Annex 7

Disposal Interview Survey

7 Disposal Interview Survey

7.1 Introduction

1. This survey was conducted with a representative of each WACS sampling point in the household, institutional and commercial (restaurant and other) categories at the same time as sampling points were selected.
2. The purpose of the Disposal Interview Survey was to determine the methods of disposal used by different categories of waste generators and to quantify the amounts of waste disposed of by different means for each source in accordance with the proposed waste stream model. Public Opinion Survey results and discussions with Tanzanian colleagues were also used for this purpose.
3. The survey questionnaires are set out in Section 7.2 for household, institutional and commercial (restaurant and other) categories.

7.2 Questionnaires

7.2.1 Household Interview Questionnaire

Please state the following:
Family Name: Address:

1. How many people live in the household?

2. What is the household expenditure (Tsh) per month?

a) less than 35,000	b) 35,000 - 50,000
c) 50,000 - 65,000	d) 65,000 - 80,000
e) 80,000 - 95,000	f) more than 95,000

3. How does your household normally dispose of it's waste? Please write YES or NO next to each option below. If you answer YES to any option, please estimate the amount of waste you dispose of by this option in each case. For example, one household hands most of its waste (about 95%) to Multinet who come once per week, while about 5% is fed to chickens.

Means of Disposal	Yes/No	Estimated amount	Other
a) discharge at a specific place inside your property (e.g. pit)			Method?
b) dispose through combustion (burning)			N/A
c) discharge at the collection point (outside your property)			Where? Collected? By whom?
d) dumps it at a market waste collection point			Which?
e) dumps it outside anywhere			Where?
f) gives it to someone to get rid of			Who? Where to?
g) hands it to DCC			How often?
h) hands it to private contractor			Who? How often?
i) recycle some of it within your property			What?
j) recycle some of it outside your property			What?
k) Other			Specify

4. In Q3, if you answered yes to options a or b, answer this question. Options a and b above refer to self disposal of waste. Proper self disposal is:

- when the waste is buried in a pit which is sufficiently deep and well located so as not to pose a health/safety risk.
- when you live in an area where the houses are not very close together and you are able to burn your waste without annoying your neighbours.

Do you consider the means you use to be proper or improper means of self disposal?

5. How many square metres of garden do you have?

a) nothing
b) small (less than 100 m^2)
c) medium (100-300m^2)
d) large (greater than 300 m^2)

6. Do you have garden wastes? (Yes/No). If no, go to Q 9.

7. How do you dispose of these garden wastes? Please write yes or no to each option below. If you write yes, please estimate the amount of waste you dispose of by this option in each case.

Means of disposal	Yes/No	Amount	Other
a) self-dispose (burn/bury)			
b) composting (producing fertiliser)			
c) discharge at the collection point			Where?
d) dispose outside anywhere			Where?
e) give it to someone to get rid of			Who? Where to?
f) call City Council collector			
g) hand it to DCC			With other waste?
h) hand it to private contractor			Who? With other waste?
i) Other			Specify
j) Don't know			

8. Can you estimate the amount of garden waste produced weekly or monthly?

9. Do you or any member of your household run a small business on your premises. e.g. kiosk, canteen, making doughnuts, cakes, chappatis, etc. If so, what do you normally do with this waste and how much waste is produced each day?

7.2.2 Institutions Interview Questionnaire

Please give the following details:

- Name of institution:
- Location:
- Interviewee:

1. For the institution, how many people are working in the section(s) from which we are collecting waste? and how many people are working in the total institution?

2. What days of the week are you open and what are your office hours?

3. How does your institution normally dispose of its waste? Please write YES or NO next to each option below. If you answer YES to any option, please estimate the amount of waste you dispose of by this option in each case. For example, your office may have 80% of its waste collected by a private contractor, 15% (computer paper) is sold to a middleman for recycling and the remaining 5% is burnt.

Means of Disposal	Yes/No	Estimated amount	Other
a) dispose of within office property (bury/burn)			Method?
b) collected by DCC			How often?
c) collected by private contractor			Who? How often?
d) collected by company vehicle			How often?
e) disposal at collection point outside property			Where? Collected? By whom?
f) disposing of anywhere outside office premises			Where?
g) recycle some of it within the office			What?
h) recycles some of it outside the office			What?
i) other			Specify:

4. If you answered yes to option a in Q3, this refers to self disposal of waste. Proper self disposal is:
- when the waste is buried in a pit which is sufficiently deep and well located so as not to pose a health/safety risk.
- when you live in an area where the buildings are not very close together and you are able to burn your waste without annoying your neighbours.

Do you consider the means you use to be proper or improper means of self disposal?

5. If waste is removed by vehicle from your office, do you keep any records of the number of trips/amount of waste removed from your office each day. If so, we would like to look at these records as we would like to obtain typical data for a weekly/monthly period.

7.2.3 Commercial (Other) Interview Questionnaire

Please state:
- Name of shop:
- Location:
- Interviewee:

1. What is the area of your shop?

2. How many staff (including boss) work in the shop?

3. Which days of the week are you open?

4. What are your working hours?

5. What do you normally do with waste from the shop?

Means of Disposal	Yes/No	Estimated amount	Other
a) dispose of within shop property (bury/burn)			Method?
b) collected by DCC			how often?
c) collected by private contractor			who? how often?
d) discharges at a collection point outside shop			where? collected? by whom?
e) discharges it anywhere outside shop			Where?
f) recycles within shop (paper, boxes, etc.)			What?
g) recycles outside shop (paper, boxes, etc.)			What? Who to?
h) other			Specify

7.2.4 Commercial (Restaurants) Interview Questionnaire

Please give the following details:

- Name of restaurant:
- Location:
- Interviewee:

1. How many tables and chairs do you have in the restaurant?

2. Do you know the average number of customers per day that eat in the restaurant?

3. Which days of the week are you open?

4. What are your opening hours?

5. What do you normally do with waste from the restaurant? Write yes or no next to each option below. If you answer yes to any option, please estimate the amount of waste you dispose of by this option in each case.

Means of Disposal	Yes/No	Estimated amount	Other
a) dispose of within restaurant property (bury/burn)			Method?
b) collected by DCC			How often?
c) collected by private contractor			Who? How often?
d) discharges at a collection point outside restaurant			Where? Collected? By whom?
e) discharges it anywhere outside restaurant			Where?
f) recycles some of it outside restaurant (animal feed, etc.)			What? Who to?
g) other			Specify

7.3 Results

7.3.1 Household Results

7.3.1.1 General

1. The tabulated results are set out in Tables 7-1 to 7-5 at the end of Section 7.3.1.
2. It was very difficult for most interviewees to estimate their expenditure level.
3. None of the households interviewed use the following methods of disposal:

- discharge of waste at a collection point outside their property.
- dumping of waste at a market collection point.
- handing waste to DCC for collection.

4. "Garden" is used loosely in the sense of all bare soil, grassed and vegetated areas. "Garden waste" refers to waste from trees, flowers, vegetables, crops, etc. produced within the property of the household.
5. This survey was conducted during the dry season, when less garden waste is produced than during the rainy season. The volumes of garden waste quoted are

based on the assumption that one medium sized bucket is equivalent to twenty litres of loose garden waste.

6. No collectors of recyclable materials were seen during this Survey.
7. The practice of internal reuse/recycling of items within the home is widespread throughout DSM and Tanzania in general. For example, bottles are reused for storing oil, honey, etc.; newspapers are used for wrapping items or lighting fires; food waste is fed to livestock.

7.3.1.2 Upanga West

1. This is a high income ward and one of the five wards in which Multinet is currently operating.
2. Five houses in the high income category were selected as sampling points.
3. Four of the five houses surveyed have their waste collected by Multinet. Each house pays 900/- per month to Multinet and the frequency of collection was stated to be 3-4 times per week.
4. The fifth house was formerly a Multinet customer but currently disposes of their waste by burning and burial in a pit dug at the back of their property, even though the garden area is less than 100 sq.m. The interviewees considered this to be a proper means of self disposal while the Study Team assessed it to be improper as burning waste is not appropriate in such a densely populated area and Multinet provides a reliable and affordable collection service in this area.
5. Two households live in apartments and have no gardens. However, of these two, one produces garden waste from trees of approximately 10 litres per week which they burn. The three remaining houses all have gardens of area less than 100 sq.m. These households estimated their weekly quantity of garden waste to be 70-100 litres. One household burns these wastes; another hands them to Multinet with their household waste and the third has most of their garden waste collected by a man for use as cattle fodder.
6. One of the two households which burn their garden waste has received complaints from one neighbour for doing this. Burning garden waste is not considered appropriate in this area due to the high population density and availability of the Multinet service.
7. Collectors of recyclable waste materials do operate in this area according to two of the households interviewed but only one household regularly sells bottles and tins to these collectors. The collectors are particularly interested in 3 litre tins and pay 300/- per tin.
8. None of the households interviewed have a home based business.

7.3.1.3 Kariakoo

1. This is a densely populated, middle/high income, mixed residential and commercial area. Multinet stopped collecting waste from here in January 1996 and since then, there has been no waste collection in the area. A high majority of residences do not have the option for disposal of waste by means of burial in a pit as they do not have any garden within their property. This, combined with the lack of a collection service

means that most waste is illegally dumped either by householders themselves at night or by handcart operators who are paid to remove it.

2. Five middle income households were selected as sampling points.
3. Four of the five households interviewed dispose of their waste by paying handcart operators to remove it. None of the interviewees knew where the handcart operators dispose of the waste collected. Three of these pay varying amounts for this service; namely, 800-1,000, 1,400 and 1,500-2,000 Tsh/week. On average, a medium size plastic bag of waste costs 200-300/- to dispose of. This is equivalent to one household's waste for 1-1.5 days.
4. The fourth household (RM-05) pays a lower weekly rate of 500-700/- as they first burn their combustible waste and then dispose of the ashes and non-combustible waste by handcart. This has drawn complaints from their neighbours.
5. The fifth household has their waste collected by a family friend who owns a car and transports the waste for disposal on their farm further out of the city.
6. Only one of the five households (RM-05) has a garden (approx. <40 sq.m.) and no houses produce any garden waste.
7. All interviewees have not had contact with collectors of recyclable waste materials.
8. Only one of the five households has a home based business. This is a doughnut making business which makes a negligible contribution to the household waste.

7.3.1.4 Mwananyamala

1. Five high, five middle and seven low income houses were selected as sampling points in this ward.
2. The high, middle and low income houses are all intermingled. This area has no waste collection service. All of the households surveyed dispose of their waste by self disposal or illegal dumping. A few households sell/give items to collectors of recyclable materials. There are two large illegal dumping areas in the immediate vicinity of the houses surveyed. One is a small lake in which waste is dumped; the other is a large open space adjacent to the lake and near to a primary school.
3. Eleven of the seventeen households dispose of their waste in a pit. Ten of these also burn the waste. Two other households burn their waste; one doing this behind their house; the other in a drum with subsequent illegal dumping of the non-combustible waste and ashes. Hence, twelve households practise self disposal while the other household practises illegal dumping. Four of these thirteen households give away/sell some recyclable materials to household collectors but the amount of waste recycled in this manner is negligible.
4. Nine of the twelve interviewees consider the pit and/or burn method to be proper means of self disposal. The Study Team assessed that only five of the twelve households were practising proper self disposal as most of the houses are located in a densely populated area and self disposal by burning is not appropriate.
5. The remaining four households dispose of their waste by illegal dumping, with one of these giving away recyclable materials on a regular basis. Together with the household which burns and then illegally dumps their waste, this gives a total of five households which usually practice illegal dumping. Three of these have no garden

area and the remaining two have less than 100 sq.m. of garden. One of the other households which normally uses the pit method (RL-06) will sometimes illegally dump their waste in the large open space near the school. Another of the five households practising illegal dumping usually dumps their waste at this place while the lake is used as the dumping site by another of these households. Two of the remaining households dump their waste in pits located outside their properties, but near to their houses. The final household burns its waste first, then loads the non-combustible waste and ashes into their car and drives some distance from their property before dumping it.

6. Fourteen households produce 5-40 litres of garden waste per week while another house produces 100 litres per week. Fourteen households dispose of the garden waste together with their household waste. The remaining household dumps it on the ground of their garden.
7. Five households give away/sell recyclable materials to household collectors on a regular basis. Four other households have observed collectors of recycled material operating in the area, looking for suitable materials in waste pits and by asking individual households. There seems to be a particular interest in perfume bottles, which apparently are refilled with fake perfume and then sold at high prices to unsuspecting customers.
8. Seven households from the middle and low income categories have a home based business. Four of these will produce significant amounts of waste.

7.3.1.5 Keko

1. Five high, five middle and eight low income houses were selected as sampling points in this ward.
2. The high and middle houses selected were all intermingled while the low income houses were from a different part of the ward and each household consisted of a family who rented a single room in a larger house. This area has no waste collection service. All of the households surveyed dispose of their waste by self disposal or illegal dumping. A few households sell/give items to collectors of recyclable materials. No large illegal dumping areas in the immediate vicinity of the houses surveyed were observed.
3. Fourteen of the eighteen households dispose of their waste in a pit with twelve of these burning the waste as well. Another household dumps the waste on their garden and then burns it. Eight of these fifteen households give away/sell some recyclable materials to household collectors but the amount of waste recycled in this manner is negligible.
4. Eleven of these fifteen interviewees considered the pit and/or burn method to be proper means of self disposal although four of these commented that necessity forces them to use this method. The Study Team assessed that only seven of the fifteen households were practising proper self disposal.
5. The remaining three households dispose of their waste by illegal dumping, with one of these giving away recyclable materials on an irregular basis. All these households have no garden area and either dig a pit outside their property or take it to a big open space near their houses and dispose of it in a pit there.

6. Thirteen households produce garden waste, ranging from 3-20 litres per week. Twelve households dispose of the garden waste together with the household waste although one composts some of their garden waste. The remaining household burns it separately.
7. Nine households do give away/sell recyclable materials to household collectors on a regular basis. One other household has observed collectors of recycled material operating in the area, particularly youths circulating around the egg/chips canteens asking for tomato sauce bottles and one person who buys used paper from people.
8. Six households have a home based business. Three of these will make significant contributions to the total waste produced by each household.

7.3.1.6 Ubungo

1. Five high, five middle and five low income houses were selected as sampling points from this ward.
2. The high, middle and low income houses are all intermingled. This area has no waste collection service. All of the households surveyed dispose of their waste by self disposal or illegal dumping. Only two households sell/give items to collectors of recyclable materials. This is a rural area and no large illegal dumping areas were observed here.
3. Fourteen of the fifteen households dispose of their waste in a pit and by burning. Two of these also dispose of some of their waste by illegal dumping and two recycle some materials. Two of these feed their food remains to the pigs/cows of one household (RH-16) and a third produces compost from its food waste.
4. Ten of these fourteen households considered the pit and/or burn method to be proper means of self disposal. The Study Team assessed that only seven of the fourteen households were practising proper self disposal.
5. The remaining one household disposes of their waste by dumping the waste directly outside its property and then burning it. The two other households which practise some illegal dumping dispose of bottles and/or cans by loading them in their respective cars and driving some distance away from their homes before dumping the waste.
6. Ten households produce 3-30 litres per week of garden waste and another three households 50-70 litres per week. Ten households dispose of their garden waste together with the household waste, although one also composts some garden waste. The remaining households dump it on the ground of their garden in order to produce compost.
7. Two households give away/sell recyclable materials to household collectors on a regular basis. No other households have observed collectors of recycled material operating in the area and it was commented that there are probably more such people operating closer to the centre of the city.
8. Three households from the middle and low income categories have a home based business. Two of these make significant contributions to the total waste produced by each household. One involves raising pigs and cows with the waste from the animals being put on the garden; the other involves brewing alcohol from maize with the waste from this operation being given to their neighbour's pigs.

