policies. Also, the MENR has drafted an environmental policy paper which includes some general policy on SWM and which has received Cabinet approval. It will soon be presented to Parliament as a Session Paper for approval and formalisation. The policy will coordinate all sector policies on the environment.

Similarly, the Ministry of Local Government (MOLG) has no policies, plans or guidelines on how local authorities should manage and regulate their SWM activities or involve the private sector.

The Ministry of Health has no policies, planning or guidelines on hospital waste. Likewise the Ministry of Industry and Commerce has no policy, planning or guidelines for industrial waste.

At the local level, NCC is responsible for its own policy formulation through its Environmental Committee. It has never prepared any comprehensive plans or formulated guidelines for SWM. Policy tends to be centered on major decisions rather than making a set of comprehensive policies, for example there is none for disposal, recycling, PSI, waste prevention, etc.

(2) Legislation

There is no national law on SWM or on the environment. There is no legislation on hospital waste and industrial waste management - neither the MOH nor the MOIC has any legislation which covers these areas.

However, the MENR has formulated the Environmental Management and Coordination Bill. This Bill is being drafted to provide a framework for the coordinated management of the environment. It is still in the drafting stage and therefore its contents are still evolving. At the moment it is being formally drafted in the Attorney General's Office. No decision has been made on when it will be presented to Parliament but it is hoped it will be enacted this year.

The Bill deals with waste management including standard setting, disposal site licensing, the control of hazardous, industrial and hospital wastes and environmental impact assessments.

At the moment NCC relies upon the provisions of the Local Government Act and its By-Laws and the Public Health Act for regulating SWM. There is no categorisation of waste in any of this legislation because it was enacted to cover municipal waste. Since there is no legislation on hospital and industrial waste, NCC and MOLG have assumed that the current legislation covers these categories.

(3) Setting Standards and Formulating Regulations

No central government Ministry or body currently prepares or sets national standards and guidelines on SWM. Additionally, there is no requirement for conducting EIA's nor are there any guidelines for EIAs. At the moment, individual organisations formulate and carry out their own EIAs.

However, it is intended that these activities will be implemented and coordinated at national level by the MENR's National Environmental Secretariat (NES), which will take the leading role in SWM policy and planning.

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NCC itself has no detailed standards, regulations and guidelines on SWM activities.

(4) Issuing Permits and Licenses

No central government Ministry or body issues permits or licenses for SWM activities, e.g., licensing hazardous or hospital waste treatment facilities or landfill sites.

These activities should be implemented and coordinated at national level by the MENR which should take the lead role in SWM policy and planning.

(5) Monitoring and Enforcement

There is no monitoring or enforcement of SWM activities at national level, e.g., monitoring the SWM activities of local authorities, of waste generators or waste operators. NCC carries out minimal monitoring of SWM.

(6) Regulation of the Private Sector in SWM

There are no national laws or any policies which cover private sector involvement (PSI) in SWM. Nor is there any responsibility assigned at central government to give guidance to local government on how to regulate the private sector.

The MOLG as the Ministry responsible for local government services should take the lead to formulate policy and to issue guidelines to local government on how to regulate and manage PSI in their services.

In addition the Ministry should act as a national watch dog and monitor local government's involvement of the private sector, e.g., to ensure compliance with standards of tendering, awarding and monitoring contracts. Local authorities should also be monitored to ensure that PSI is providing value for money and other agreed criteria.

(7) Linkages between Institutions

There is virtually no coordination or linkages between institutions involved with SWM. Coordination of policy, planning and legislation is carried out through the Interministerial Committee on the Environment chaired by National Environmental Secretariat (NES).

Likewise there is little coordination between NCC and central government for SWM policy, planning or legislation.

2.3.1 Ministry of Local Government

(1) Background

Section 16 of the Kenya Constitution empowered the President to establish the Ministry of Local Government and to appoint the Minister of Local Government. The Ministry of Local Government is the parent Ministry for all

local authorities in Kenya and has significant administrative authority and control over their operations and activities.

These administrative authority and control are assigned to the Minister of Local Government under the Local Government Act (CAP 265) in which there are 186 clauses governing the way in which MOLG controls local authorities. Ministerial approval is needed, among other things, for all council resolutions covering:

- (a) all By-Laws;
- (b) annual budgets;
- (c) any contract not given to the lowest tenderer;
- (d) any payment to a contractor under a local Government Loan Authority loan;
- (e) any expenditure funded by service charges; and
- (f) any grant or donation to an outside body.

The Ministry is also the coordinator through which all local authorities are linked to all central government Ministries and to the Parliament.

The total number and types of local authorities in Kenya over which MOLG has responsibility are:

- (a) City Council: 1 (NCC only)
- (b) County Councils: 57
- (c) Municipal Councils: 58
- (d) Town Councils: 34
- (e) Urban Councils: 21

All local authorities are constituted under the Local Government Act as corporate bodies with power to own assets, employ staff, set financial budgets, acquire property, etc. They are governed by Councils and have other administrative powers and duties vested in them under the Local Government Act. They also have political power derived from their electoral mandate.

MOLG's organisation chart is given in Figure B.2-1 below.

(2) Relation of MOLG to NCC

Like other local authorities the relationship between NCC and MOLG is one which is subject to the Ministry's various statutory controls and supervision but it is not totally subordinate.

NCC has its own administrative powers vested in it and political responsibilities towards its citizens derived from its electoral mandate. On the other hand, Ministerial approval is required under a number detailed controls which implies that NCC lacks real autonomy.

The demarcation between these two is a little unclear. In part this is due to deficiencies in the Local Government Act which needs amendment.

Section B

However, the Ministry is now engaged with the UNDP in initiating a substantial capacity building program for NCC which, it is hoped, will have far reaching effects on NCC's governance, service delivery and financial effectiveness. The capacity building program is discussed in more detail in **Chapter 3** below.

2.3.2 Ministry of Environment and Natural Resources

The Ministry of Environment and Natural Resources comprises the National Environmental Secretariat (NES), which is the MENR's environmental coordinating body, the Department of Mines and Geology and the Department of Forests, and the National Environmental Action Plan (NEAP) which has been responsible for formulating the environmental policy and drafting the Environmental Management and Coordination Bill.

Currently NES has no regulatory role. On enactment of the Bill NES will be transformed into the National Environmental Management Agency which will be subsumed under the MENR and will carry out the MENR's environmental regulatory responsibilities.

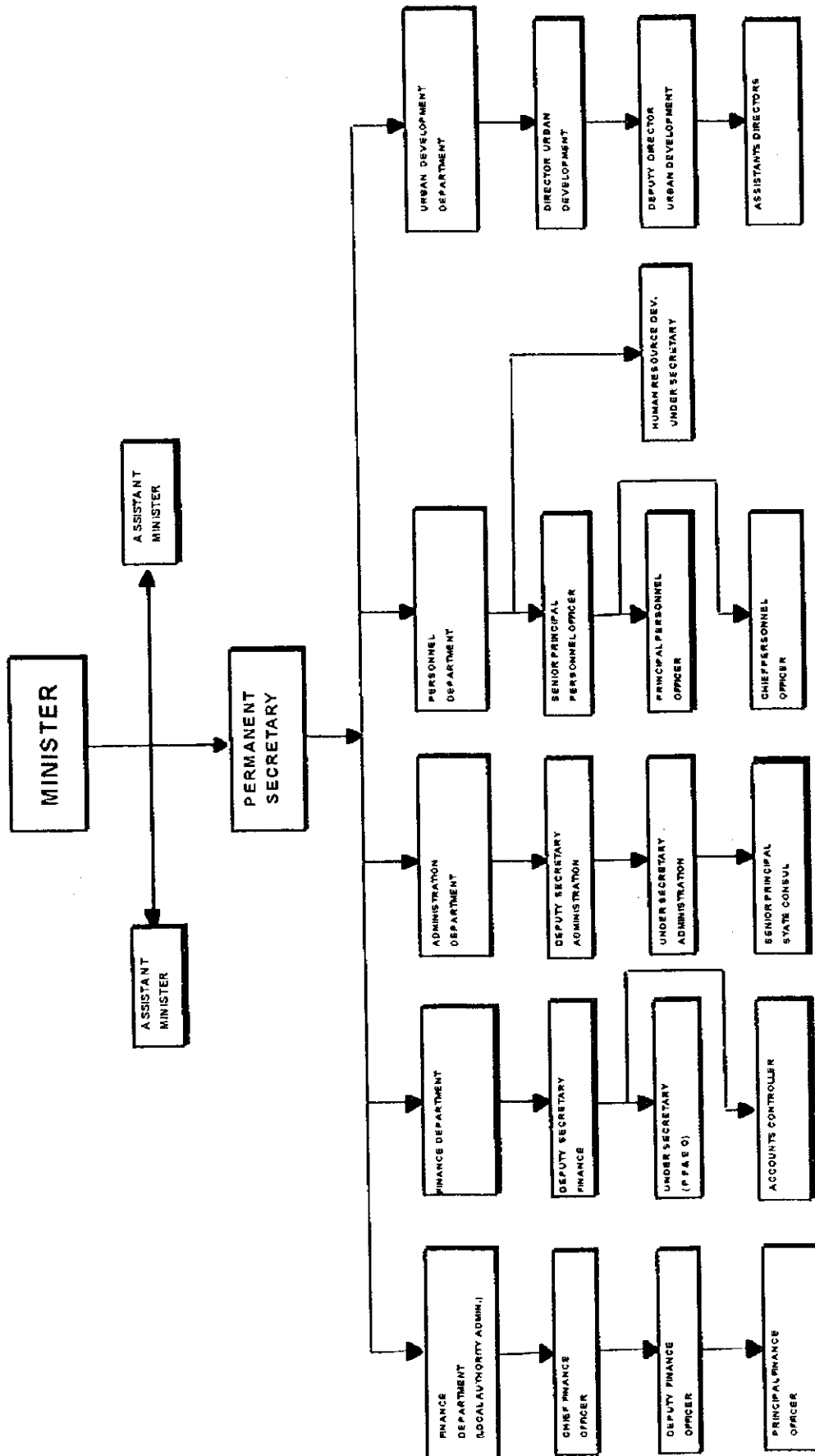


Figure B.2-1 Organisation Chart of the Ministry of Local Government

Section B

The National Environmental Secretariat is still in the process of establishing its policies, legislation and organisational and management structures. NES's current structure will be properly established as soon as the Bill is enacted.

The MENR is to receive a substantial capacity building program for NES from the World Bank focused on training, including:

- (a) establishing an organisational structure;
- (b) setting standards;
- (c) devising regulatory methodologies and procedures; and
- (d) establishing an environmental monitoring and enforcement capacity.

The MENR will also receive capacity building in environmental planning under the UNDP's Capacity 21 program. This will be provided jointly with the Ministry of Planning.

2.3.3 Ministry of Health

The Ministry of Health (MOH) has a general responsibility under the Public Health Act to deal with health hazards arising from problems with solid waste. However, there is no specific legislation on the regulation and management of hospital waste.

The only responsibilities the MOH has towards hospital waste is when new hospitals or clinics are being set up. The MOH is responsible to ensure and approve that all new hospitals' and clinics' arrangements for treating and collecting pathogenic hospital waste are acceptable. There is no monitoring after set up.

The MOH also sits on the Interministerial Committee on the Environment in a purely advisory role.

2.3.4 Ministry of Industry and Commerce

The MOIC has no responsibility under any legislation or any policy initiative at central government level to regulate, monitor or provide disposal services towards industrial waste or any other type of solid waste.

There are no laws or any standards on the management or regulation of industrial waste in Kenya.

The only responsibilities central government has towards industrial waste is when a new industrial company or facility is set up. The Investment Promotion Centre (IPC) - a parastatal under the Treasury - is responsible to approve and screen all new industries including their arrangements for industrial waste. The IPC Act has minimal requirements for industrial waste and after set up there is no monitoring or follow up.

The Ministry is currently formulating a new Industrial Act which may include provisions on managing and recycling industrial waste. The MOIC also sits on the Interministerial Committee on the Environment in a purely advisory role.

2.4 Nairobi City Council

2.4.1 Authority and Legal Base

Nairobi was incorporated as a City Council in 1950 and is the only City Council in Kenya. At the acquisition of independence in 1963 the city area was extended to its current boundaries which cover about 690 square kilometers. In the same year the Local Government Act was enacted by the Parliament.

Since independence the city has grown enormously in population which has created a number of complex social problems. Current population growth is estimated at 7%.

NCC's authority and powers are derived from the Local Government Act and its By-laws. Under the Local Government Act, NCC is a corporate body vested with administrative powers and duties and with its own assets, staff, financial budgets, property, etc. It also has political power derived from its electoral mandate.