Table 7-1: Disposal Interview Survey Results Summary

Code	No. in house	Income x 1000 (Tsh)	H'hold refuse disposal method	Garden Area (sq.m.)	Garden Waste Y/N	Garden waste disposal method	garden waste volume (l/wk)	Business activity at home (Y/N; description)
RH-01	4	> 95	h	0	Y(tree)	x(burn)	10	N
RH-02	8	> 95	h,j	0	N	N/A	0	N
RH-03	7	> 95	h	< 100	Y	w(with h.w.)	100	N
RH-04	10	> 95	h	< 100	Y	x(burn)	70	N
RH-05	11	> 95	a,j *1	< 100	Y	x,z *1	100	N
RM-01	12	80-95	f	0	N	N/A	0	make/sell doughnuts *2
RM-02	8	50-95	f	0	N	N/A	0	N
RM-03	12	80-95	f	0	N	N/A	0	N
RM-04	6	50-95	f	0	N	N/A	0	N
RM-05	8	50-80	a,b,f	< 100	N	N/A	0	N
RH-06	4	> 95	e	0	N	N/A	0	N
RH-07	7	> 95	a,b,j	< 100	Y	x(with h.w.)	5	N
RH-08	4	> 95	a,b	> 300	Y	x(with h.w.)	40	N
RH-09	5	> 95	e,j	< 100	Y	x(with h.w.)	5	N
RH-10	5	> 95	b,e	0	N	N/A	0	N
RM-06	5	50-95	a,b	< 100	Y	x(with h.w.)	10	N
RM-07	8	50-95	e	0	Y(tree)	x(with h.w.)	5	make/sell doughnuts *2
RM-08	12	50-95	a,b	< 100	Y	x(with h.w.)	10	N
RM-09	8	50-95	b,j	< 100	Y	x(with h.w.)	5	make/sell mats *2
RM-10	7	50-95	a,b,j	< 100	Y	x(with h.w.)	5	fruit kiosk *3
RL-01	6	< 50	e	< 100	Y	x(on g.s.)	30	small canteen *4
RL-02	7	< 50	a,b	< 100	Y	x(with h.w.)	100	fruit/vege kiosk *3
RL-03	7	< 50	a,b	< 100	Y	x(with h.w.)	10	sell charcoal *2
RL-04	4	< 50	a,b	100-300	Y	x(with h.w.)	20	N
RL-05	8	< 50	a,b,j	100-300	Y	x(with h.w.)	10	N
RL-06	9	< 50	a,e	100-300	Y	x(with h.w.)	10	N
RL-07	8	< 50	a,b	100-300	Y	x(with h.w.)	10	hairdrying(tin waste) *3
RH-11	10	200	a,b,j	< 100	Y	x(with h.w.)	5	N
RH-12	6	150	a,b,j	> 300	Y	x(with h.w.)	20	shop (box/plastic) *4
RH-13	4	> 95	a,b	0	Y	N/A	0	make/sell ice-cream *2
RH-14	8	> 95	a,j	< 100	N	x(with h.w.)	5	N
RH-15	6	150	a,b,j	< 100	Y	x(burn)	10	N
RM-11	9	50-95	b,j	100-300	Y	x(with h.w.),y	20	sell chapattis,shop,tailor,*4
RM-12	9	85	a,b,j	< 100	Y	x(with h.w.)	5	tailor *3
RM-13	6	65-96	a,b	< 100	Y	x(with h.w.)	5	N
RM-14	11	50-95	a,b	< 100	Y	x(with h.w.)	10	N
RM-15	5	50-95	a,b	100-300	Y	x(with h.w.)	5	small canteen, tailor *4
RL-08	8	< 50	a,b,j	0	Y(tree)	x(with h.w.)	3	N
RL-09	8	< 50	a	0	N	N/A	0	N
RL-10	5	< 50	a,b	0	Y(tree)	x(with h.w.)	3	N
RL-11	2	< 50	a,b	0	N	N/A	0	N
RL-12	4	< 50	a,b,j	0	Y(tree)	x(with h.w.)	3	hair plaiting *2
RL-13	4	< 50	e	0	Y(tree)	x(with h.w.)	5	N
RL-14	4	< 50	e,j	0	N	N/A	0	N
RL-15	2	< 50	e	0	N	N/A	0	make/sell doughnuts *2
RH-16	8	> 95	a,b *5	> 300	Y	x(with h.w.)	50	raise cows/pigs *6
RH-17	8	> 95	a,b,e,j *5	< 100	Y	x(with h.w.)	15	N

RH-18	7	> 95	a,b,e	> 300	Y	x,y(on g.s.)	30	N
RH-19	9	> 95	a,b	> 300	Y	x,y(on g.s.)	20	N
RH-20	9	120	a,b	> 300	Y	x,y(on g.s.)	30	N
RM-16	10	65-95	a,b,j	< 100	Y	x(with h.w.)	70	make local brew from maize,*7,*4
RM-17	5	80-95	a,b	< 100	Y	x(with h.w.)	70	N
RM-18	4	50-65	a,b	> 300	Y	x(with h.w.)	20	N
RM-19	9	80-95	b,e	0	Y(tree)	x(with h.w.)	10	N
RM-20	7	50-95	a,b *8	< 100	Y	x(with h.w.),y	20	make/sell doughnuts(*2)
RL-16	3	< 50	a,b	0	N	N/A	0	N
RL-17	5	< 50	a,b	0	N	N/A	0	N
RL-18	6	< 50	a,b	< 100	y	x(with h.w.)	3	N
RL-19	7	< 50	a,b	< 100	Y	x(with h.w.)	3	N
RL-20	2	< 50	a,b	< 100	Y	w(with h.w.)	3	N

Notes:

with h.w. = garden waste is disposed of with household waste

on g.s. = garden waste is disposed of by throwing on the ground surface in the garden/farm

*1 = someone comes to collect garden waste (grass) to feed their cows

*2 = small contribution to waste

*3 = medium contribution to waste

*4 = large contribution to waste

*5 = food remains are fed to cows/pigs of RH-16

*6 = cow/pig waste is used as fertiliser on another farm

*7 = remains of maize from local brew making is given to neighbour's pigs

*8 = some food waste is composted

Key: Household (H'hold) Refuse Disposal Method

a discharges waste at a specific place inside property (e.g. pit)
b dispose of waste by combustion
e dumps waste illegally
f gives waste to someone else to dispose of
h hands waste to private contractor
j recycles some waste outside property

Key: Garden Waste Disposal

w hands waste to private collector
x self disposal (burn/bury)
y composting
z gives waste to someone else to dispose of

Table 7-2: Disposal Interview Survey - Self Disposal Results Summary

Code	Area	Garden Area (sq.m.)	% of s.d. waste	Method	Type of waste	Evaluation of s.d.		Comments
						Int.	S.T.	
RH-05	UA	< 100	> 70	pit/burn	no ga	P	I	I (d.p.), garden waste given away as cattle feed
RH-07		< 100	> 95	pit/burn	> 95	P	I	I (d.p.); give away some bo/ct/pa for recycling
RH-08		> 300	100	pit/burn	all	P	P	P as big area
RM-06		< 100	100	pit/burn	all	P	P	residents: "1 pit enough for 6 months"
RM-08	S	< 100	100	pit/burn	all	I	I	I (d.p.)
RM-09	U	< 100	> 95	dump/burn	> 95 *1	P	I	I (d.p.); residents: "due to necessity"
RM-10	P	< 100	100	pit/burn	all	I	I	I (d.p.); very small amount recycled
RL-02	A	< 100	100	pit/burn	all	I	I	I (d.p.), residents: "all available pit space used"
RL-03		< 100	100	pit/burn	all	P	I	I (d.p.)
RL-04		100-300	100	pit/burn	all	P	I	pit is badly situated, *2
RL-05		100-300	100	pit/burn	all	P	P	P as big area; very small amount recycled
RL-06		100-300	100	pit	all	P	P	P as big area
RL-07		100-300	100	pit/burn	all	P	P	P as big area
RH-11		< 100	> 95	pit/burn	> 95 *1	P	P	residents: "almost all pit space used"
RH-12		> 300	> 95	pit/burn	> 95	P	P	some bo recycled
RH-13		0	100	pit/burn	all	P	I	I (d.p.); residents: "forced by necessity"
RH-14		< 100	100	pit	all	P	P	residents: "forced by necessity"
RH-15		< 100	> 95	pit/burn	> 95	P	P	residents:"forced by necessity to use pit/burn"
RM-11	S	100-300	> 90	dump/burn	> 90 *1	I	I	all waste dumped on garden ground, dry, burn
RM-12	U	< 100	> 95	pit/burn	> 95 *1	P	I	I (d.p.)
RM-13	U	< 100	100	pit/burn	all	P	I	I (d.p.)
RM-14	A	< 100	100	pit/burn	all	P	I	I (d.p.)
RM-15		100-300	100	pit/burn	all	I	P	P as big area
RL-08		0	> 95	pit/burn	> 90 *1	P	P	in pit of landlord (RH-12) - large area
RL-09		0	100	pit	all	P	P	in pit of landlord (RH-12)
RL-10		0	100	pit/burn	all	I	I	I (d.p.); residents: "all available pit space used"
RL-11		0	100	pit/burn	all	I	I	
RL-12		0	> 95	pit/burn	> 95	P	I	I (d.p.); some bo recycled
RH-16		> 300	< 50	pit/burn	no food	P	P	P as very big area
RH-17		< 100	< 50	pit/burn	no food	P	P	
RH-18		> 300	> 80	dump/burn	no bo/ct	P	I	all waste dumped on garden ground, dry, burn
RH-19		> 300	100	pit/burn	all	P	P	P as big area
RH-20		> 300	100	dump/burn	all	P	I	dump all waste on garden,burn combustibles
RM-16	R	< 100	> 95	pit/burn	> 95 *1	I	P	residents: "almost all available pit space used"
RM-17	A	< 100	100	pit/burn	all	P	P	
RM-18		> 300	100	pit/burn	all	P	P	P as big area
RM-20		< 100	100	pit/burn	all	P	P	
RL-16		0	100	pit/burn	all	P	I	most waste dumped without being buried, *3
RL-17		0	100	pit/burn	all	P	I	most waste dumped without being buried, *3
RL-18		< 100	100	pit/burn	all	I	I	waste dumped on ground, burned
RL-19		< 100	100	pit/burn	all	I	I	waste dumped on ground, burned
RL-20		< 100	100	pit/burn	all	I	I	waste dumped on ground, burned

Notes: bo = bottles; ct = cans/tins; pa = paper; int. = interviewee; s.d = self disposal; S.T = Study Team
I (d.p.) = S.T. evaluated s.d. to be improper as waste was burned in pit in densely populated (d.p.) area
*1 = some newspapers recycled
*2 = pit located next to toilet block and infiltrated by water - many children seen playing in this area
*3 = behind house on large property owned by landlord

Table 7-3: Disposal Interview Survey - Recycling Results Summary

Code	Items Collected	Buying price (Tsh/unit)	Interviewee's comments
RH-02	bo		
	ct	300 ea.	3 litre tins
RH-05	unstated		
RH-07	bo (small)	200-300ea.	in high demand (supposed to be filled with fake perfume)
	bo/ct	give away	other bottles (blackcurrant, etc.) and tins
	pa	200-500/kg	
RH-09	bo	give away	mainly soft drink bottles; collectors pass approx. every 2 wks
	ct	give away	mainly beer cans; collectors pass approx. every 2 wks
	pa	give away	collectors pass frequently for newspapers/magazines
RM-09	pa	give away	newspapers-collectors often look outside houses rather than ask at door
RM-10	me	give away	corrugated iron - normally they do not give to them
	pa	300/kg	mainly magazines - normally they do not give to them
RL-05	bo (beer)	50 ea.	collectors pass approx. once per month
	bo (soft)	25 ea.	collectors pass approx. once per month
RH-11	pa	400/kg	old paper for use for wrapping goods
RH-12	bo	unstated	
RH-13	bo	unstated	sometimes collectors pass but they don't often give or sell to them
RH-15	bo	N/A	owner takes to bar for refund
	pa	very low	newspapers/magazines but owner has not sold for some time
RM-11	pa	100/kg	collectors sell to Kibo Paper factory
RM-12	pa	give away	paper/magazines used to wrap clothes in by home tailoring business
RL-08	pa	give away	magazines - take to doughnut maker in Temeke (seldom)
RL-12	bo/pl	very low	plastic includes broken buckets
RL-14	bo/ct/pa	?	children sell items to youths who pass
RM-16	pa	400/kg	collectors are mainly youths

Note: bo = bottles; ct = cans/tins; pa = paper; pl = plastics

Table 7-4: Disposal Interview Survey - Illegal Dumping Results

Code	Method	Amount (%)	Disposal place
RH-06	pit	100	directly outside property in pit on pedestrian area next to road
RH-09	dump	> 95	open space near school; recycles some newspapers, bottles and cans
RH-10	dump	> 80	burns on property; transports ash/other waste by car; dumps outside
RM-07	pit	100	pit outside property used by >3 houses; waste burned; many children
RL-01	dump	100	in lake directly behind property
RL-06	dump	seldom	open space near school (however, normally use pit on property
RL-13	pit/dump	100	pit outside property
RL-14	pit/dump	100	pit outside property
RL-15	pit/dump	100	pit outside property
RH-17	dump	< 30	transports some waste, especially bottles, by car; dumps outside
RH-18	dump	< 30	transports some waste (bottles/cans/tins) by car; dumps outside
RM-19	dump	100	waste dumped on ground directly outside property; burned

Table 7-5: Disposal Interview Survey - Disposal by "Person other than Householder" Results

Code	Operator	Disposal Site	Collection Charge	no. of bags/wk	Total Tsh/wk	Comments
RM-01	handcart	unknown	200/- mpb	4 or 5	800-1000	mpb = medium plastic bag
RM-02	handcart	unknown	200/- mpb	7	1400	
RM-03	handcart	unknown	200-300/day	7	1500-2000	
RM-04	car	farm	N/A	N/A	N/A	friend takes waste to farm for disposal
RM-05	handcart	unknown	500-700 lpb	1	500-700	lpb = large plastic bag

7.3.2 Institutions and Commercial Enterprises Results

Table 7-6: Survey Results for Institutions and Commercial Enterprises

Institution		**No. of employees**		**Disposal Method**
Code	**Name**			
I-01	NAFCO	50		dispose at collection point outside property; collected by Multinet. Fee = 75,000/- p.a.
I-02	SDP	18 full-time; 5 part-time		collected by Multinet approx. twice per week
I-03	NUWA	21		self disposal (burn/bury) - mainly paper
I-04	NEMC	47		collected by Multinet. Waste put in heap at back of office block
I-05	NLUPC	47		collected by Multinet approx. twice per month. Not paid for.
Commercial (Other)		**No. of workers**	**Area (sq.m.)**	**Disposal Method**
Code	**Name**			
CO-01	RTC	4	200	collected by Multinet 1-2 times per week
CO-02	Hassan Printers	26	300	collected by Multinet 1-2 times per week
CO-03	Dubai Shopping Centre	4	100	collected by Multinet almost every day (60,000/- p.a.)
CO-04	Kara Traders	5	140	collected by Multinet almost every day (60,000/- p.a.)
CO-05	Quality Kitenge Shop Ltd	7	100	collected by Multinet almost every day (60,000/- p.a.)
Commercial (restaurants)		**No. of customers**	**No. of chairs**	**Disposal Method**
Code	**Name**			
CR-01	M.G. Pandya Hotel Ltd	not known	92	give waste to handcart operators (1,000-1,500/- for 5 days); not known where the waste is disposed of.
CR-02	Chicken King	100-130	59	collected by Multinet once per week (30,000/month)
CR-03	Amrapali Hotel	not known	42	collected by Multinet every day. Yet to pay for this year.
CR-04	Burco Office Equipment Restaurant	not known	58	collected by Multinet or DCC approx. once per week. Sometimes, waste is taken for composting at owner's farm at Mbezi. Some people collect 10-15 kg/day of food waste for animal feed.
CR-05	Zanzibar Hotel	not known	30	collected by Multinet every day (30,000/- per month). Some people collect bottles/cans from their waste.

Notes: 1) CO-02 stopped giving waste paper to Kibo Paper some time ago.
2)Some people come to CO-05 to collect plastic bags, buy boxes/cardboard, clothes hangers for various purposes.

Annex 8

Waste Stream Component Calculations

8 Waste Stream Component Calculations

8.1 Household Waste Disposal

8.1.1 Calculation of the Total Amounts of Different Items of Waste Produced by Residential Households

The WACS composition data was used together with population data (by income) to calculate the total daily amounts of different items of waste generated by households. Table 8-1A shows the percentage of each item measured in WACS for each household income category together with the total amount of waste (t/d) for each household income category as calculated in Section 6.1.3 of Annex 6. In Table 8-1B, the percentage composition and household waste generation amounts were used to calculate the total amount of waste produced per day for each item in each income category and overall. The total waste generation amount values for each item were then used to calculate a weighted average WAGR for each item:

$$\text{Weighted average WAGR (kg/cap/day)} = \frac{\text{total amount of waste produced for a particular item (kg/d)}}{\text{total population (persons)}}$$

Weighted average WAGRs were also calculated for:

i)garden waste which consists of "grass/wood" and "other" composition categories where "other" is mainly soil and sand as explained more in Section 6.1.4 of Annex 6;

ii)all waste except garden waste.

These and the other WAGRs shown in Table 8-1 were used in the calculations in Sections 8.1.3, 8.1.4 and 8.1.5.

Table 8-1: Estimated Daily Waste Generation Amounts for Different items of Household Waste

A: Percentage Waste Composition data for each Household Income Category

Generation Source	waste amt. kg'd	kitchen waste	paper	textile	plastic	grass/ wood	leather/ rubber	metal	glass	ceramic/ stone	other	total
Household - High	295,953	44.54	3.14	3.83	3.35	19.79	0.26	1.77	8.81	0.47	14.04	100.00
Household - Middle	829,641	41.91	3.04	0.47	1.86	30.88	0.98	2.11	2.42	0.29	16.03	100.00
Household - Low	290,657	39.80	3.31	0.63	1.90	14.96	1.23	1.77	1.34	0.40	34.66	100.00
Overall	1,416,251	42.03	3.12	1.20	2.18	25.30	0.88	1.97	3.53	0.35	19.44	100.00

Note: the overall percentage composition values are calculated on a weighted average basis

B: Estimation of the Daily Amount of Waste generated for each Item according to Household Income Category

Generation Source	Population	kitchen waste	paper	textile	plastic	grass/ wood	leather/ rubber	metal	glass	ceramic/ stone	other	total
Household - High	397,787	131,812	9,292	11,323	9,917	58,566	781	5,232	26,081	1,405	41,543	295,953
Household - Middle	1,063,644	347,689	25,231	3,871	15,459	256,226	8,135	17,520	20,072	2,433	133,003	829,640
Household - Low	568,799	115,691	9,619	1,820	5,525	43,481	3,575	5,134	3,900	1,170	100,742	290,657
Total	2,030,230	595,192	44,143	17,014	30,900	358,274	12,491	27,887	50,053	5,009	275,288	1,416,250
Wt. Avg. WAGR	kg/cap/d	0.2932	0.0217	0.0084	0.0152	0.1765	0.0062	0.0137	0.0247	0.0025	0.1356	0.6976

Note: Weighted Average (Wt. Avg.) WAGR (garden waste): 0.3121 kg/cap/d
Weighted Average WAGR (all except garden waste): 0.3855 kg/cap/d

8.1.2 Amount of Waste Disposed by Different Methods from Households

The above data and POS results were used to determine the amounts of household waste disposed by self disposal, illegal dumping, discharge and recycling. These terms are defined in Section 4.4.1 of the M/P Main Report. Some additional points concerning discharge and illegal dumping relevant to this section, are stated below.

Discharge: Each possible option in this category represents an intermediate stage as the waste does not stay at the discharge point but is subsequently transferred to another place. Hence, the disposal of waste at market waste collection points and at other collection points (e.g. residents in urban areas disposing of waste at points from where it is collected by Multinet) is classified as 'discharge' and not 'illegal dumping'.

Recycling: This is divided into two categories:

a) external. This is when the household sells/gives waste to an external person/shop/company etc. for recycling. E.g. paper or bottles may be sold to a middleman or food and grass/kitchen waste may be given away for animal feed.

b) internal. This is when waste is reused/recycled within the property; e.g. paper, bottles, food leftovers. In this case, eventually all material will be discarded. For example, bottles or bags break; paper may be used on both sides and is thrown out, etc. Hence, this waste will enter the waste stream via one of the 4 options. There are two exceptions:

- food leftovers, used by the owners to feed their own animals or to make compost.
- garden wastes, collected by the owner and used to make compost.

Such waste effectively never leaves the property and does not enter the waste stream. It is important to try and assess the quantities of waste disposed in this manner as a change in practice could lead to this waste being discharged and entering the waste stream. Hence, where possible, these amounts are included in the quantity of waste that is recycled.

The following assumptions apply to the analysis in Sections 8.1.3 - 8.1.5.

- All types of waste produced by a household (household refuse, recyclable materials, garden waste, etc.) were collected during WACS.
- All POS interviewees were told that "refuse" in Q3-1 relates to household refuse only and doesn't include garden waste (i.e. Q3-1 and Q3-9 are mutually exclusive).
- Each household has the same number of people; this being the average number determined in POS. Hence the percentage of households is equivalent to the percentage of people. The POS and WAGR data is in terms of number of households and people respectively and this assumption is necessary to make the two sets of data compatible.

8.1.3 All Waste Except Garden Waste

The results of POS Q3-1, which relates to the disposal of household refuse were used to calculate the amounts of waste disposed by each of the four disposal methods. The options in Q3-1 were characterised as follows:

Method	Q3-1 Options
Self disposal	dispose through combustion
Illegal Dumping	discharge outside
Discharge	discharge at specific place, discharge at market, hand to Multinet, hand to private collector
Recycling	no information can be obtained from this question

It was assumed that the "dispose through combustion" option in Q3-1 is equivalent to "dispose to pit and/or burning". This can be justified as follows: In Q3-1 there was no option for self disposal by using a pit. However, the Disposal Interview Survey (DIS) results (see Annex 7) showed that out of 42 of the 60 sampling points that practised self disposal, 83% used a pit and burning, 10% dumped their waste in their garden and later burned it while only 7% put their waste in a pit without subsequent burning.

The method used is described below and the results are tabulated in Table 8-2.

1. Add the appropriate percentages for different options in Q3-1 to get the total percentages of UA, SUPA, SUUA and RA households using self disposal, illegal dumping and discharge methods.
2. Multiply these percentages by the population in each area category to get the number of people using each disposal method.
3. For each method, add the totals for each area category to get the total number of people using that method of disposal.
4. Multiply these totals by the weighted average WAGR for all items of waste except garden waste (0.3855 kg/cap/d) to get the waste disposed of per day by each method.

Table 8-2: Amounts of Household Refuse Disposed by Different Methods

Category	Households (%) using each method			Population
	self-disposal	discharge	illegal dump	in each area
UA	0	68	32	56,880
SUPA	67	7	26	776,356
SUUA	65	8	27	963,016
RA	74	2	24	233,978
			TOTAL	2,030,230

Category	Population using each method			Population
	self-disposal	discharge	illegal dump	in each area
UA	-	38,678	18,202	56,880
SUPA	520,159	54,345	201,853	776,356
SUUA	625,960	77,041	260,014	963,016
RA	173,144	4,680	56,155	233,978
Total population	1,319,263	174,744	536,223	2,030,230
Waste (kg/d)	508,598	67,367	206,723	782,689

WAGR (all except garden waste) 0.3855 kg/cap/d

8.1.4 Garden Waste

The POS survey questions Q3-8 and Q3-9 relate to the disposal of garden wastes. These results were used to calculate the amounts of waste disposed by each of the four methods after categorising the options in Q3-9 as follows:

Method	Q3-9 Options
Self disposal	self disposal (open combustion/burn, bury in the backyard, etc.)
Illegal Dumping	self disposal (open combustion/burn, bury in the backyard, etc.)
Discharge	discharge at collection point, call collector of City Council, Multinet, private collector
Recycling	composting

The following assumptions were used:

- The WACS data for garden waste includes all types of garden wastes (grass, wood, soil, sand, etc.).
- The self disposal option in Q3-9 covers both self disposal and illegal dumping.

The amount of illegally dumped waste can not be determined directly from Q3-9 as this question had no option for "illegal dumping". However, the "self disposal" option in Q3-9 did not specify whether self disposal was done within or outside a household's property, which in terms of the definitions used in this Study correspond to self disposal and illegal dumping respectively. Hence the self disposal option is considered to include illegal dumping. The amounts of waste self-disposed, discharged and recycled (compost) are first calculated using POS data and the Illegal Dumping Survey results are then used to estimate the amount of illegally dumped waste within the self-disposed amount.

a. POS Analysis

1. The percentages in Q3-9 sum to give 100%. This means they relate to the disposal methods used by the households that have garden wastes and not all households. Hence the percentages are adjusted first using Q3-8 to get the percentage of all households using a particular method. e.g. 27% of urban households have garden wastes and of these 50% discharge their garden wastes by self disposal. Hence, percentage of urban households self-disposing of their garden wastes is 0.5 x 27% = 13.5%.
2. Add the appropriate adjusted percentages for different options in Q3-9 to get the total percentage of UA, SUPA, SUUA and RA households using self disposal, discharge and recycling.
3. Multiply these percentages by the population in each area category to get the number of people using each disposal method and those producing no garden waste.
4. For each method, add the totals for each area category to get the total number of people using each method of disposal and the total number of people not producing garden waste.
5. The weighted average WAGR for garden wastes stated in Table 8-1 is based on the total population but not all the population produce garden waste. As this calculation is based on the number of people producing garden waste, the WAGR must be

adjusted accordingly. This is done using the total number of people having garden wastes (801,531) and the total amount of garden waste produced (from Table 8-1: grass/wood and other = 633,562 kg/d) giving a weighted average WAGR of 0.7094 kg/cap/d.

6. Multiply the population totals by the weighted average WAGR for garden wastes to get the waste disposed of per day by each method.

These results are tabulated in Table 8-3.

Table 8-3: Amounts of Garden Waste Disposed by Different Methods

Category	% with no garden waste	Households (%) using each method			Total %	population in each area
		self-disposal	discharge	compost		
UA	73.0	13.5	13.5	0.0	100.0	56,880
SUPA	72.0	22.7	2.2	3.1	100.0	776,356
SUUA	56.0	28.6	10.6	4.8	100.0	963,016
RA	38.0	47.1	5.0	9.9	100.0	233,978
					Total	2,030,230

Category	popn. with no garden waste	Population using each method			population in each area*
		self-disposal	discharge	compost	
UA	41,522	7,679	7,679	-	15,358
SUPA	558,976	176,078	17,390	23,912	217,380
SUUA	539,289	275,423	101,694	46,610	423,727
RA	88,912	110,250	11,605	23,211	145,066
Total population	1,228,699	569,429	138,369	93,732	801,531
Waste (kg/d)	-	450,100	109,372	74,090	633,562

* excluding those with no garden waste
WAGR (garden waste): 0.7904 kg/cap/d

b. Illegal Dumping Waste Amount

1. Use the Residential Block Illegal Dumping Survey results (Section 3.6 of M/P Main Report) for the percentage (by volume) of garden waste in illegally dumped household waste and the total volumes of illegally dumped waste in different area categories to calculate the total volume of garden waste in each category.

2. Add these volumes together to get the total volume of garden waste and hence the percentage of garden waste in the total illegal dumping household waste amount. This calculation is shown in Table 8-4 and gives a value for the percentage of garden waste of 58.9%.

3. From Table 8-7, the amount of illegally dumped household refuse is 197,254 kg/d. Use this value and the above percentage of 58.9% to calculate the amount of illegally dumped garden waste (X); i.e. X/(X+197,254) = 0.589; X = 282,895 kg/d.

4. Amend the self disposal amount accordingly; i.e. 450,100 - 282,895 = 167,205 kg/d.

Table 8-4: Calculation of percentage of garden waste in total illegal dumping household waste amount

Area Category	% of garden waste by vol.)	Vol. of illegally dumped waste in area category (cu.m.)	Vol. of garden waste (cu.m.)
UA - Mchafukoge	0	11	0
- Kariakoo	0	202	0
- Upanga West	52	109	57
SUPA - Mwananyamala	82	29,451	24,150
SUUA - Keko	66	199,295	131,535
RA - Ubungo	52	298,368	155,151
Total	58.9	527,436	310,893

8.1.5 Recycling

The POS questions Q5-4, 5-5, 5-6 and 5-7 refer to recycling of materials. This data is used to estimate the amounts of different items that are recycled.

The following assumptions were used:

- The items recycled would otherwise be disposed of by one of the other three discharge options: self disposal, illegal dumping or discharge.
- The recycled materials from household refuse are present in the same proportions in the calculated quantities of household refuse disposed by self disposal, illegal dumping and discharge.
- The recycled materials from garden waste are present in the same proportions in the calculated quantities of garden waste disposed by self disposal, illegal dumping and discharge but not composting (waste which is composted is already being recycled internally and will not be recycled externally).
- Q5-4 refers to someone collecting/buying recycled materials from households while Q5-6 refers to households selling recycled materials to shops. These two options for the recycling of materials are considered to be mutually exclusive (independent).

The method used is described below:

1. Add the percentages of households in each category from whom people collect/buy recycled materials (Q5-4) and who sell to shops (Q5-6) to get the total percentage of households practising recycling in each area category.
2. Use the total number of households interviewed of 501 to convert these percentages to actual numbers of households who recycle materials. This is done to check that the data in Q5-5 and Q5-7, expressed in terms of numbers of households recycling different materials, is consistent (i.e. the number of households recycling any item in any residential area must be less than or equal to the number of households practising recycling in that area). These results are presented in Table 8-5.

Table 8-5: Percentage and Number of Households recycling waste items

Area Category	UA		SUPA		SUUA		RA		Total	
	rc	s	rc	s	rc	s	rc	s	rc	s
% of Households	30	3	35	2	24	0	33	3	95.5	4.5
No. of Households	15	2	70	4	48	0	17	1	150	7
Sample Size	50		200		200		51		501	

Note: rc = collection of recyclable items by people; s = sale to shops

3. Add the data for Q5-5 and 5-7 together to get the total number of households recycling each item in each area category.

4. Sum the corresponding data for each item from different area categories to get the total number of households recycling each item. Convert this number to a percentage by dividing by the number of households sampled (501).

5. Multiply this percentage by the population of DSM to get an estimate of the number of people recycling each item in the city.

6. If a household states it recycles a particular item such as bottles, it will not recycle all bottles. Based on the experience of Tanzanian colleagues, the actual percentage of each item likely to be recycled (the practical amount) was estimated as low (40%) or high (80%) and the amounts of each item recycled were adjusted accordingly. These percentages and results are tabulated in Table 8-6.

Table 8-6: Materials Recycled from Households

Item	Households(no.) in each area				total	% of all	popn. recy.	WAGR	recy.	Waste
	UA	SUPA	SUUA	RA	h'holds	h'holds	each item	kg/cap/d	rates (%)	kg/d
bottle	15	73	47	15	150	29.9	607,853	0.0316	80	15,371
glass	1	6	14	1	22	4.4	89,152	0.0037	40	132
cardboard	2	1	2	0	5	1.0	20,262	0.0217	40	176
paper	10	14	6	2	32	6.4	129,675	0.0217	40	1,128
aluminium tin	9	29	18	8	64	12.8	259,351	0.0137	80	2,851
steel tin	5	18	7	1	31	6.2	125,623	0.0137	40	690
metal	2	8	8	10	28	5.6	113,466	0.0137	40	624
kitchen waste	0	7	3	3	13	2.6	52,681	0.2932	80	12,355
garden waste	1	3	4	0	8	1.6	32,419	0.3121	40	4,047
plastic	3	14	4	2	23	4.6	93,204	0.0046	40	170
textile	0	0	0	1	1	0.2	4,052	0.0084	40	14
wood/timber	1	4	3	0	8	1.6	32,419	0.1765	40	2,288
sacks	0	3	1	0	4	0.8	16,209	0.0084	40	54
charcoal	0	0	0	1	1	0.2	4,052	0.0000	0	-
									TOTAL	39,900

Note: h'holds = households; popn. = population; recy. = recycling

7. Use the total amount of recycled materials to subtract appropriate amounts off the calculated quantities of waste disposed by self disposal, illegal dumping and discharge to take recycling into account. The appropriate amounts are obtained by assuming that the proportion of materials that are normally recycled but which are included in the self disposal, illegal dumping and discharge quantities is the same. Two cases must be considered:

- for recyclable materials from household refuse, the total quantities of waste disposed of by self disposal, illegal dumping and discharge are considered. Using ratios, calculate the amount of recyclable materials present in each of the three discharge options. For example, 39,900 kg/d is the total amount of waste that is estimated to be

recycled. This includes 4,047 kg/d of garden waste which must be subtracted to give 35,854[1] kg/d of recyclable household refuse. From Table 8-2, 508,598 kg/d of household refuse are disposed by self disposal out of a total daily production of household refuse of 782,689 kg/d. Hence if a is the amount of recycled materials assumed to be present amongst the amount self-disposed, then: a/35,854 = 508,598/782,689; a = 23,298 kg/d and the quantity of waste that is self-disposed is 508,598 - 23,298 = 485,300 kg/d.

- for garden waste, the total quantities of garden waste disposed of by self disposal (167,205 kg/d from b), illegal dumping (282,895 kg/d from b) and discharge (109,372 kg/d from Table 8-3) are considered. Composting is excluded. Ratios are used as above to calculate the amount of recyclable materials assumed to be present in each of these quantities and the amounts disposed by these means are correspondingly adjusted. For example, 167,205 kg/d of garden waste is disposed of by self disposal out of a total daily production of garden waste of 633,562 kg/d. This total includes 74,090 kg/d of composted garden waste and this amount must be subtracted from the garden waste total to give a revised total of 559,472 kg/d. Hence, if b = amount of recycled garden waste amongst the self disposed amount, then b/4,047 = 167,205/559,472; b = 1,209 kg/d.

These results are presented in Table 8-7.