The Act empowers NCC as a local authority to make By-laws. Section 201 of the Act gives the local authority power to "make By-laws in respect of such matters as are necessary or desirable." Section 204 stipulates that the By-laws must be submitted to the Minister for his approval.

The Council can also make Council Resolutions which must be approved by MOLG.

2.4.2 Structure and Organisation

Figure B.2-2 gives the organisational chart for NCC. The City Council comprises 73 councilors of whom 55 are popularly elected and 18 are nominated by the Minister of Local Government. One of the nominated councilors is the Provincial Commissioner of Nairobi. Each elected councilor represents one of the city's 55 wards.

The Council is headed by the Mayor. The Mayor's and the Deputy Mayor's appointment are approved by NCC.

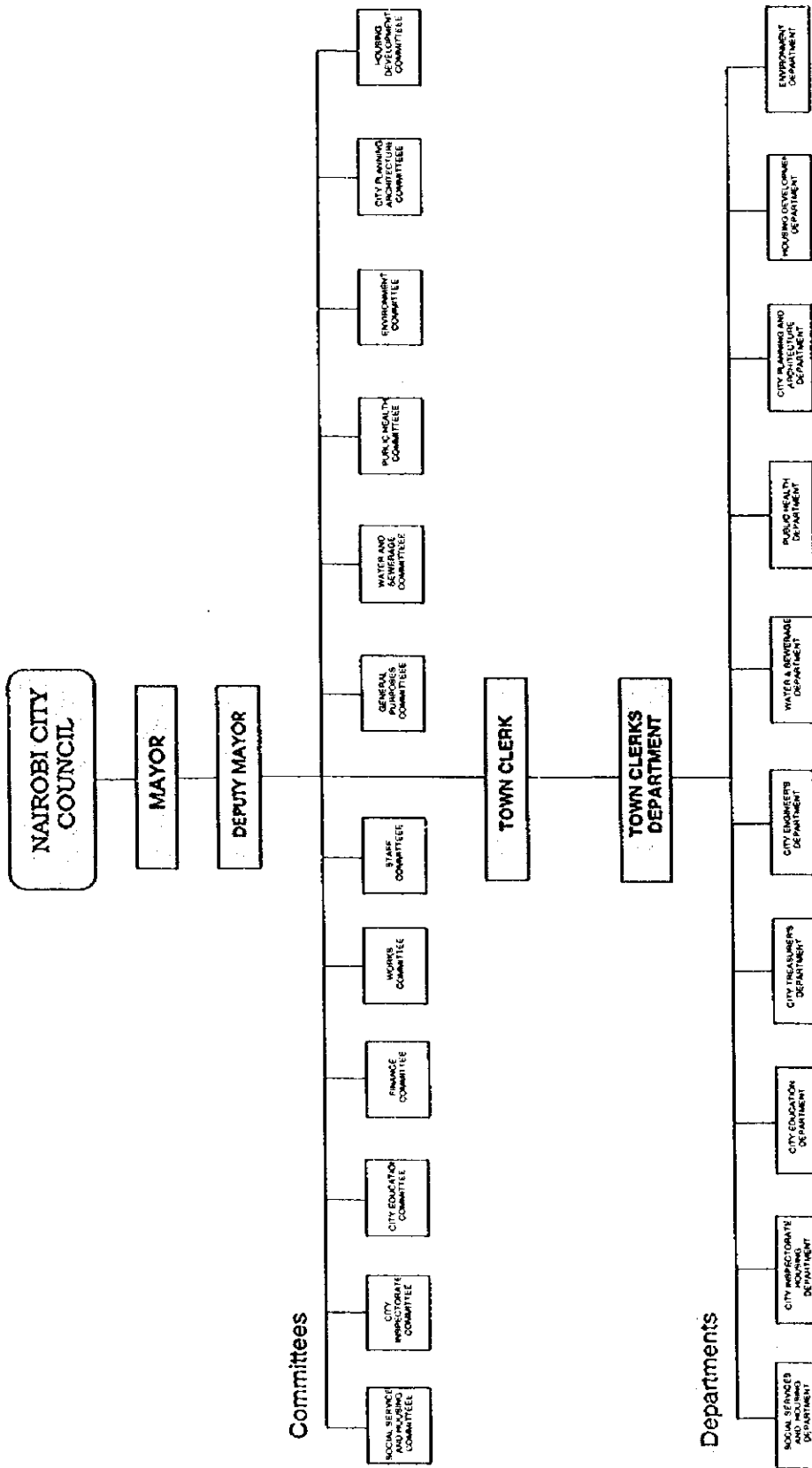


Figure B.2-2 Organisation Chart of the Nairobi City Council

The Council manages its affairs through twelve Council Committees and some of which have Sub-Committees - there are currently five Sub-Committees. Committees are comprised of Councilors one of whom is the nominated chairman. Committees vote by consensus not by majority voting. The Committee quorum is 9. The principal Committees are the General Purposes Committee, the Staff Committee and the Finance Committee.

The Council implements its policies through its executive which comprises eleven Departments including the Town Clerks Department. The executive is headed by the Town Clerk to whom the Heads of Departments report. Each Department other than the Town Clerks Department is governed by one of the Council's Committees. The General Purposes Committee and the Staff Committee do not govern any Department but set general policy for all Departments.

The Heads of Department initiate policy which is then formulated and approved by the Department's governing Committee. Before policy goes through the political approval process, the Head of Department obtains agreement at the Heads of Department meeting. It is then presented to other relevant Committees for approval.

It is obligatory for the Head of Department to attend the Committee. Other chief officers in the administration attend as appropriate. The two most important committees are:

- (a) the General Purposes Committee, which considers all major policy formulation and decisions, e.g., contracting out collection services to the private sector or reorganising of the DoE; and
- (b) the Finance Committee, which considers the annual budget and any decisions which have financial implications.

After the relevant Committees approve proposals they are sent to the full Council for approval as a Council Resolution. All Council Resolutions are then approved by the Minister of Local Government as a formality. The Department is then responsible for implementation.

The Heads of Department meeting acts as a clearing house for inter departmental issues and Council policy.

NCC's structure conforms with the provisions the Local Government Act and has remained virtually unchanged since 1963. Organisation charts of the Town Clerks Department, the City Treasurer's Department, the City Inspectorate, the Department of Water and Sewerage, the City Engineer's Office and the Department of Public Health are given in Section 2.2 of Data Book (1).