Table 8-7: Quantities of Household Waste Generated per Day Disposed by Different Methods

Household	self-disposal	discharge	illegal dumping	recycling	total
refuse (kg/d)	508,598	67,367	206,723	-	782,689
less recycled waste	23,298	3,086	9,470	-	35,854
total	485,300	64,281	197,254	-	746,835
add recycled waste	-	-	-	35,854	35,854
adjusted total	485,300	64,281	197,254	35,854	782,689
Garden	self-disposal	discharge	illegal dumping	recycling	total
garden waste (kg/d)	167,205	109,372	282,895	74,090	633,562
less recycled waste	1,209	791	2,046	-	4,047
total	165,996	108,581	280,849	74,090	629,515
add recycled waste	-	-	-	4,047	4,047
adjusted total	165,996	108,581	280,849	78,137	633,562
TOTAL	651,296	172,862	478,102	113,991	1,416,251

Additional notes: 1. There are 8 people who state people collect/buy garden waste from them. This is likely to be grass waste which is used as animal feed. Similarly, kitchen waste which is given away or sold is likely to be used for animal feed.
2. In WACS, glass and plastic were two of the physical composition categories used. However, in Q5-5 and Q5-7 of POS, glass, plastic and bottles were three of the items people were asked if they recycle. As bottles may be either glass or plastic, the percentages of bottles in the plastic and glass items in WACS household waste was estimated to be 70% and 85% respectively by WACS Assistants based on their observations during the survey. These percentages were then used to

[1] 39,900 - 4,047 = 35,853 rather than 35,854. The difference of 1 in this calculation is due to round off error from the spreadsheet calculations and the values should be taken as stated in the text. This also applies to some other calculations in the tables presented in this section.

calculate a WAGR for bottles and amended WAGRs for plastic and glass as shown in Table 8-8 below:

Table 8-8: Calculation of WAGRs for bottles, plastic and glass

Item	Production of Waste (kg/d)	Production of plastic or glass bottle waste (kg/d)	Production of other plastic waste (kg/d)	Production of other glass waste (kg/d)
plastic	30,900.7	21,630.5	9,270.2	---
glass	50,052.7	42,544.8	---	7,507.9
Total	80,953.4	64,175.3	9,270.2	7,507.9
WAGR (kg/cap/d)	N/A	0.0316	0.0046	0.0037

Note: WAGRs are calculated by dividing the totals in each category by population (2,030,230).

3. Some other assumptions had to be made for certain items from Q5-5 and Q5-7 in order to be able to use WAGRs from WACS. These are summarised below.

- The paper WAGR was used for paper and cardboard.
- The metal WAGR was used for aluminium tin, steel tin and metal.
- The kitchen waste WAGR was used for kitchen waste.
- The composite garden waste WAGR (grass/wood and other) was used for garden waste.
- The textile WAGR was used for textiles and sacks.
- The grass/wood WAGR was used for wood/timber.
- Charcoal was assumed not to be recycled.

8.2 Restaurant Waste

The aim of this section is to estimate the percentage of restaurant waste that is recycled, using the DIS results of Annex 7. From interviews with the five restaurants used as WACS sampling points, it was found that one of them gives away approximately 10-15 kg of food/day while another gives away bottles and cans/tins.

From WACS composition data, the percentages of metal and glass in restaurant waste are 0.47% and 0.59% respectively giving a total of 1.06%. It is assumed that all five restaurants produce the same amount of waste daily which can be calculated using the WAGR of 37.446 kg/enterprise/d.

Considering the one restaurant which recycles bottles and cans/tins and assuming it gives away 80% of its cans/tins and bottles, these recycled items represent 0.8 x 1.06 = 0.85% of this one restaurant's waste, equivalent to 0.17% for all five restaurants. Hence the cans/tins and bottles recycled represent 0.17% of the total restaurant's waste.

Considering the recycling of kitchen waste, for all 5 restaurants the daily production of waste is 5 x 37.446 = 187.23 kg/d. Assuming 12.5 kg/d is recycled by the one restaurant, this represents 12.5/187.23 = 6.68%.

Hence the total percentage of restaurant waste which is recycled is 6.9%, made up of 6.7% kitchen waste and 0.2% cans/tins and bottles.

8.3 Self Disposal Assessment

The aim of this assessment is to determine the percentage of households practising proper self disposal.

The Disposal Interview Survey (DIS) conducted included the 60 households selected as WACS sampling points. For each household practising self disposal, the interviewee was asked about their method of self disposal (pit/burning/other) and to assess whether they considered it to be proper or improper without being given any definition of these terms. An independent assessment of the self disposal status was then made by the interviewer (St.), based on the following guideline: "disposal by pit is normally suitable except if the pit is badly located and/or poses a health/safety threat. In a high population density area where the average plot area is small, self disposal by burning is not proper due to public nuisance and pollution created by burning whereas the converse applies to a low population density area".

The procedure used to calculate the amounts of waste disposed of by proper and improper self disposal is summarised below.

1. The number of households using self disposal (SD) as their main method of waste disposal and the total number of households in each area category are tabulated in Table 8-9 below, from which the percentage of households interviewed practising self disposal is calculated.
2. The Int. and the St. assessments of proper/improper self disposal give two indicators of the total number of households in each area category practising proper self disposal. As both of these assessments are subjective in nature, the average of the two indicators was taken as being representative of the number of households practising proper self disposal.
3. The average figure was converted to a percentage of households practising proper self disposal in each category (equivalent to percentage of people).
4. The percentages of households practising proper self disposal and self disposal in general are then multiplied by the population in each area category to get the number of people practising proper self disposal and self disposal (proper and improper) in each area category and overall.

Table 8-9: Calculation of the Number of People doing proper self disposal

Category	No of Households			Assessment of Proper SD - No. of Households			H'holds doing proper SD	Population	No. of People practising SD	
	doing SD	Total	%	Int.	St.	Avg.	%		proper only	proper & improper
UA	1	10	10	1		0.5	5.0	56,880	2,844	5,688
SUPA	12	17	71	9	5	7.0	41.2	776,356	319,859	551,213
SUUA	15	18	83	11	7	9.0	50.0	963,016	481,508	802,513
RA	14	15	93	10	7	8.5	56.7	233,978	132,666	217,600
TOTAL	42	60		31	18			2,030,230	936,877	1,577,014

Note: The percentages used for the number of households practising self disposal of 10, 71, 78 and 93% for each of the area categories are consistently above those measured in the POS of 0, 67, 65 and 74% respectively.

From Table 8-9, the total number of people practising self disposal is 1,577,014 of which 936,877 or 60% are practising proper self disposal.

8.4 Final Disposal Waste Amount

8.4.1 Estimated Final Disposal Waste Amount (Phase 2)

a. Initial Data Collection and Data Limitations

In Phase 2 of this Study, the final waste disposal amount for municipal solid waste (MSW) was estimated from Vinguguti disposal site records for 1996. During 1996, no weighbridge was installed at Vinguguti disposal site. Each day, a record of the number of trips made by DCC, Multinet, and direct haulage vehicles was kept. The trip data was subsequently converted to tonnes based on estimates of the tonnages carried by different vehicles as set out in Table 8-10.

Table 8-10: Estimated Tonnages of Waste carried by different Vehicles

Vehicle	Conversion Factors (Tonnes of waste per vehicle)
DCC, THA	4
Multinet	3
KMC	2
TTCL, NBC	7
TCC - tractor	1
- truck	4
Individual	1 (usual)
Office/commercial, Industrial, Other	1-7 (variable)

Notes: 1. KMC = Kariakoo Market Corporation, NBC = National Bank of Commerce, TTCL = Tanzania Telecommunications Company Limited, THA = Tanzania Harbours Authority, TCC = Tanzania Cigarette Company.
1. KMC have measured (by weighbridge) the tonnage of market waste carried by their private contractors' vehicles as 2-2.5 tonnes.
2. Most individual vehicles are relatively small and are assumed to carry 1 tonne of waste. For larger vehicles, the estimated tonnage of waste is increased according to the vehicle size.

3. Office/commercial covers vehicles from Whitesands Hotel, embassies, BOT, etc. Industrial covers vehicles from Vitamin Foods, Kassam Retread, Coast Miller, Goldstar, Banco, Tanzania Breweries, etc. For these categories, the tonnage of waste is estimated based on vehicle size.

The waste disposal data is not considered to be very accurate nor complete for the following reasons:

1. The conversion factors used are estimates only. No allowance was made for the variation in waste tonnages between different trips made by the same vehicle due to the percentage of the vehicle capacity utilised, the types and density of waste carried.
2. Comparison with Multinet's vehicle trip records for May and June 1996 showed that the recorded number of trips per day frequently differed from that stated by DCC. However, Multinet explained that these discrepancies are due to differences in the recording systems used by Multinet and DCC and that the monthly trip totals recorded by DCC (for which Multinet is billed) are in reasonable agreement with Multinet's records, differing by only 3 and 10 trips for May and June respectively. However, Multinet vehicles operate from 7am - 9pm and it is suspected that a large number of trips made by Multinet vehicles remain unrecorded and unbilled.
3. Comparison with KMC's records of the daily number of trips made by their private contractors for February and June 1996 showed that the number of trips per day was consistently understated in the DCC records with the KMC monthly totals being 31% and 26% greater respectively. KMC confirmed that this is normal and in their experience, the unrecorded waste is dumped at Vingunguti disposal site outside of official opening hours.
4. The disposal site is staffed by DCC workers for 7 days per week officially between 0730-1830 (Mon. - Fri.) and 0730-1530 (Sat., Sun.). However, usually the DCC recording point at Vingunguti is not staffed until 0900 or even later. Hence, any disposal of waste outside the official hours, as in the case of KMC above, is not accounted for. DCC disposal site staff estimated that a maximum of **5%** of all vehicles entering the disposal site are not recorded.

During Phase 2, it was not possible to compensate for reason 1 above. However, it was possible to compensate for reasons 2, 3 and 4 by making an independent estimate of the number of unrecorded trips.

This was done by assuming that all dumping occurs between 0600-1900 (Mon-Sun) and that all vehicles are recorded between 0730-1830 (Mon-Fri) and 0730-1530 (Sat-Sun). This means 20 hours are available for unrecorded dumping per week while the number of hours during which dumping is recorded will be 81 hours/week. If the vehicle frequency is assumed to be constant, then **25%** of all trips to the disposal site will be unrecorded. In reality, this figure will be even higher if recording begins after 0730.

The actual percentage of all trips which are unrecorded is thought to be intermediate between this estimate of 25% and the DCC estimate of 5% and an average figure of **15%** was used to correct the final disposal amount as shown in (b) below. Most of these unrecorded trips are thought to be made by KMC and Multinet vehicles.

b. Categorisation of Data

Vingunguti disposal site records were used to make an initial estimation of the final disposal amount. All vehicles bringing waste to the disposal site were divided into four categories:

1. DCC.
2. Private Contractors: authorised private refuse collection contractors - Multinet, Mazingira, Alyson's Traders and Kimangele.
3. Direct Haulage: all vehicles belonging to the generator or generator's agent which bring waste directly to Vingunguti disposal site. This includes Kariakoo market (KMC), institutions (NBC, TTCL) and other (individuals, office/commercial, unidentified) but industrial direct haulage vehicles are specified separately in (4).
4. Industry: direct haulage vehicles bringing industrial waste such as from THA and TCC. These are specified separately from (3) as industrial waste is outside the scope of this Study and should not be included in the final disposal amount for MSW.

c. Data for January - June 1996

Data was collected for the six month period from January - June 1996 inclusive. The raw data is shown in Table 8-19 - Table 8-24 in Section 8.7. The data was then arranged into the four categories listed in (b) above as shown in Table 8-25 - Table 8-30 and illustrated in Figure 8-1 - Figure 8-6 in Section 8.7. These tables and figures show that there is considerable variation in the number of trips and tonnages of waste dumped on a daily basis throughout the six month period.

The total number of trips and tonnages per month for each category were calculated for this data and are shown in Table 8-11 and Table 8-12 respectively. Data from industrial vehicles is tabulated but is excluded from calculation of the monthly total and daily averages.

Table 8-11: Total Number of Trips per month by different vehicles

Month	DCC	Multinet	Direct Haulage	Industrial	Total (excluding industrial)	Daily Avg. (excluding industrial)
January	463	428	333	137	1224	39
February	329	251	344	155	924	31
March	516	493	391	132	1400	45
April	380	515	291	126	1186	40
May	291	599	235	104	1125	36
June	363	605	228	146	1196	40
Tot.	**2342**	**2891**	**1822**	**800**	**7255**	**40**
Daily Avg.	**13**	**16**	**10**	**4**		

Table 8-12: Total Tonnage of Waste per month carried by different vehicles

Month	DCC	Multinet	Direct Haulage	Industrial	Total (excluding industrial)	Daily Avg. (excluding industrial)
January	1852	1284	600	326	3736	120.5
February	1316	753	565	413	2634	90.8
March	2064	1479	613	380	4156	134.1
April	1520	1545	449	389	3514	117.1
May	1164	1797	403	282	3364	108.5
June	1452	1815	374	424	3641	121.4
Tot.	**9368**	**8673**	**3004**	**2214**	**21045**	**115.6**
Daily Avg.	**51.5**	**47.7**	**16.5**	**12.2**		

d. WACS data

DCC disposal site data was also collected for the period in which WACS was carried out: June 19-25 inclusive, and is shown in Table 8-13. Data from industrial vehicles is tabulated but is excluded from calculation of the final municipal waste (MSW) disposal amount.

Table 8-13: Disposal Site Data during WACS

Date	DCC		Multinet		Direct Haulage		Industrial		Total (excluding industrial)	
	Trips	wt. (t)	Trips	wt (t.)	Trips	wt (t.)	Trips	wt (t.)	Trips	wt (t.)
Wed, Jun 19	15	60	23	69	7	12	3	12	45	141
Thur, Jun 20	27	108	24	72	14	31	7	16	65	211
Fri, Jun 21	19	76	24	72	12	16	7	19	55	164
Sat, Jun 22	1	4	23	69	5	10	4	13	29	83
Sun, Jun 23	0	0	12	36	2	4	3	9	14	40
Mon, Jun 24	21	84	24	72	12	21	6	18	57	177
Tues, Jun 25	27	108	23	69	11	23	8	26	61	200
Total	110	440	153	459	63	117	38	113	326	1016
Daily Avg.		**62.9**		**65.6**		**16.7**		**16.1**	**47**	**145.1**

e. Comparison of Six Month and WACS Data

The average daily number of trips during WACS is 47 and average daily tonnage of waste is 145.1 t/d. These average values are higher than those for the 6 month (Jan.-Jun.) period (40 trips and 115.6 t/d) and for June itself (40 trips and 121.4 t/d).

The six month and June averages are considered to be lower than normal for the following reasons:

- The data for February is unusually low, especially for Multinet. Multinet stated that the poor performance during February 1996 was primarily due to a change in management that occurred during this month which caused some disturbance to their refuse collection programme including reduced availability of refuse collection vehicles.

- The long rains occur during April and May. Normally, the daily number of trips and tonnage of waste decreases during this time as demonstrated by this data.
- June marks the start of the dry season and the monthly averages are consequently greater than those for April and May. Fig C-6 shows that as June progresses there is a gradual increase in the daily tonnage of waste dumped and clearly, more waste is dumped in the second half of the month when WACS was carried out than in the first half.

f. Estimated Final Disposal Amount

For the reasons outlined in (e) above, it was decided to use the WACS average daily tonnage figure of 145.1 t/d as the estimated final disposal amount. This figure was increased by 15% to allow for waste disposed outside of official opening hours, giving an estimated final disposal amount for MSW of 166.9 t/d.

8.4.2 Weighbridge Measurement of Final Disposal Amount

Following the weighbridge beginning operation in February 1997, weighbridge data was obtained for the period 11-28 February 1997 inclusive in order to check the validity of the final disposal amount estimated in Section 8.4.1. This data is summarised in Table 8-14.

Currently, the weighbridge is operated from 9am - 4pm by DCC although refuse collection trucks are able to enter the disposal site 24 hours per day due to the absence of a gate. The measured data was revised as shown in Table 8-14 to take into account waste brought to the disposal site outside weighbridge opening hours as follows:

1. DCC vehicles bring waste for disposal within the official opening hours. No correction is made in this case.
2. Multinet is the main customer bringing waste to the disposal site outside these opening hours as Multinet vehicles are working from 7am - 9pm. The average number of trips made by a single Multinet vehicle recorded by the weighbridge is approximately two per day. It has been assumed that each vehicle makes one extra unrecorded trip on average per day, bringing the total number of trips per vehicle to three. In other words, the actual number of trips and waste amount brought by Multinet vehicles has been increased by 50%.
3. It was also suspected that Kariakoo market (KMC) may be making some unrecorded trips for, as stated in section 8.4.1a, the number of trips per day made by KMC was consistently understated in DCC records for the period February - June 1996 by 26-31%. Following the installation of the weighbridge, the average number of trips made by KMC recorded by the weighbridge is 3.3. According to KMC records, an average of 4 trips/day are made for market waste removal. Hence, the total daily number of trips has been increased to 4, equivalent to an increase of 20%.
4. Table 8-14 shows that the daily amount of waste brought by other vehicles is small. From experience, the majority of these vehicles operate within official opening hours. For these reasons, any extra trips made by other vehicles has been ignored.

These revisions increase the final disposal amount for the 18 day period from 2,344 to 2,645 tonnes, an increase of 13%, which is consistent with the 15% figure used in Section 8.4.1 to account for unrecorded waste.

Table 8-14: Weighbridge data for 11-28 February 1997 inclusive

Disposal Site Customers	Measured Data		Revised Data		Revised Average	
	Trips	Tonnes	Trips	Tonnes	Trips/d	Tonnes/d
DCC	418	1,212	418	1,212	23.2	67.3
Private Contractor						
* Multinet Africa	249	543	374	815	20.8	45.3
* Mazingira	39	75	39	75	2.2	4.2
* Alyson's Traders	6	10	6	10	0.3	0.6
* Kimangele	20	27	20	27	1.1	1.5
Direct Haulage						
* KMC	59	146	71	175	3.9	9.7
* NBC	7	9	7	9	0.4	0.5
* TTCL	4	6	4	6	0.2	0.3
* Individual	175	253	175	253	9.7	14.1
Industrial						
* THA	24	42	24	42	1.3	2.3
* TCC	26	21	26	21	1.4	1.2
Total	1,027	2,344	1,164	2,645	64.5	147.0
Final Disposal Amount	(MSW)					143.5

Comparison of the weighbridge measured data with the conversion factors used by DCC for tonnages of waste for different vehicles shown in Table 8-10 shows that there are errors in the conversion factors, most of which are higher than the actual tonne/trip values for different vehicles. Hence, the weighbridge final disposal amount will be used in the waste stream as it is based on actual measurements rather than these approximate and erroneous conversion factors.

The revised final disposal amount is 147.0 t/d. Industrial waste of 3.5 t/d has been included in Table 8-15 above but has been subtracted from the final waste disposal amount to get a final disposal amount for MSW of 143.5 t/d.

8.5 Estimated Recycled Waste Amount from Vingunguti Disposal Site

8.5.1 Actual Recycled Waste Amount - Discussion of Methods Used

The recycled waste amount from Vingunguti disposal site was estimated using three methods:

1. Scavenger Interview Survey (SIS) results for estimated quantities of different items collected by scavengers from Vingunguti disposal site.
2. Middleman Interview Survey (MIS) results for estimated quantities of different items purchased from scavengers by middlemen operating in the immediate vicinity of Vingunguti disposal site.

3. Scavenger Waste Amount Survey (SWAS) results for estimated quantities of items collected by scavengers.

These surveys' methodologies and results are explained in annex 9. The basis of the methods used and their accuracy and limitations are discussed here.

a. SIS

The SIS calculation is based on:

- estimations of the quantities of different items collected by each of the 30 scavengers interviewed in SIS;
- estimation of the total number of full-time scavengers from Scavenger Attendance Survey results and discussions with DCC disposal site staff.

There is some uncertainty in both these estimations, giving an associated error in the SIS estimations of +/-40%.

b. MIS

The MIS calculation is based on:

- estimations of the quantities of different items collected by each of 11 middlemen operating in the immediate vicinity of the disposal site and interviewed in MIS;
- assuming that 90% of all scavengers at Vingunguti sell their collected items to these middlemen;
- assuming that the middlemen interviewed represent at least 90% of all middlemen operating in the Vingunguti area;
- extrapolation of estimated quantities using these assumptions to get total quantities.

The second assumption in the above calculation is the main source of error as discussed below:

- Five and seven middlemen dealing in other metals and paper respectively were interviewed and this assumption is thought to be valid for these two types of waste. For food leftovers, only one middleman was interviewed who although he does not represent 90% of all middleman dealing in food, he is known to dominate the food market. In these three cases, the estimated quantities will be relatively accurate.
- For cans/tins and wood, three and two middlemen were interviewed respectively. It is thought that these numbers do not represent 90% of the total and hence the estimated quantities will be low.
- For other items, only 1 middleman was interviewed in each case (glass bottles; plastics and sacks) and this assumption is not true. Hence, the estimated quantities were not used.

c. SWAS

The SWAS estimations are based on:

- physical measurement of collected quantities by scavengers;

- assuming that all items collected from Vingunguti disposal site were recorded.

This assumption is not true. However, the quantities of different items collected from the disposal site can be used as a lower limit on the amounts of waste materials that are collected daily.

8.5.2 Estimated Recycled Waste Amount

The recycled waste amount from Vingunguti disposal site was estimated using the three methods explained above and the results are presented in Table 8-15. The average quantity for each item is calculated and summed to get the total recycling amount of 2.1 t/d (range = 1.1-2.6 t/d).

Table 8-15: Comparison of Estimated Recycled Amounts for Different Items and Calculation of the Recycled Waste Amount

Unit: kg/d

Item	bo	ct	fo	hu	me	pa	pl	pt	sa	ty	wo	oth	Total
SIS	87	132	---	200	162	1256	62	6	126	15	147	---	2193
MIS	---	120	83	---	433	1765	(4)	---	(9)	---	117	41	2572
SWAS	76	165	5	75	136	233	36	34	17	7	260	29	1073
Avg.	82	139	44	138	244	1086	49	20	72	11	175	35	2095
%	3.9	6.6	2.1	6.6	11.6	51.8	2.3	1.0	3.4	0.5	8.4	1.7	99.9

Note: 1. Items in brackets are excluded from calculation of average amounts.
2. bo = glass bottle; ct = cans/tins; fo = food leftovers; hu = cereal/rice husks; me = other metal; pa = paper; pl = plastic; pt = paint; sa = sack; ty = tyre; wo = wood; oth = other.

This is the amount of waste recycled from all waste brought to the disposal site (143.5 t/d of MSW and 3.5 t/d industrial waste). For the waste stream determination, it is required to determine the amount of waste recycled from the final MSW disposal amount alone. This is done on a pro rata basis to give 2.05 /td which is reported here as 2.1 t/d.

8.5.3 Estimated Recyclable Quantities of Waste Materials Brought to Vingunguti Disposal Site

The discharge component of the waste stream consists of different amounts of waste from household, commercial (restaurant, hotel, other), market, institution, street sweeping and informal sector sources. This data (see Section 4.4.1 of M/P Main Report) was used together with the composition data to estimate the quantities of recyclable materials which are brought to Vingunguti by Multinet, DCC and private vehicles for final disposal. These quantities represent the maximum quantities that can be recycled and the actual quantities of different materials recycled will be smaller.

It is assumed that:

- The discharge stream data realistically represents the waste which is brought to Vingunguti for disposal by DCC, Multinet, and private vehicles.
- The proportions of waste in the discharge stream from different sources (household, commercial, market, street sweeping & informal sector) is the same in the waste that is disposed of at Vingunguti.

- Hotel and informal sector waste were not included in WACS. Hence, hotel and informal sector waste are assumed to have the same composition as institutional and market waste respectively.

The following method was used:

1. The composition data and discharge quantities are multiplied to get the amounts of recyclable materials present in the discharge stream from different sources and the total amount.
2. Of the 299.3 t/d of MSW which is discharged, 143.5 t/d of MSW is disposed of at Vingunguti, according to weighbridge measurements. Hence, the discharge quantities from (1.) are multiplied by the ratio 143.5/299.3 to get the estimated amount of recyclable materials disposed of at Vingunguti.

These results are shown in Table 8-16.

Table 8-16: Estimated Quantities of Recyclable Materials disposed of at Vingunguti Disposal Site

A: WACS Composition Data for Calculating Composition of Discharge Waste

Discharge Source	kitchen waste	paper	textile	plastic	grass/ wood	leather/ rubber	metal	glass	ceram/ stone	other	total
H'hold(avg.)	0.4203	0.0312	0.0120	0.0218	0.2530	0.0088	0.0197	0.0353	0.0035	0.1944	1.00
Restaurant	0.9339	0.0187	0.0120	0.0171	0.0076	0.0000	0.0047	0.0058	0.0001	0.0000	1.00
Hotel	0.0921	0.7145	0.0258	0.0608	0.0092	0.0000	0.0405	0.0331	0.0074	0.0166	1.00
Shop	0.0076	0.7157	0.0254	0.0838	0.0152	0.0051	0.0533	0.0000	0.0051	0.0888	1.00
Institution	0.0921	0.7145	0.0258	0.0608	0.0092	0.0000	0.0405	0.0331	0.0074	0.0166	1.00
Market	0.5955	0.0318	0.0050	0.0085	0.2718	0.0000	0.0006	0.0025	0.0022	0.0821	1.00
St. sweep	0.2301	0.1753	0.0125	0.0640	0.1897	0.0236	0.0246	0.0101	0.0091	0.2610	1.00
Inf. Sect.	0.5955	0.0318	0.0050	0.0085	0.2718	0.0000	0.0006	0.0025	0.0022	0.0821	1.00

Note: The insitutional and market composition data is used for hotel and informal sector waste respectively

B: Estimation of the Maximum Quantity of Recycled Materials Arriving at Vingunguti

Discharge Source	Waste t/d	kitchen waste	paper	textile	plastic	grass/ wood	leather/ rubber	metal	glass	ceram/ stone	other	total
H'hold(avg.)	172.9	72.7	5.4	2.1	3.8	43.7	1.5	3.4	6.1	0.6	33.6	172.9
Restaurant	12.7	11.9	0.2	0.2	0.2	0.1	0.0	0.1	0.1	0.0	0.0	12.7
Hotel	1.6	0.1	1.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	1.6
Shop	11.8	0.1	8.4	0.3	1.0	0.2	0.1	0.6	0.0	0.1	1.0	11.8
Institution	8.6	0.8	6.1	0.2	0.5	0.1	0.0	0.3	0.3	0.1	0.1	8.6
Market	33.9	20.2	1.1	0.2	0.3	9.2	0.0	0.0	0.1	0.1	2.8	33.9
St. sweep.	1.3	0.3	0.2	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.3	1.3
Inf. Sect.	56.5	33.6	1.8	0.3	0.5	15.4	0.0	0.0	0.1	0.1	4.6	56.5
Disch. Tot.	299.3	139.7	24.5	3.3	6.4	68.9	1.6	4.6	6.8	1.0	42.6	299.3
F.D. Tot.	143.5	67.0	11.7	1.6	3.1	33.0	0.8	2.2	3.2	0.5	20.4	143.5

Note: H'hold = household, St. sweep = street sweeping; Inf. Sect. = Informal Sector,
Disch. Tot. = discharge total; F.D. Tot. = final disposal total; ceram = ceramic

8.6 Recycling Waste Amount from Discharge and Illegal Dumping

The following assumptions were used:

- The amount of recyclable items collected by scavengers at any component (discharge, collection, etc.) of the waste stream is proportional to the total waste amount for that component.

- The total waste amount for any component includes all types of waste including garden waste, although this is of limited recyclable value to scavengers. This is done as it is simpler and considered more practical to look at recycling in terms of the total amounts of waste at any point and not just recyclable waste.
- 27.6% of the discharge waste amount is collected directly from discharge points and is not available for scavenging at this point as explained below.

Discharge options can be classified into two groups:

1. dumping at market collection points, disposing at collection points outside, collection by DCC.
2. giving the waste to Multinet/other private contractors, company vehicles (direct haulage), handcart operators.

For group 1, there is some time delay between discharge and collection, meaning scavengers have ample time to collect recyclable materials. Presently, most of the DCC collection service is focused on collection from markets and some collection points, again giving scavengers time to collect recyclable materials. Hence it is estimated that only 20% of the DCC collection amount is collected immediately with no opportunity for scavenging.

For group 2, the waste is discharged directly to the collector and there is no time for scavenging at the discharge point. Using the categories of Table 8-14, it is assumed that 90% of the waste collected by Multinet/other private contractors and by direct haulage vehicles is collected immediately with no opportunity for scavenging. Handcart operators collect waste directly from generators who generally store the waste within their premises before giving it to the handcart operators when they pass. Hence, it is assumed that there is no opportunity for scavenging in this case.

Before the recycled waste amount from discharge can be calculated, it is necessary to subtract the amount of waste which is collected immediately without scavenging from the discharge waste amount. This is done in Table 8-17 using the above percentages and DCC Vingunguti weighbridge data from Section 8.4 expressed in terms of t/d.

Table 8-17: Amount of Waste Collected immediately after discharge

Type of Vehicle	DCC	Private Contractors	Direct Haulage	Total
Final Disposal Amount for MSW (t/d)	67.3	51.6	24.6	143.5
% not available for scavenging	20	90	90	
Waste not available for scavenging	13.5	46.4	22.1	82.5

Note: Industrial waste is not included as only MSW is of interest here.

Thus 82.5 t/d (27.6% of the discharge waste amount) must be subtracted from the discharge waste amount of 299.3 t/d to give 216.8 t/d, this representing the amount of discharged waste available for scavenging. The recycled waste amounts from discharge and illegal dumping were then calculated as shown below:

Discharge waste amount available for scavenging: 216.8 t/d
Discharge recycled waste amount = X
Illegal Dumping waste amount: 704.3 t/d
Illegal Dumping recycled waste amount = Y

Final Disposal Waste Amount: 143.5 t/d
Final Disposal Recycling Amount: 2.1 t/d
For recycling at discharge: X/2.1 = 216.8./143.5; X = 3.1 t/d
For recycling at illegal dumping points: Y/2.1 = 704.3/143.5 = 10.1 t/d

The recycled amounts at different points of the waste stream are shown in Table 8-18.

Table 8-18: Recycling at different points of the waste stream

Component	Type of Scavenger	Amount of Scavenging (t/d)	Estimated no. of scavengers
Generation	household collector	39.3	843
Discharge	scavenger	3.1	67
Illegal Dumping	dump scavenger	10.1	217
Final Disposal	dump scavenger	2.1	45
Total		54.6	1172

Note: The recycled amount from households (to household collectors and shops is 39.9 t/d (Table 8-6) of which 95.5% = 38.1 t/d is collected by recycle collectors. 0.2 and 1.0 t/d of waste is collected from shops and restaurants respectively by recycled collectors, giving a total of 39.3 t/d collected from generation points as shown above.

A check on this calculation can be made by calculating the number of scavengers this total recycling amount is equivalent to based on the productivity of the scavengers at Vingunguti of 46.6 kg/d/person. Number of scavengers = 54,600/46.6 = 1172.

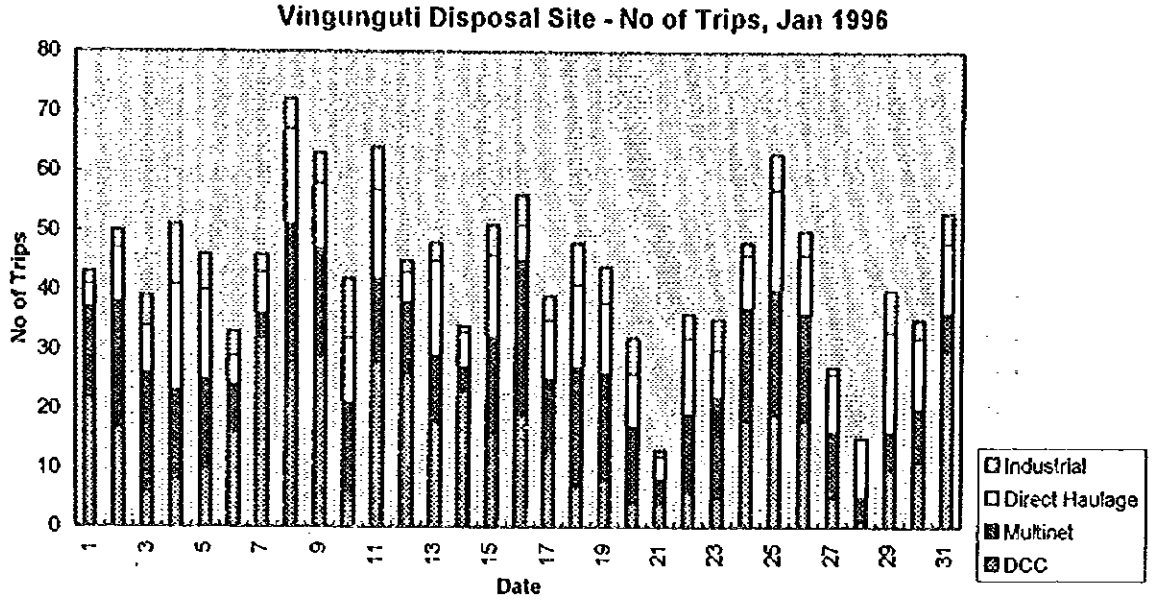
Kaseva and Gupta (1996)[2] estimated that in 1993-95 there were 600 solid waste scavengers in DSM, 109 at Vingunguti and the remaining mainly working at 14 collection centres around the city calculated on the basis of average daily attendance. Most of these collection centres are no longer used although some still function as illegal dumping sites. Kironde (1995)[3] asserts this number to be a gross underestimate, a view shared by this Study team which suspects there are 1000-1500 scavengers operating in DSM.