2.4.3 Institutional Evaluation of NCC

(1) Background

NCC has had a turbulent history since independence. By the early 1980's a spiral of decline had set in, so that in 1983 the MOLG suspended the Council and appointed several Commissions to run it for 9 years until 1993. The

Commissions were not successful and an elected Council was restored. However, mismanagement continued under the new arrangements.

In 1984 the Local Government Act was amended to transfer the appointment of Senior Council Officers of scale 1 to 9 from the Council to the Public Service Commission (PSC) an independent national body. This change was to have far reaching effects on the subsequent staffing of senior managers. The PSC, not the Council, has the power of appointment, transfer, discipline and discharge over all these employees.

(2) Financial Constraints

Currently the capacity of NCC to deliver its public and statutory responsibilities to the citizens of Nairobi is severely limited. In some areas the Council has virtually ceased to deliver its services. Several institutional deficiencies are contributory but the overriding constraint is financial. This is because of:

- (a) the complete absence of any central government financing of NCC's operational or capital expenditures;
- (b) the financial weakening of NCC as a result of the abolition of the graduated personal tax (GPT). GPT was NCC's main source of financing. In addition central government grants were also abolished. After abolition of GPT, NCC's financial situation began a spiral of decline;
- (c) poor revenue generation. NCC needs to reform its fiscal revenue base to design and set more efficient taxes which are easier to collect, pass the costs of inflation through to citizens and optimise revenues. Land taxes are currently highly inelastic; other charges and taxes are set too low;
- (d) very inadequate billing systems - generally accounting systems are deficient and financial staff lack financial skills;
- (e) poor collection. Collection rates for all revenue sources are low due to (1) citizens' unwillingness to pay because of poor service levels, (2) poor collection systems, (3) some revenue collectors are stealing cash receipts, and (4) debt collection through the courts is difficult because the judicial system is cumbersome and laws are deficient;
- (f) poor financial management and discipline - the absence of effective financial planning and budgetary control systems;
- (g) unrestrained employment policies of the Council which have added large numbers of unqualified and mostly junior staff to NCC's wage bill and severely constrained NCC financially; and
- (h) NCC's financial indebtedness to other GOK bodies.

The tremendous increases in urban population and the commensurate demand for services combined with NCC's financial constraints has meant that NCC cannot resource its services.

NCC's services are entirely financed from NCC's "general taxation", i.e., General Fund and Service Charge revenues. Although Service Charges are only supposed to be used to finance the Council's services they are mostly being used to pay NCC's salaries. In substance they are being spent like general tax revenues.

Currently the City Treasurer estimates that over 85% of collected revenues are spent on salaries. Leaving less than 15% for non salary recurrent expenditures and capital expenditures. Financial reform of NCC is a key priority if it wishes to improve service levels.

(3) Other Institutional Deficiencies

As well as financial constraints there are also a number of other deficiencies: The recent UNDP Sector Review of Nairobi City Council (October 1996) cited a number of problems: These are:

- (a) heads of department and senior officers lack control over their human resources because of serious political interference by Councilors over the appointment, promotion, discipline and discharge of their staff. This has caused significant over-manning at lower levels of staff;
- (b) senior and middle officers poor management capabilities;
- (c) lack of departmental policies and objectives;
- (d) poor organisational structure;
- (e) duplication and overlap of functions;
- (f) ineffective functional relations between the executive and the Council;
- (g) absence of management information systems; and
- (h) lack of equipment and capital investment.

In particular managers and supervisors lack of control over their human resources, particularly at junior levels has seriously constrained the delivery of services.

2.4.4 Impact of NCC's Disfunctionality on SWM Services

NCC's disfunctionalities seriously affect the delivery of the Department of the Environment's (DoE's) SWM services.

The overriding constraint is financial. Solid waste charges are pooled in the general fund. As NCC spends approximately 85% of its general tax revenues on salaries, this leaves very little for SWM operational expenditures or investment in new vehicles and equipment. SWM services are therefore totally under-funded.

The second constraint is the lack of control over the management of its human resources at junior levels. This is due to (1) serious political interference by Councilors over the appointment, promotion, discipline and discharge of staff; (2) lack of a robust human resource policies and programs at NCC; and (3) poor

discipline, little cooperation and high absenteeism of manual labourers. Other institutional deficiencies also significantly affect the DoE's performance.

2.4.5 Current Initiatives for Reform of Nairobi City Council

There are a number of initiatives by the GOK to reform Nairobi City Council. These are:

Firstly, the GOK Presidential Commission on Local Authorities - the "Omamo" Commission - has finalised its report on Nairobi and other local authorities. It has made a number of recommendations on reform. The Commission was set up in May 1995 to review the governance, structure, legal basis and financing of local government. It reports to the Presidents Office.

Secondly, MOLG and the UNDP have jointly implemented a substantial Technical Assistance for Capacity Building Program for Nairobi City (TACBNCC) under a UNDP Programme Support Implementation Arrangement (PSIA). This Capacity Building Program (CBP) started in January 1998 and will continue for two years until 31 December 1999.

The overall objective of the CBP is to develop and strengthen the management capability of Nairobi City Council (NCC). The CBP's immediate objectives are to:

- (a) explore new strategies for institutional and human resource management and development in NCC;
- (b) initiate strategies for enhanced services delivery by NCC; and
- (c) introduce performance improvement programmes so that NCC is able to operate at a higher level of efficiency and effectiveness.

The CBP's long term objective is to improve the management systems and processes of NCC including financial management, human resource management and the enhancement of managerial skills to enable NCC to function as a model local authority in Kenya.

The program may have very significant implications for the improvement of SWM services as improvements in SWM depend to a large degree upon the reform of NCC. A detailed description of the CBP is given in Chapter 4.

Thirdly, the GOK is soon to announce new measures to improve the financing of local government. This will include some sharing of central government finances with local government, e.g., the fuel levy. These measures will improve the financial situation at NCC.

Fourthly, the World Bank is administering a Local Government Reform Program. Although the Program does not include Nairobi, MOLG will transfer the lessons and experience to Nairobi.

The Program covers 11 local authorities and has four main components in its first Phase. Each component will be completed by August 1998. Future investment will be based on these studies. The components are:

- (a) infrastructure needs assessment;
- (b) financial capacity building - Simplified Accounting Systems;
- (c) resource mobilisation and revenue generation; and
- (d) inter-governmental fiscal relations.