Hence the calculated number of 1172 scavengers and estimated recycling amounts at each of the four points are considered reasonable. An estimation of the number of scavengers involved in collection of recyclable materials from each point (using 46.6 kg/d) is included in Table 8-18 above.

8.7 Vingunguti Disposal Site Data

As explained in Section 8.4, disposal site data for the 6 month period: January - June 1996 is tabulated on the following pages and illustrated in Figure 8-1 - Figure 8-6.

[2] "Recycling - an Environmentally Friendly and Income Generating Activity towards Sustainable Solid Waste Management. Case Study - Dar es Salaam, Tanzania"; M.E. Kaseva & S.K. Gupta; unpublished paper; Ardhi Institute; DSM; Tanzania, 1996
[3] "The Governance of Waste Management in African Cities: The Case of Dar es Salaam, Tanzania"; Report for International Workshop on Waste Management in African Cities; J.M.L. Kironde; Ardhi Institute; DSM; Tanzania; 1995



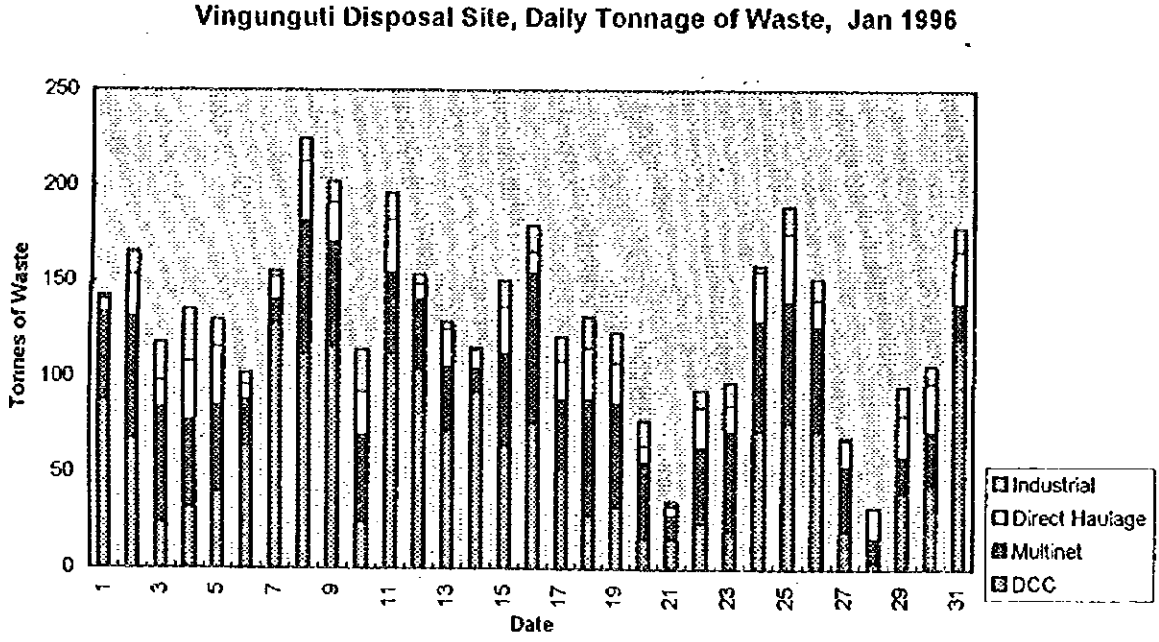
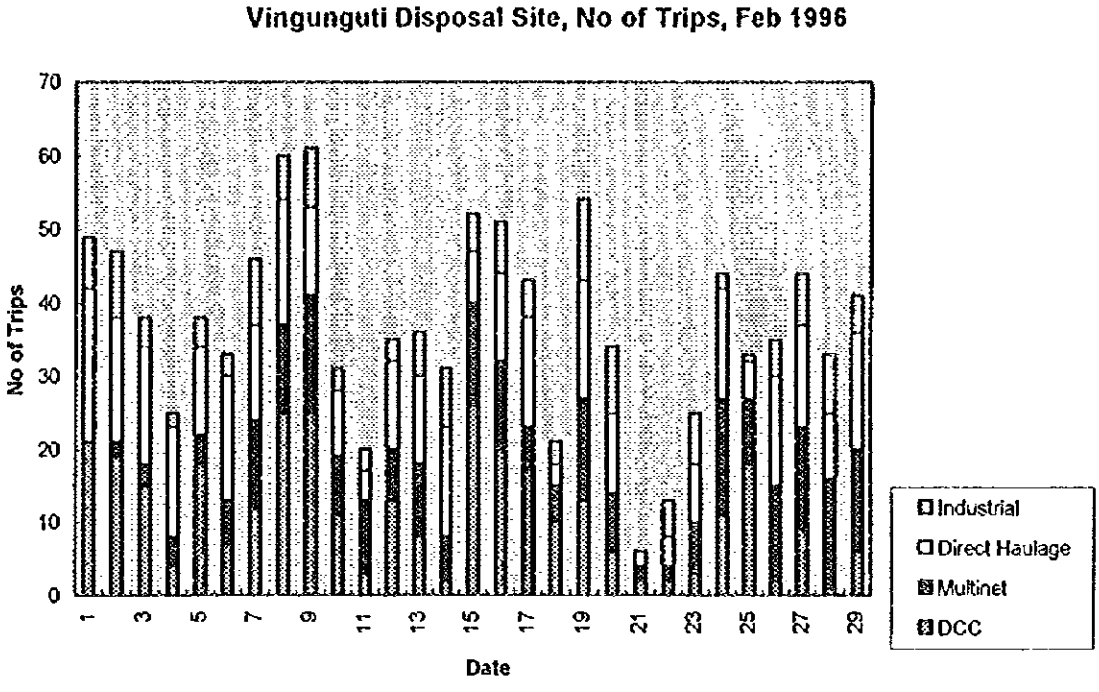


Figure 8-1: Vingunguti Disposal Site Data - January 1996



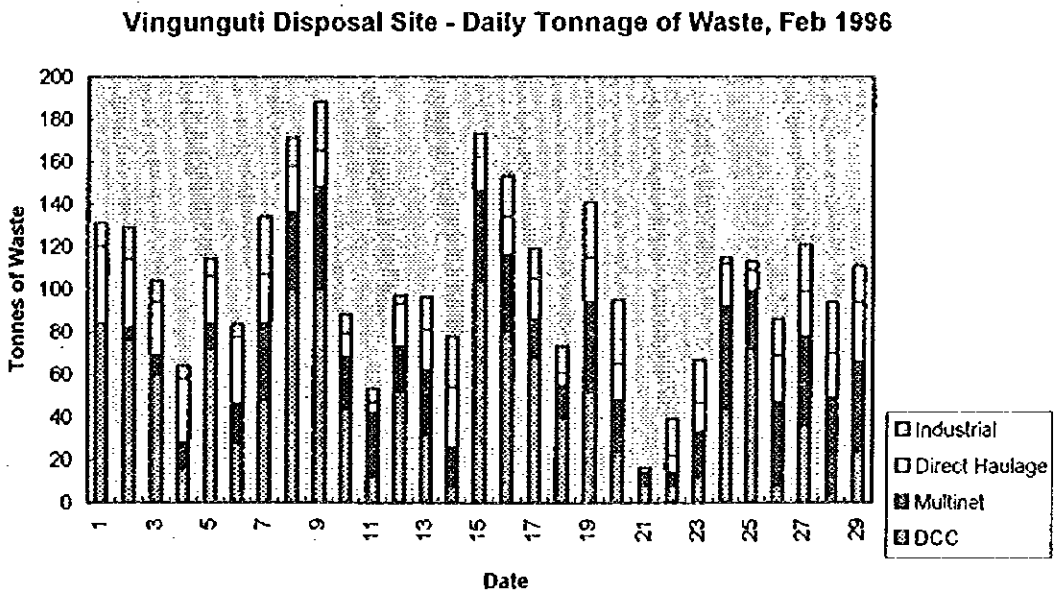
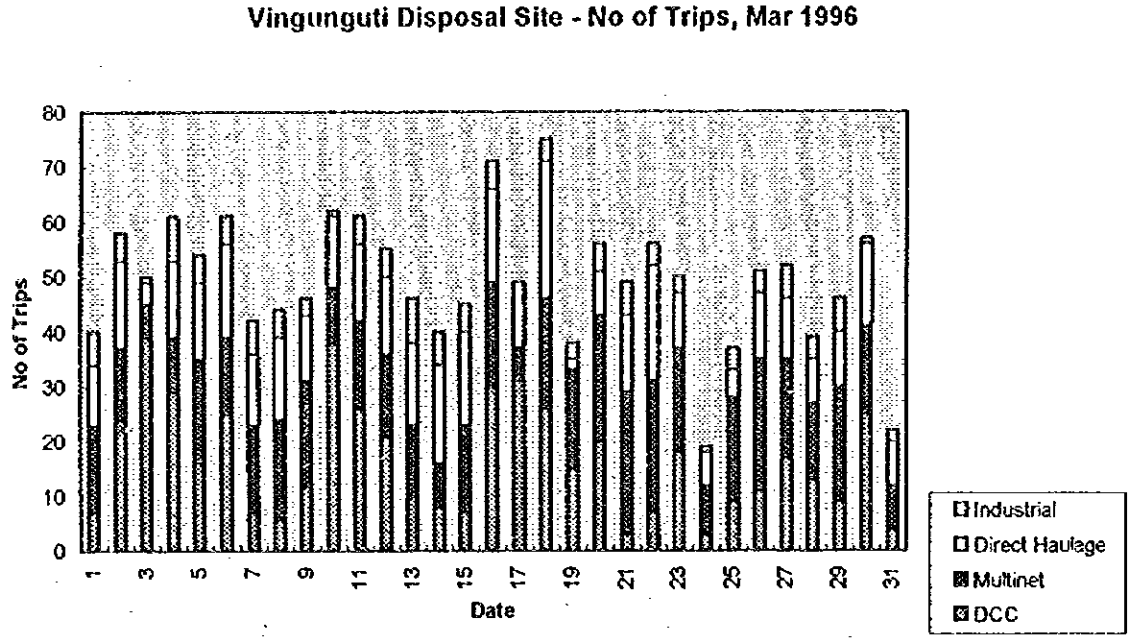


Figure 8-2: Vingunguti Disposal Site Data - February 1996



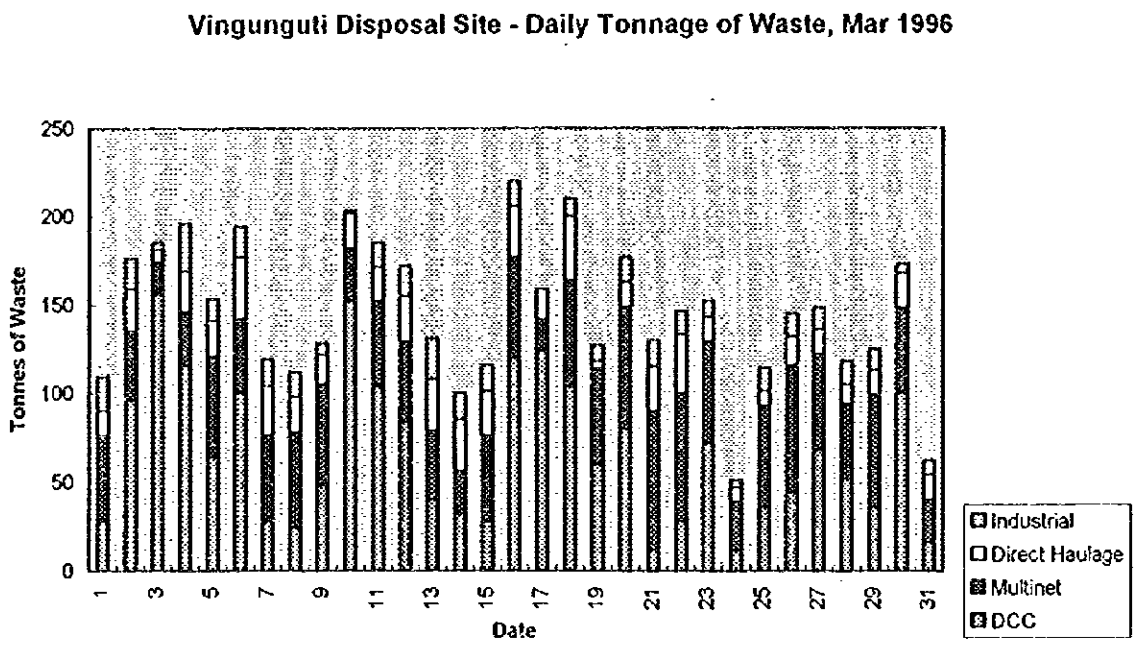
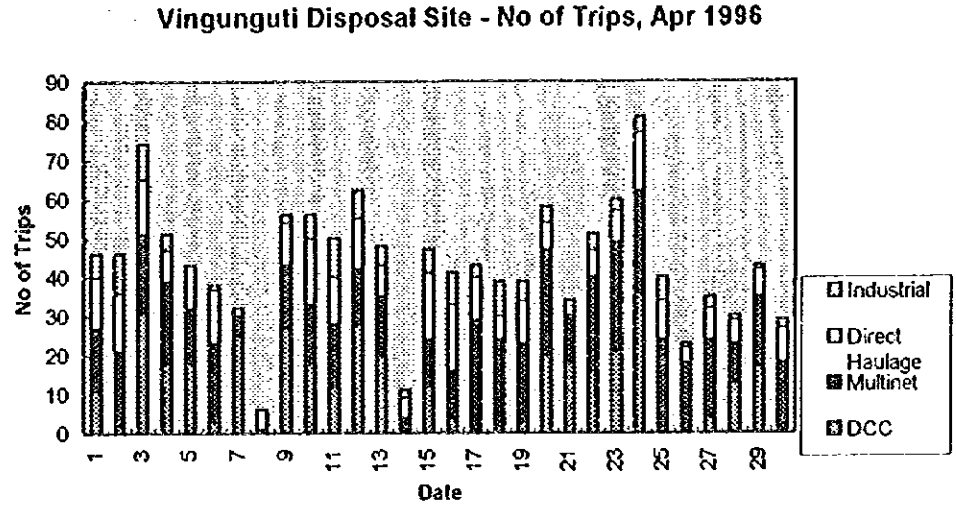


Figure 8-3: Vingunguti Disposal Site Data - March 1996



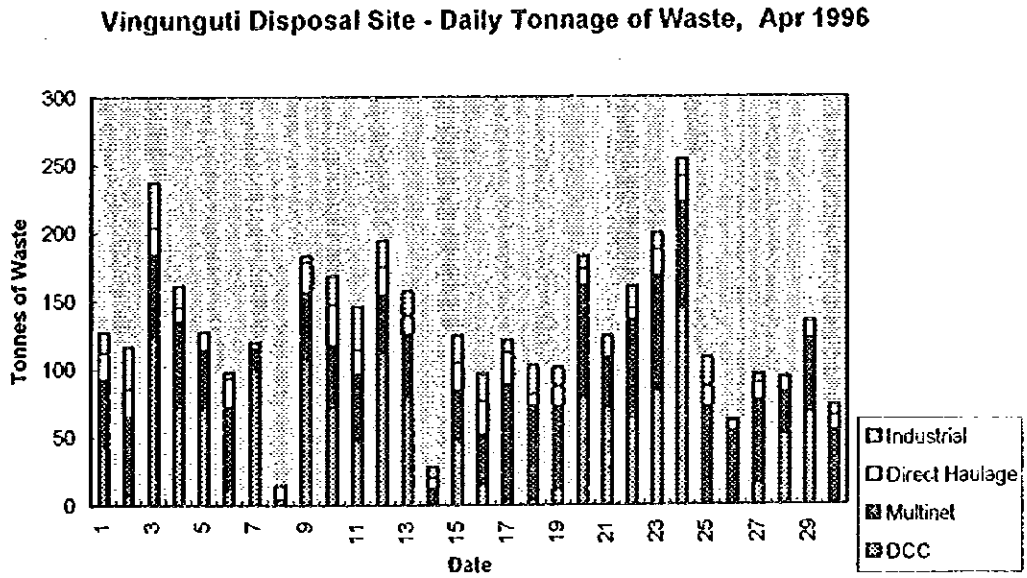
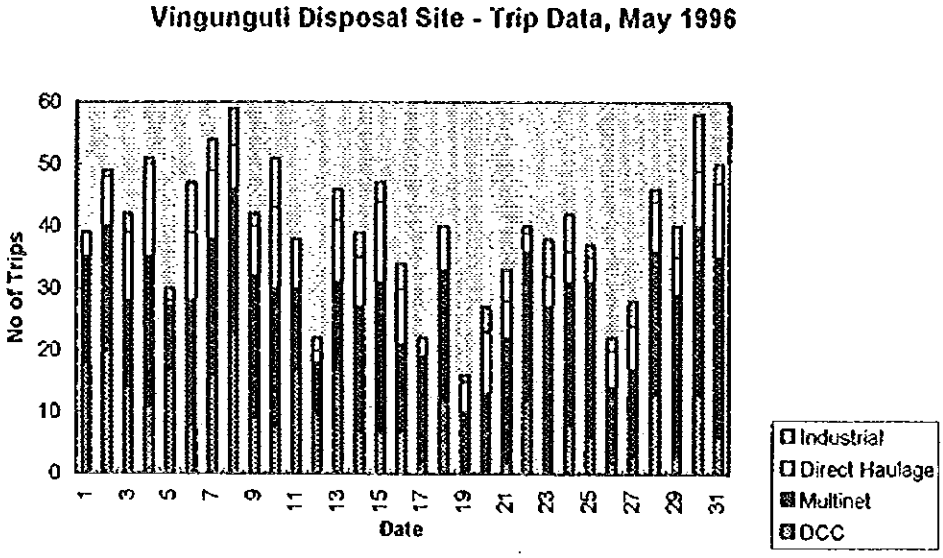


Figure 8-4: Vingunguti Disposal Site Data - April 1996



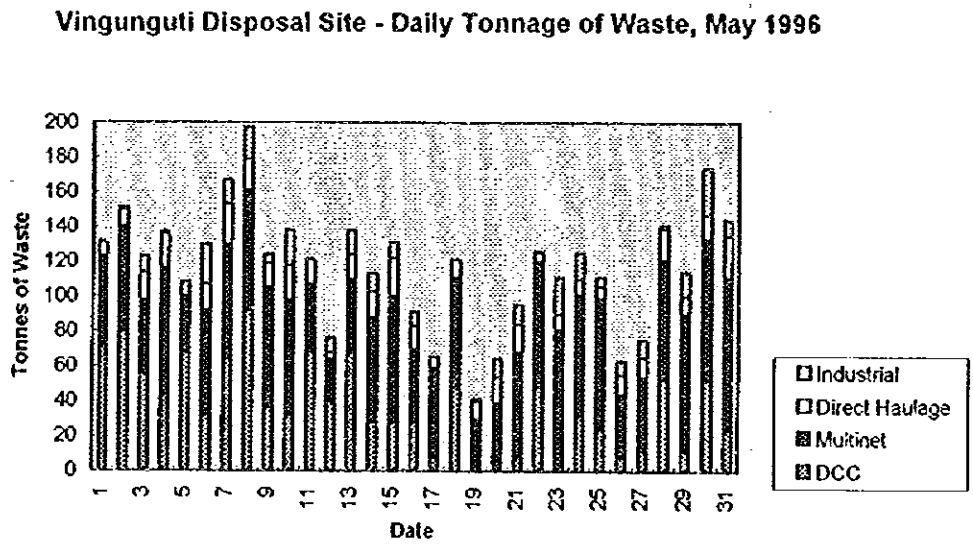
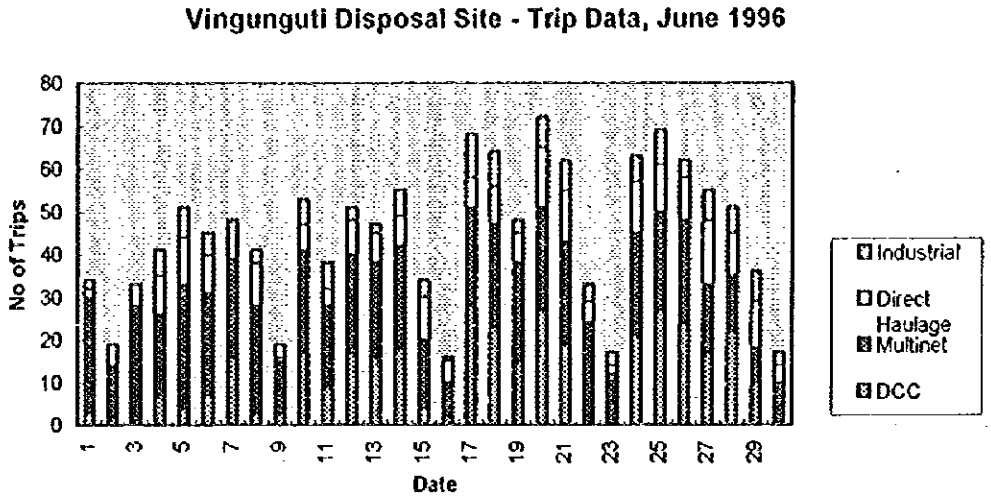


Figure 8-5: Vingunguti Disposal Site Data - May 1996



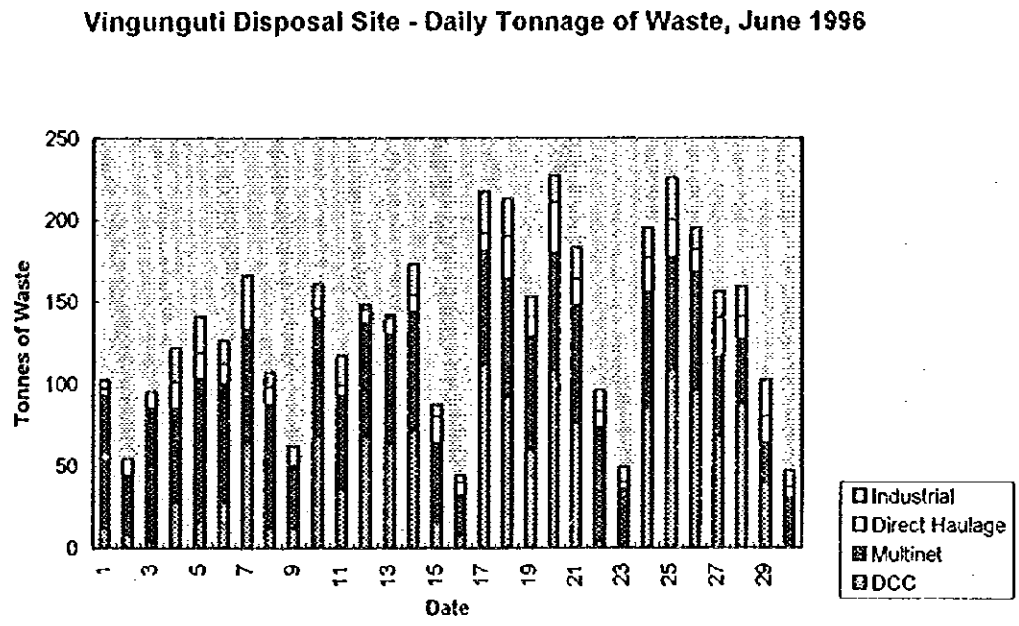


Figure 8-6: Vingunguti Disposal Site Data - June 1996

Table 8-19: Vingunguti Disposal Site Records for January 1996

JAN 96	DCC		Multi net		Kariak oo market		TTCL (Institution)		NBC (Institution)		THA (Industry)		TCC (Industry)		Individual		Office/ Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	22	88	15	45	3	6	0	0	0	0	0	0	0	0	0	0	1	1	2	2	0	0	43	142
2	17	68	21	63	4	8	0	0	1	7	3	12	0	0	3	4	1	3	0	0	0	0	50	165
3	6	24	20	60	4	8	0	0	0	0	4	16	1	4	2	2	2	4	0	0	0	0	39	118
4	8	32	15	45	4	8	0	0	1	7	4	16	3	3	9	10	4	6	3	8	0	0	51	135
5	10	40	15	45	5	10	0	0	1	7	2	8	2	2	6	8.5	3	5	2	4	0	0	46	129.5
6	16	64	8	24	3	6	0	0	0	0	0	0	1	1	1	1	1	1	3	5	0	0	33	102
7	32	128	4	12	5	10	0	0	0	0	0	0	0	0	2	2	0	0	3	3	0	0	46	155
8	28	112	23	69	5	10	0	0	1	7	2	8	1	1	5	6	5	8.5	2	3	0	0	72	224.5
9	29	116	18	54	4	8	0	0	1	7	2	8	1	1	4	4	2	2	2	2	0	0	63	202
10	6	24	15	45	4	8	0	0	1	7	4	16	1	1	3	5	3	3	5	5	0	0	42	114
11	28	112	14	42	5	10	0	0	1	7	2	8	1	1	6	8	3	3	4	5	0	0	64	196
12	26	104	12	36	3	6	0	0	0	0	1	4	0	0	2	2	0	0	1	1	0	0	45	153
13	18	72	11	33	4	8	0	0	0	0	0	0	0	0	10	10	2	2	3	3	0	0	48	128
14	23	92	4	12	4	8	0	0	0	0	0	0	0	0	2	2	0	0	1	1	0	0	34	115
15	16	64	16	48	4	8	0	0	1	7	3	12	2	2	4	4	5	5	0	0	0	0	52	150
16	19	76	26	78	4	8	0	0	0	0	3	12	1	1	1	2	1	1	1	1	0	0	55	179
17	13	52	12	36	4	8	0	0	1	7	3	12	1	1	4	4	1	1	0	0	0	0	42	121
18	7	28	20	60	4	8	0	0	1	7	3	12	1	1	7	8	2	4	3	3	0	0	47	131
19	8	32	18	54	3	6	1	7	0	0	3	12	1	1	5	5	3	3	2	3	0	0	45	123
20	4	16	13	39	0	0	0	0	0	0	2	8	1	1	4	4	5	5	3	4	0	0	30	77
21	4	16	4	12	1	2	0	0	0	0	0	0	0	0	3	3	0	0	1	2	0	0	14	35
22	6	24	13	39	6	12	0	0	0	0	1	4	1	1	6	8	1	1	2	4	0	0	36	93
23	5	20	17	51	6	12	0	0	0	0	2	8	1	1	2	2	0	0	2	3	0	0	34	97
24	18	72	19	57	5	10	1	7	1	7	0	0	1	1	2	2	0	0	1	2	0	0	49	158
25	19	76	21	63	7	14	1	7	1	7	2	8	2	2	6	6	2	2	2	4	0	0	62	189
26	18	72	18	54	3	6	0	0	0	0	2	8	1	1	6	6	1	2	1	2	0	0	49	151
27	5	20	11	33	4	8	0	0	0	0	0	0	1	1	4	4	2	2	0	0	0	0	27	68
28	1	4	4	12	6	12	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	19	32
29	10	40	6	18	4	8	0	0	0	0	2	8	1	1	9	10	4	4	4	6	0	0	36	95
30	11	44	9	27	6	12	1	7	0	0	2	8	1	1	4	5	1	2	0	0	0	0	36	106
31	30	120	6	18	3	6	1	7	1	7	2	8	2	2	3	4	4	4	1	2	0	0	53	178
Tot.	463	1852	428	1284	127	254	5	35	13	91	54	216	29	32	129	146	59	74.5	54	78	0	0	1362	4062

Table 8-20: Vingunguti Disposal Site Records for February 1996

FEB 96	DCC		Multi net		Karia koo mkt		TTCL Inst.		NBC Inst.		THA Inst.		TCC Ind.		Individual		Office /Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	21	84	0	0	5	10	0	0	1	7	1	4	3	3	11	14	4	5	3	4	0	0	49	131
2	19	76	2	6	7	14	0	0	0	0	1	4	3	3	7	9	1	2	5	8	2	7	47	129
3	15	60	3	9	3	6	0	0	0	0	2	8	1	1	9	10	1	1	1	1	3	8	38	104
4	4	16	4	12	5	10	0	0	0	0	1	4	0	0	5	5	1	1	1	2	4	14	25	64
5	18	72	4	12	5	10	0	0	0	0	1	4	2	2	4	4	1	1	1	2	2	7	38	114
6	7	28	6	18	2	4	0	0	0	0	1	4	1	1	6	6	3	5.5	1	1	6	16	33	83.5
7	12	48	12	36	4	8	0	0	1	7	6	24	2	2	6	6	2	2	1	1	0	0	46	134
8	25	100	12	36	5	10	0	0	0	0	2	8	2	2	6	6	6	6	2	3	0	0	60	171
9	25	100	16	48	4	8	0	0	0	0	5	20	3	3	5	5	3	4	0	0	0	0	61	188
10	11	44	8	24	2	4	0	0	0	0	2	8	1	1	6	6	1	1	0	0	0	0	31	88
11	3	12	10	30	1	2	0	0	0	0	1	4	0	0	2	2	1	1	2	2	0	0	20	53
12	13	52	7	21	5	10	0	0	0	0	0	0	1	1	6	8	1	2	2	3	0	0	35	97
13	8	32	10	30	7	14	0	0	0	0	3	12	2	2	4	4	1	1	1	1	0	0	36	96
14	2	8	6	18	5	10	1	7	0	0	5	20	1	1	8	10	1	1	2	3	0	0	31	78
15	26	104	14	42	3	6	1	7	0	0	2	8	1	1	2	2	1	1	2	2	0	0	52	173
16	20	80	12	36	6	12	0	0	0	0	4	16	2	2	2	2	4	4	1	1	0	0	51	153
17	17	68	6	18	4	8	0	0	0	0	3	12	1	1	7	7	4	4	1	1	0	0	43	119
18	10	40	5	15	3	6	0	0	0	0	3	12	0	0	0	0	0	0	0	0	0	0	21	73
19	13	52	14	42	4	8	0	0	0	0	5	20	3	3	10	11	2	2	3	3	0	0	54	133
20	6	24	8	24	6	12	0	0	0	0	7	28	2	2	3	3	2	2	0	0	0	0	34	94
21	2	8	2	6	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	6	14
22	2	8	2	6	4	8	0	0	0	0	4	16	1	1	0	0	0	0	0	0	0	0	13	41
23	3	12	7	21	5	10	0	0	0	0	4	16	0	0	2	2	1	2	3	4	0	0	25	74
24	11	44	16	48	4	8	0	0	0	0	0	0	1	1	9	9	2	3	1	2	0	0	44	106
25	18	72	9	27	5	10	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	33	118
26	2	8	13	39	7	14	0	0	0	0	4	16	1	1	5	5	3	3	0	0	0	0	35	88
27	9	36	14	42	6	12	0	0	0	0	5	20	1	1	6	7	2	2	1	1	0	0	44	116
28	1	4	15	45	6	12	0	0	1	7	5	20	1	1	2	2	0	0	2	3	0	0	33	99
29	6	24	14	42	6	12	0	0	1	7	4	16	1	1	7	7	2	2	0	0	0	0	41	111
Tot.	329	1316	251	753	129	258	2	14	4	28	82	328	37	37	142	154	50	58.5	36	48	17	52	1079	3042.5

Table 8-21: Vingunguti Disposal Site Records for March

MAR 96	DCC		Multinet		Kariakoo mkt		TTCL Inst.		NBC Inst.		THA Inst.		TCC Ind.		Individual		Office/Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	7	28	16	48	3	6	0	0	0	0	4	16	1	1	5	5	3	3	1	2	0	0	40	109
2	24	96	13	39	7	14	0	0	0	0	4	16	1	1	9	10	0	0	0	0	0	0	58	176
3	39	156	6	18	3	6	0	0	0	0	1	4	0	0	1	1	0	0	0	0	0	0	50	185
4	29	116	10	30	7	14	0	0	0	0	6	24	1	1	7	9	0	0	1	2	0	0	61	196
5	16	64	19	57	5	10	0	0	0	0	2	8	1	1	8	9	1	1	2	3	0	0	54	153
6	25	100	14	42	7	14	0	0	1	7	4	16	1	1	5	5	4	9	0	0	0	0	61	194
7	7	28	16	48	5	10	0	0	1	7	3	12	1	1	4	4	3	7	2	2	0	0	42	119
8	6	24	18	54	5	10	0	0	0	0	3	12	2	2	6	6	4	4	0	0	0	0	44	112
9	12	48	19	57	3	6	0	0	0	0	1	4	1	1	9	11	0	0	1	1	0	0	46	128
10	38	152	10	30	7	14	0	0	0	0	0	0	0	0	3	3	3	3	1	1	0	0	62	203
11	26	104	16	48	5	10	0	0	0	0	3	12	1	1	4	4	5	5	1	1	0	0	61	185
12	21	84	15	45	5	10	1	7	0	0	4	16	1	1	7	8	1	1	0	0	0	0	55	172
13	10	40	13	39	7	14	1	7	0	0	5	20	1	1	6	7	1	1	2	2	0	0	46	131
14	8	32	8	24	5	10	1	7	0	0	3	12	1	1	3	3	9	9	2	2	0	0	40	100
15	7	28	16	48	8	16	0	0	0	0	3	12	1	1	6	6	3	3	1	2	0	0	45	116
16	30	120	19	57	6	12	0	0	1	7	3	12	1	1	7	7	3	3	1	1	0	0	71	220
17	31	124	6	18	5	10	0	0	0	0	0	0	0	0	6	6	1	1	0	0	0	0	49	159
18	26	104	20	60	6	12	0	0	0	0	2	8	1	1	16	21	2	2	1	1	1	1	75	210
19	15	60	18	54	2	4	0	0	0	0	2	8	1	1	0	0	0	0	0	0	0	0	38	127
20	20	80	23	69	5	10	0	0	0	0	3	12	2	2	1	1	2	3	0	0	0	0	56	177
21	3	12	26	78	5	10	1	7	0	0	3	12	1	1	7	7	1	1	2	2	0	0	49	130
22	7	28	24	72	6	12	0	0	0	0	3	12	1	1	11	14	4	7	0	0	0	0	56	146
23	18	72	19	57	3	6	0	0	0	0	2	8	0	0	3	4	4	4	1	1	0	0	50	152
24	3	12	9	27	2	4	0	0	0	0	1	4	0	0	4	4	0	0	0	0	0	0	19	51
25	9	36	19	57	3	6	0	0	0	0	3	12	1	1	2	2	0	0	0	0	0	0	37	114
26	11	44	24	72	4	8	0	0	0	0	3	12	1	1	6	6	2	2	0	0	0	0	51	145
27	17	68	18	54	3	6	0	0	0	0	2	8	1	1	5	5	3	3	3	3	0	0	52	148
28	13	52	14	42	3	6	0	0	0	0	3	12	1	1	4	4	1	1	0	0	0	0	39	118
29	9	36	21	63	3	6	0	0	0	0	2	8	1	1	4	5	3	3	3	3	0	0	46	125
30	25	100	16	48	5	10	0	0	0	0	0	0	1	5	8	8	2	2	0	0	0	0	57	173
31	4	16	8	24	5	10	0	0	0	0	2	8	0	0	2	2	1	2	0	0	0	0	22	62
Tot.	516	2064	493	1479	148	296	4	28	3	21	80	320	27	31	169	187	66	80	25	29	1	1	1532	4536