Although many of the DoE's weaknesses are attributable to NCC's deficiencies, the Department can initiate changes itself. Most importantly the DoE should become financially autonomous by generating its own revenues to improve the financing of its SWM services.

NCC's Department of Water and Sewerage is an example of how financial autonomy and organisational change are possible without waiting for NCC to change as a whole. The positive steps being taken by the GOK and the UNDP to reform NCC are very welcome and it is hoped will significantly improve NCC's and the DoE's performance.

2.4.6 The Role of the Nairobi City Council in SWM

Nairobi City Council has a primary duty of care for the provision and the regulation of Solid Waste Management services to the City of Nairobi. NCC's major objectives towards solid waste management are to:

- (a) improve public health;
- (b) improve the environment; and
- (c) maintain public cleanliness in order to keep public places aesthetically acceptable;

by ensuring the proper storage, collection, transportation, safe treatment and disposal of solid waste.

Under the Public Health Act and the Local Government Act and its By-laws, NCC might appear to have, by implication but not expressly, responsibility for all types of solid waste in Nairobi, i.e., municipal, hospital and industrial.

NCC's main responsibilities towards SWM are:

- (a) to formulate and implement SWM policies;
- (b) to provide services for the collection, transportation, treatment and disposal of solid waste;
- (c) to regulate and monitor the activities of all generators of solid waste;
- (d) to regulate and monitor private companies engaged in solid waste activities;
- (e) to formulate and enforce laws and regulations relating to SWM; and
- (f) to coordinate with other departments within NCC, donor agencies, NGOs and other government organisations involved in SWM.

2.5 Organisation and Management of SWM Services in Nairobi City

2.5.1 Organisation of SWM in Nairobi City Council

NCC delivers its SWM services through the **Department of the Environment (DoE)** which is one of its administrative departments. The DoE is solely responsible for the delivery of these services through its **Cleansing Section**. The DoE also manages Nairobi's city parks through its **Parks Section**. The Parks service is beyond the scope of the Study's TORs and is therefore not considered.

The Council's **Environmental Committee** is the DoE's governing which formulates policy and approves major decisions concerning the DoE.

No other department within NCC provides SWM services, however some of NCC's departments have responsibilities with respect to SWM or support the DoE's activities. These departments are as mentioned below.

The City Engineer's Department: The City Engineer's Department (CED) provides all maintenance services for the DoE's vehicles. CED staff who are responsible for routine maintenance are supervised by DoE staff at the **Cleansing Section's Transportation Unit** based at the DoE's **Kaloleni Depot**. Non routine maintenance is carried out at the CED's main vehicle workshop. Maintenance arrangements are covered in more detail in **Subsections 2.5.7(4) and 2.5.7(5)** below.

The City Inspectorate: Currently the enforcement of NCC's By-Laws which relate to SWM is the responsibility of the City Inspectorate. Arrangements are currently underway to second a number of **Enforcement Officers (Askari)** including two (2) **Prosecuting Officers** from the **Inspection Section** of the City Inspectorate to the DoE which will manage them.

The DoE does not carry out any monitoring of SWM activities ie waste generators or private collection companies other than some inspection of its own collection and disposal activities services. Monitoring and enforcement arrangements are covered in more detail in **Subsection 2.5.10** below.

The Department of Public Health: The Department of Public Health (DoPH) used to be administer the **Cleansing Section** and had responsibility for SWM before the Section was transferred to the DoE in 1996. Currently the DoPH has no role in SWM except to give advice to the DoE on aspects of SWM which have public health implications.

The DoPH's **Health Inspectorate Section (HIS)** does not carry out formal monitoring of the collection or disposal activities of NCC or the private sector companies, or of illegal dumping by waste generators (e.g., industrial, commercial waste) unless there is a public health hazard.

The DoPH's role is therefore reactive. It becomes involved if it is informed by the DoE or the public of a SWM problem creating a public health hazard. The DoE has no guidelines or rules which cover how to report to the DoPH when it identifies such situations.

There is no overlap with the City Inspectorate's monitoring role.

Coordination between the DoE and other Departments is carried out through the weekly Heads of Department Meetings.

2.5.2 Setup and Legal Authority of the Environmental Committee and the Department of Environment

(1) Setup of the Environmental Committee

The Environmental Committee was established in 1994 at the initiative of the Town Clerk for the purpose of coordinating environmental activities, firstly amongst departments within NCC and, secondly, between NCC and outside bodies ie NGOs and Ministries. The focus of its activities is on solid waste.

The Committee is now the governing committee of the DoE and formulates the departments environmental policy and approves its major operational decisions eg staffing issues, PSI, etc.

(2) Setup of the Department of Environment

Until the establishment of the DoE in 1996 the DoPH had always been responsible for the delivery SWM services through its Cleansing Section.

As the level of SWM services continued to decline through the early 1990s a Presidential Task Force was established in 1994 for "Cleaning up Nairobi". In the same year the Council also established the Environmental Committee.

By 1995 the Council saw the need to set up a separate Department to manage SWM and the environment for the following reasons:

- (a) the Medical Officer of Health at the DoPH found it difficult to manage the Cleansing Section because his span of control was too wide - he was responsible for ten sections. As a result decisions were slow and planning and management ineffective. This impacted on the delivery of SWM services;
- (b) the need to coordinate the Parks Section, previously managed by the City Engineer, and the DoPH's Cleansing Section to ensure the collection of parks waste. Neither Section took responsibility for its collection because of overlapping responsibilities, and disputes and conflicts regularly arose;
- (c) no responsibility was assigned at NCC for removing solid waste from the Nairobi River. The DoE is now responsible.

On 6 February 1996 the Full Council passed a Resolution to set up the DoE. On 15 June 1996, Col. Nthigah was appointed directly by the President as the new Director. The Director's PSC appointment was formalised later.

It was not until 19 June 1996 that the DoPH's Cleansing Section and the City Engineer's Parks Section were transferred in whole to create the new DoE. At the same time the President launched the Nairobi City Clean-Up Campaign.

(3) The DoE's Legal Authority and Responsibilities towards Solid Waste

Under the Public Health Act and the Local Government Act and its By-Laws NCC has prime responsibility for solid waste management for Nairobi City. As a department of NCC, the DoE's operations are regulated by the Local Government Act and its By-Laws.

The DoE's main responsibilities towards solid waste management are given in Box 1 below.

Box 1 - The DoE's Responsibilities for SWM

- to implement NCC's SWM policies formulated by the Council's Environmental Committee
- to maintain public cleanliness, protect public health and the environment and keep public places aesthetically acceptable by providing services for the collection, transportation, treatment and disposal of solid waste
- to regulate and monitor the activities of all generators of solid waste
- to regulate and monitor private companies engaged in solid waste activities
- to enforce all laws and regulations relating to SWM
- to coordinate with other departments within NCC, donor agencies, NGO's the private sector and other Governmental Organisations involved in SWM

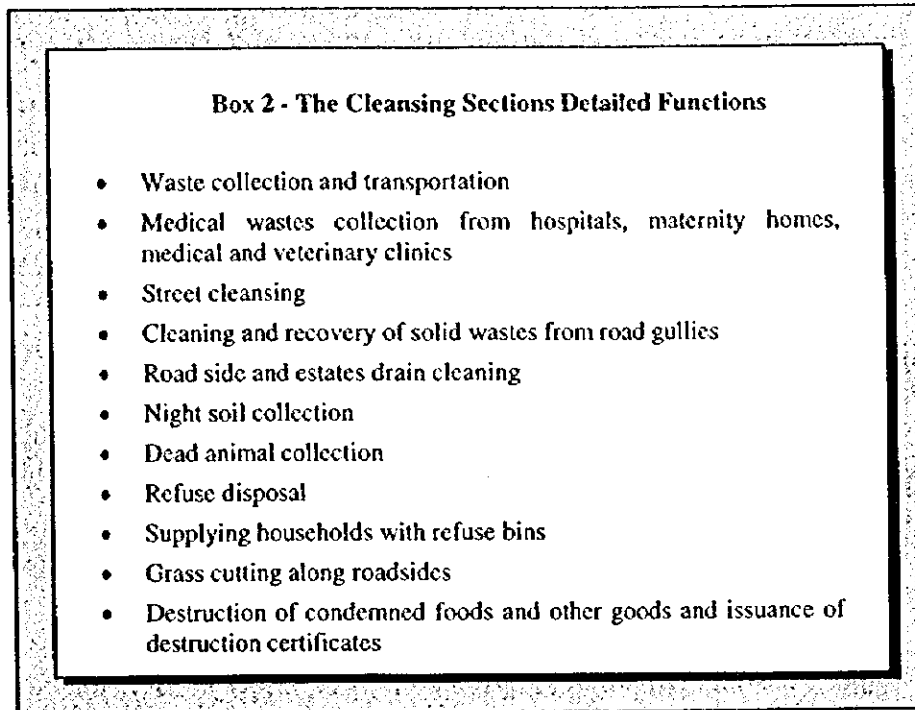
At the moment the DoE collects waste from a number of large hospitals in Nairobi. Since its capacity is increasingly constrained it has decided to cease collection and require that hospitals and clinics in Nairobi use a private collection and treatment service. Users would directly contract and pay fees to the private operator. NCC would have no contractual responsibilities but would be responsible to regulate and monitor the private operator's activities.

The DoE has already identified and approved a private sector company - Sanitation Cares Kenya Limited which will be responsible for collection, transportation and treatment of all hospital waste. NCC will remain responsible for disposal at the Dandora site. This policy was approved under a recent Council resolution.

Sanitation Cares is currently building a medical waste incinerator which is expected to become operational at the end of June. Currently hospitals and

other generators of medical waste are not monitored by NCC or by the Ministry of Health. It is understood that the forthcoming Environmental Act will designate some responsibilities for hospital waste.

The Cleansing Section's detailed functions are given in **Box 2** below.



Likewise NCC lacks the capacity to manage the collection and disposal of industrial waste. NCC is awaiting guidance from the new Environmental Act before it formulates policy. It is assumed that the new Act will make generators of waste responsible for their wastes. A complete legal analysis is given in **Supporting Report Section C, Legal Study**.

(4) Improvements as a Result of Setting up the DoE

The establishment of a separate Department of Environment has already realised some benefits. The main benefits are:

- (a) decision making has improved, particularly, the daily operational planning and decisions;
- (b) overlapping responsibilities and disputes and conflicts between the Parks Section and the Cleansing Section have been resolved. The Parks Section now collect and dispose their waste;
- (c) the Environmental Committee and the DoE have good relations; and
- (d) co-ordination with other Departments has greatly improved.

2.5.3 Evaluation of the Organisational Structure and Capacity of the DoE

(1) Introduction

An efficient organisational structure has clear reporting lines, rational departmentation of functions, clear assignment of responsibilities to staff which avoids duplication and overlapping, reasonable spans of control, an appropriate number of staffing levels and an appropriate senior management structure.

Although a number of deficiencies are identified these are not intended to be critical and should be considered in the light of the constraints imposed on the DoE by deficiencies in NCC's organisational structure, procedures and culture. These weaknesses are common to local governments all over the world both in the developed as well as developing countries.

(2) Departmental Structure

The organisational chart of the DoE given in **Figure B.2-3** shows a well defined structure. The Department is divided into two operational Sections - the Cleansing Section and the Parks Section - and an Administration Section. The DoE is headed by the Director of Environment who is assisted by a Deputy Director.

Directly underneath the Deputy Director are two Assistant Directors (both positions are currently vacant) one of whom is responsible for the Cleansing Section and one is responsible for the Parks Section. Directly underneath the Assistant Director for Cleansing is the Cleansing Superintendent who is supported by two Deputy Cleansing Superintendents.

(3) Cleansing Section

The Cleansing Section is divided into six districts for operational purposes. Each District provides both collection and transportation and street cleansing (street sweeping and gully cleaning) services.

The Districts are grouped into two Divisions, each Division having 3 Districts. One Division also manages a Transportation Unit. The Administration Section reports directly to the Deputy Director of Environment.

DEPARTMENT OF ENVIRONMENT

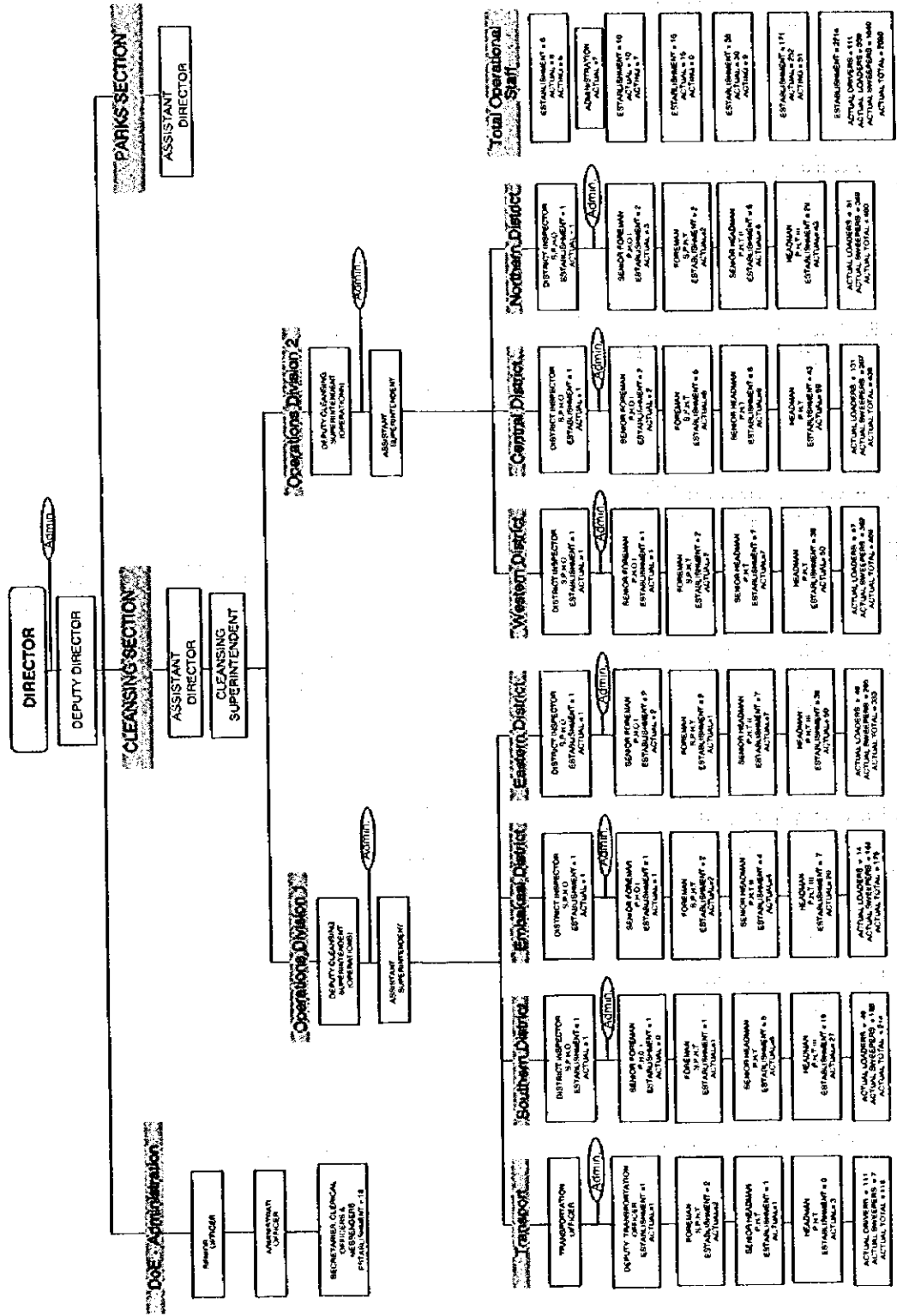
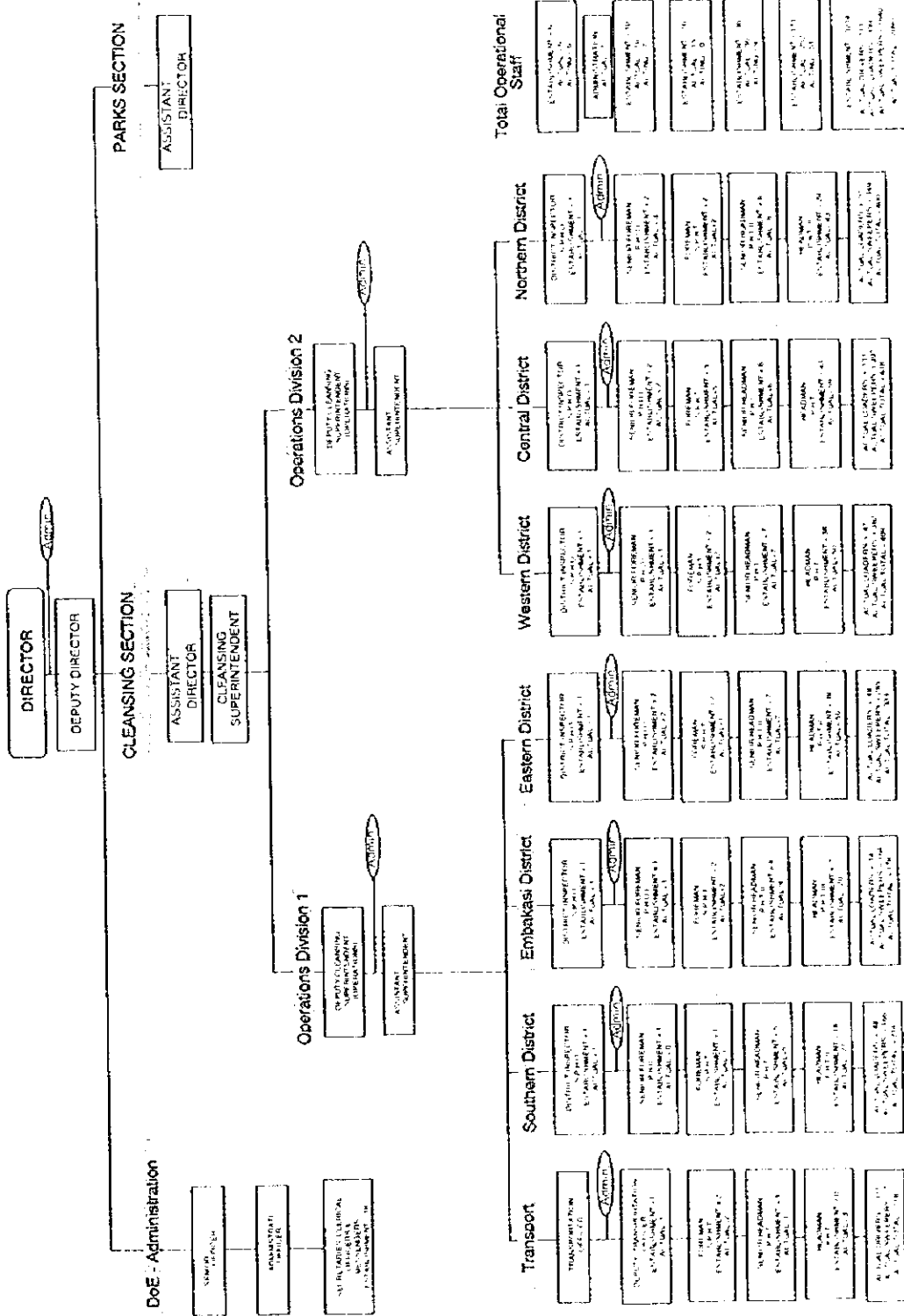


Figure B.2-3 Organisation Chart of the Department of Environment

NOTES: 1) S.P.H.O. Senior Public Health Officer
 2) P.H.O. Public Health Officer
 3) S.P.H.T. Senior Public Health Technician
 4) P.H.T. Public Health Technician

DEPARTMENT OF ENVIRONMENT



NOTES: 1: S.P.H.O. Senior Public Health Officer
 2: P.H.O. Public Health Officer
 3: S.P.H.T. Senior Public Health Technician
 4: P.H.T. Public Health Technician

Figure B.2.3 Organisation Chart of the Department of Environment

Each of the two Deputy Cleansing Superintendents is responsible for one Division and is in turn directly supported by one Assistant Cleansing Superintendent. The Deputy Cleansing Superintendent (Operations) manages the Transportation Unit and Southern, Embakasi and Eastern Districts. He also has overall responsibility for all operations of District.

The other Deputy Cleansing Superintendent manages the other 3 Districts - Northern, Central and Western Districts. Embakasi is a new district established from part of the eastern and northern districts. The department covers the very eastern side of the city and was set up because it is a rapidly growing commercial and residential area. A new District Inspector and the establishment were approved by the Full Council in March 1997.

(4) Operational Districts

Each District is headed by a District Inspector and provides both collection and transportation and street cleansing services to a designated area of the city. Each District has its own assigned staff, equipment (excluding vehicles) and operating base - an office and depot.

Organisation charts of each District are given in Section 2.3 of Data Book (1). A comparison of the charts shows that there are some horizontal structural differences amongst the Districts. However Districts have very similar vertical structures because their staff grading and scale classifications are the same. Staff therefore have very similar responsibilities in each district.

Districts only operate day shifts with the exception of the Central District which operates both day and night shifts.

The size of Districts ranges considerably from Embakasi with 202 staff to Central with 511 staff. Twenty-two percent (22%) of the Cleansing Section's staff work in collection disposal and 78% work in street cleansing. Each District is divided into:

- (a) Subdistricts: headed by Senior Foreman
- (b) Locations: headed by Foreman (there are few locations)
- (c) Beats: collection and street cleansing, headed by Senior Headman.

The Senior Headman supervises a number of Headmen who are assigned either to street cleansing or collection. On average a Senior Headman supervises 6.4 Headmen.

Headmen directly supervise groups of manual workers in the field, i.e., loaders or sweepers. Typically a Headman will supervise one driver and four loaders or about 15 sweepers.

(5) Disposal - Dandora Dumpsite

Embakasi District also manages the Dandora site with one Foreman. He is supported by three clerical officers who collect Tipping Fees and one

Headman and some manual workers. The Foreman keeps a log of all trucks that dispose their waste at the site. Tipping fees are periodically collected by officers of the City Treasurer.

(6) Transportation Unit

The Transportation Unit is responsible for the operational management of the cleansing Section's vehicles and for their routine maintenance. The organisation chart of the Transportation Unit is given in Section 2.4 of Data Book (1).

(7) Administration Section

The Administration Section which was set up in February 1997 is headed by an acting Senior Administrative Officer who reports directly to the Deputy Director. The Section provides a mixture of administration services to the DoE. A more detailed description of the Section is given in Section 2.5 of Data Book (1).

(8) NCC's Proposals for the Future Role of the DoE.

At the moment the DoE's focus is on solid waste management as well as the management of the City's parks. However, NCC intends to develop the capacity of the DoE to cover environmental protection of air and water as well as solid waste. A comprehensive structure and organisation have not been formulated in detail.

2.5.4 Evaluation of the Cleansing Section's Organisation Structure

(1) Evaluation of the Cleansing Section's Vertical Structure

The vertical structure is shaped by the scaling of staff rather than by functional needs. This is a typical characteristic of local or central government organisations. As a result Districts have very similar vertical structures and staff have very similar responsibilities in each district. This typically creates too many levels and duplication or overlap of responsibilities.

The vertical structure is analysed to ascertain the extent of the duplication and overlap of responsibilities between levels. Detailed responsibility descriptions for all senior managers, supervisors and manual workers is given in Section 2.6 of Data Book (1).

Figure B.2-4 below gives the main vertical groupings of staff in the Cleansing Section from management, supervisors down to manual labourers. It is clear from the Figure that there are too many levels. There are 13 levels from the Director to manual labourers.

This contributes to ineffective management and slow decision making as information and requests take too long to travel up and decisions and directions from senior officers take too long to travel down. Information and decisions also get distorted in this process.

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In particular there are too many levels of senior managers. Between the Director and the District Heads who are the key middle managers in the Cleansing Section, there are five staffed levels including the Director (this excludes the position of Assistant Director Cleansing which is currently vacant).

Among these officers there is a considerable overlap in making daily decisions about operations and monitoring the performance of those operations. In fact in some cases there appear to be few real differences in their responsibilities and functions.

This is characteristic of the "chain of approvals" syndrome where people review, report, and make approvals in a long chain but add no real value.

There is similar overlap of supervisory responsibilities between the positions of Senior Foreman and Foreman I/II and between Foreman I/II and the Senior Headman. The Foreman II position was created for promoting long serving staff who are disqualified from promotion to Senior Foreman of higher levels because they lack the necessary educational qualifications.

At the level of manual workers the DoE is bottom heavy and overstaffed. These positions are filled with scales 16, 17 and 18. Over-staffing is dealt with in **Section 2.6, Human Resource Management and Development.**