Table 8-22: Vinguguti Disposal Site Records for April 1996

APR 96	DCC		Multi net		Karia koo mkt		TTCL Inst.		NBC Inst.		THA Inst.		TCC Ind.		Individual		Office /Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	11	44	16	48	7	14	0	0	0	0	3	12	1	1	3	3	3	3	2	2	0	0	46	127
2	2	8	19	57	5	10	0	0	0	0	7	28	2	2	8	8	2	2	1	1	0	0	46	116
3	31	124	20	60	6	12	0	0	0	0	6	24	3	9	3	3	5	5	0	0	0	0	74	237
4	18	72	21	63	2	4	0	0	0	0	4	16	0	0	6	6	0	0	0	0	0	0	51	161
5	18	72	14	42	2	4	0	0	0	0	0	0	0	0	7	7	2	2	0	0	0	0	43	127
6	3	12	20	60	7	14	0	0	0	0	1	4	0	0	7	7	0	0	0	0	0	0	38	97
7	25	100	5	15	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	119
8	1	4	0	0	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	14
9	27	108	16	48	4	8	1	7	0	0	0	0	2	5	5	5	1	2	0	0	0	0	56	183
10	18	72	15	45	6	12	1	7	0	0	4	16	2	5	8	9	2	2	0	0	0	0	56	168
11	12	48	16	48	6	12	0	0	0	0	6	24	3	6	6	6	0	0	1	1	0	0	50	145
12	28	112	14	42	6	12	0	0	0	0	4	16	1	1	7	9	0	0	2	2	0	0	62	194
13	20	80	15	45	6	12	0	0	0	0	3	12	1	4	2	2	0	0	1	2	0	0	48	157
14	0	0	4	12	3	6	0	0	0	0	2	8	0	0	2	2	0	0	0	0	0	0	11	28
15	12	48	12	36	3	6	0	0	0	0	3	12	2	5	11	11	3	3	1	3	0	0	47	124
16	4	16	12	36	6	12	0	0	0	0	3	12	2	5	10	11	1	1	3	3	0	0	41	96
17	1	4	28	84	4	8	1	7	0	0	2	8	1	1	6	9	0	0	0	0	0	0	43	121
18	1	4	23	69	2	4	0	0	0	0	4	16	2	2	4	4	0	0	3	3	0	0	39	102
19	3	12	20	60	4	8	0	0	0	0	3	12	1	1	7	7	0	0	1	1	0	0	39	101
20	20	80	27	81	5	10	0	0	0	0	1	4	1	1	2	2	0	0	2	4	0	0	58	182
21	18	72	12	36	0	0	0	0	0	0	4	16	0	0	0	0	0	0	0	0	0	0	34	124
22	16	64	24	72	1	2	0	0	0	0	3	12	1	4	5	5	1	1	0	0	0	0	51	160
23	21	84	28	84	5	10	1	7	0	0	2	8	1	4	2	2	0	0	0	0	0	0	60	199
24	36	144	26	78	4	8	0	0	0	0	3	12	0	0	10	10	1	1	1	1	0	0	81	254
25	0	0	24	72	5	10	0	0	0	0	4	16	2	5	2	2	3	3	0	0	0	0	40	108
26	0	0	18	54	3	6	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	23	62
27	4	16	20	60	5	10	0	0	0	0	1	4	2	2	3	3	0	0	0	0	0	0	35	95
28	13	52	10	30	5	10	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	30	94
29	17	68	18	54	5	10	0	0	0	0	0	0	0	0	2	2	0	0	1	1	0	0	43	135
30	0	0	18	54	2	4	0	0	0	0	2	8	0	0	4	4	3	3	0	0	0	0	29	73
Tot.	380	1520	515	1545	126	252	4	28	0	0	75	300	30	63	134	141	27	28	21	26	0	0	1312	3903

Table 8-23: Vingunguti Disposal Site Records for May 1996

MAY 96	DCC		Multinet		Kariakoo mkt		TTCL Inst.		NBC Inst.		THA Inst.		TCC Ind.		Individual		Office /Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	18	72	17	51	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	131
2	20	80	20	60	2	4	0	0	0	0	0	0	1	1	5	5	1	1	0	0	0	0	49	151
3	14	56	14	42	4	8	0	0	0	0	2	8	1	1	6	6	1	2	0	0	0	0	42	123
4	11	44	24	72	5	10	0	0	0	0	0	0	1	1	9	9	1	1	0	0	0	0	51	137
5	17	68	10	30	1	2	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	30	108
6	8	32	20	60	3	6	0	0	0	0	5	20	1	1	8	9	0	0	2	2	0	0	47	130
7	16	64	22	66	5	10	1	7	0	0	3	12	2	2	5	6	0	0	0	0	0	0	54	167
8	23	92	23	69	5	10	1	7	0	0	4	16	2	2	1	1	0	0	0	0	0	0	59	197
9	9	36	23	69	5	10	0	0	0	0	1	4	1	1	2	3	1	1	0	0	0	0	42	124
10	8	32	22	66	3	6	0	0	0	0	4	16	0	0	5	6	5	8	4	4	0	0	51	138
11	17	68	13	39	4	8	0	0	0	0	0	0	0	0	3	3	1	3	0	0	0	0	38	121
12	10	40	8	24	2	4	0	0	0	0	2	8	0	0	0	0	0	0	0	0	0	0	22	76
13	17	68	14	42	4	8	0	0	0	0	3	12	0	0	5	5	1	1	2	2	0	0	46	138
14	7	28	20	60	5	10	0	0	0	0	1	4	2	5	2	3	1	2	1	1	0	0	39	113
15	7	28	24	72	7	14	0	0	0	0	2	8	0	0	4	5	1	2	1	1	1	1	47	131
16	7	28	14	42	4	8	0	0	0	0	1	4	1	1	5	5	0	0	2	3	0	0	34	91
17	2	8	17	51	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	65
18	12	48	21	63	3	6	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	40	121
19	0	0	10	30	5	10	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	16	41
20	0	0	13	39	5	10	0	0	0	0	2	8	1	1	3	3	2	2	1	1	0	0	27	64
21	2	8	20	60	4	8	1	7	0	0	2	8	1	1	1	1	0	0	2	2	0	0	33	95
22	12	48	24	72	2	4	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	40	126
23	0	0	27	81	4	8	0	0	0	0	5	20	1	1	0	0	1	1	0	0	0	0	38	111
24	8	32	23	69	4	8	0	0	0	0	3	12	0	0	1	1	0	0	3	3	0	0	42	125
25	6	24	25	75	3	6	0	0	0	0	1	4	1	1	1	1	0	0	0	0	0	0	37	111
26	2	8	12	36	5	10	0	0	0	0	2	8	0	0	1	1	0	0	0	0	0	0	22	63
27	3	12	14	42	4	8	0	0	0	0	2	8	1	1	3	3	0	0	1	1	0	0	28	75
28	13	52	23	69	3	6	1	7	0	0	0	0	1	1	4	5	0	0	1	1	0	0	46	141
29	3	12	26	78	4	8	0	0	0	0	3	12	1	1	2	2	0	0	1	1	0	0	40	114
30	13	52	27	81	4	8	0	0	0	0	6	24	1	1	4	4	1	2	2	2	0	0	58	174
31	6	24	29	87	12	24	0	0	0	0	2	8	1	1	0	0	0	0	0	0	0	0	50	144
Tot.	291	1164	599	1797	128	256	4	28	0	0	58	232	23	26	85	92	17	26	23	24	1	1	1229	3646

Table 8-24: Vingunguti disposal Site Records for June 1996

JUN 96	DCC		Multinet		Kariakoo mkt		TTC L Inst.		NBC Inst.		TH A Inst.		TCC Ind.		Individual		Office/Comm.		Industrial		Unidentified		Tot. trips	Tot. wt.
Date	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)	trips	wt(t.)		(t.)
1	3	12	27	81	2	4	0	0	0	0	1	4	1	1	0	0	0	0	0	0	0	0	34	102
2	2	8	12	36	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	54
3	1	4	27	81	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	95
4	7	28	19	57	6	12	0	0	0	0	4	16	0	0	3	4	0	0	2	5	0	0	41	122
5	4	16	29	87	5	10	0	0	0	0	2	8	4	13	3	3	3	3	1	1	0	0	51	141
6	7	28	24	72	0	0	0	0	0	0	3	12	1	1	7	8	1	3	1	1	1	1	45	126
7	16	64	23	69	0	0	0	0	0	0	6	24	3	9	0	0	0	0	0	0	0	0	48	166
8	3	12	25	75	0	0	0	0	0	0	2	8	1	1	8	9	2	2	0	0	0	0	41	107
9	3	12	12	36	1	2	0	0	0	0	3	12	0	0	0	0	0	0	0	0	0	0	19	62
10	17	68	24	72	0	0	0	0	0	0	3	12	1	1	5	5	1	1	2	2	0	0	53	161
11	9	36	19	57	1	2	0	0	0	0	2	8	2	8	2	3	1	1	2	2	0	0	38	117
12	17	68	23	69	0	0	0	0	0	0	0	0	1	1	8	8	0	0	2	2	0	0	51	148
13	16	64	22	66	3	6	0	0	0	0	0	0	1	1	4	4	0	0	1	1	0	0	47	142
14	18	72	24	72	3	6	0	0	0	0	3	12	2	5	4	4	0	0	1	2	0	0	55	173
15	4	16	16	48	6	12	0	0	0	0	1	4	1	1	4	4	0	0	2	2	0	0	34	87
16	2	8	8	24	3	6	0	0	0	0	1	4	0	0	2	2	0	0	0	0	0	0	16	44
17	28	112	23	69	4	8	0	0	0	0	4	16	4	7	3	3	0	0	2	2	0	0	68	217
18	23	92	24	72	5	10	1	7	1	7	3	12	4	10	2	2	0	0	1	1	0	0	64	213
19	15	60	23	69	4	8	0	0	0	0	2	8	1	4	2	2	1	2			0	0	48	153
20	27	108	24	72	5	10	1	7	1	7	3	12	1	1	7	7	0	0	3	3	0	0	72	227
21	19	76	24	72	4	8	0	0	0	0	4	16	1	1	6	6	2	2	2	2	0	0	62	183
22	1	4	23	69	5	10	0	0	0	0	3	12	1	1	0	0	0	0	0	0	0	0	33	96
23	0	0	12	36	2	4	0	0	0	0	2	8	1	1	0	0	0	0	0	0	0	0	17	49
24	21	84	24	72	3	6	0	0	1	7	4	16	1	1	7	7	1	1	1	1	0	0	63	195
25	27	108	23	69	5	10	0	0	1	7	5	20	2	5	5	6	0	0	1	1	0	0	69	226
26	24	96	24	72	4	8	0	0	0	0	2	8	2	5	6	6	0	0	0	0	0	0	62	195
27	17	68	16	48	3	6	0	0	1	7	2	8	2	5	11	11	0	0	3	3	0	0	55	156
28	22	88	13	39	4	8	0	0	0	0	3	12	2	5	5	5	1	1	1	1	0	0	51	159
29	10	40	8	24	5	10	0	0	0	0	4	16	2	5	6	6	0	0	1	1	0	0	36	102
30	0	0	10	30	2	4	0	0	0	0	2	8	0	0	2	3	0	0	1	2	0	0	17	47
Tot.	363	1452	605	1815	95	190	2	14	5	35	74	296	42	93	112	118	13	16	30	35	1	1	1342	4065

Table 8-25: Categorised Vingunguti Disposal Site Data for January 1996

Jan-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	22	15	4	2	43
2	17	21	9	3	50
3	6	20	8	5	39
4	8	15	18	10	51
5	10	15	15	6	46
6	16	8	5	4	33
7	32	4	7	3	46
8	28	23	16	5	72
9	29	18	11	5	63
10	6	15	11	10	42
11	28	14	15	7	64
12	26	12	5	2	45
13	18	11	16	3	48
14	23	4	6	1	34
15	16	16	14	5	51
16	19	26	6	5	56
17	13	12	10	4	39
18	7	20	14	7	48
19	8	18	12	6	44
20	4	13	9	6	32
21	4	4	4	1	13
22	6	13	13	4	36
23	5	17	8	5	35
24	18	19	9	2	48
25	19	21	17	6	63
26	18	18	10	4	50
27	5	11	10	1	27
28	1	4	10	0	15
29	10	6	17	7	40
30	11	9	12	3	35
31	30	6	12	5	53
Tot.	463	428	333	137	1361
Avg.	14.9	13.8	10.7	4.4	43.9

Jan-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	88	45	7	2	142
2	68	63	22	12	165
3	24	60	14	20	118
4	32	45	31	27	135
5	40	45	30.5	14	129.5
6	64	24	8	6	102
7	128	12	12	3	155
8	112	69	31.5	12	224.5
9	116	54	21	11	202
10	24	45	23	22	114
11	112	42	28	14	196
12	104	36	8	5	153
13	72	33	20	3	128
14	92	12	10	1	115
15	64	48	24	14	150
16	76	78	11	14	179
17	52	36	20	13	121
18	28	60	27	16	131
19	32	54	21	16	123
20	16	39	9	13	77
21	16	12	5	2	35
22	24	39	21	9	93
23	20	51	14	12	97
24	72	57	26	3	158
25	76	63	36	14	189
26	72	54	14	11	151
27	20	33	14	1	68
28	4	12	16	0	32
29	40	18	22	15	95
30	44	27	26	9	106
31	120	18	28	12	178
Tot.	1852	1284	600	326	4062
Avg.	59.7	41.4	19.4	10.5	131.0

Table 8-26: Categorised Vingunguti Disposal Site Data for February 1996

Feb-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	21	0	21	7	49
2	19	2	17	9	47
3	15	3	16	4	38
4	4	4	15	2	25
5	18	4	12	4	38
6	7	6	17	3	33
7	12	12	13	9	46
8	25	12	17	6	60
9	25	16	12	8	61
10	11	8	9	3	31
11	3	10	4	3	20
12	13	7	12	3	35
13	8	10	12	6	36
14	2	6	15	8	31
15	26	14	7	5	52
16	20	12	12	7	51
17	17	6	15	5	43
18	10	5	3	3	21
19	13	14	16	11	54
20	6	8	11	9	34
21	2	2	2	0	6
22	2	2	4	5	13
23	3	7	8	7	25
24	11	16	15	2	44
25	18	9	5	1	33
26	2	13	15	5	35
27	9	14	14	7	44
28	1	15	9	8	33
29	6	14	16	5	41
Tot.	329	251	344	155	1079
Avg.	11.3	8.7	11.9	5.3	37.2

Feb-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	84	0	36	11	131
2	76	6	32	15	129
3	60	9	25	10	104
4	16	12	30	6	64
5	72	12	22	8	114
6	28	18	31.5	6	83.5
7	48	36	23	27	134
8	100	36	22	13	171
9	100	48	17	23	188
10	44	24	11	9	88
11	12	30	5	6	53
12	52	21	20	4	97
13	32	30	19	15	96
14	8	18	28	24	78
15	104	42	16	11	173
16	80	36	18	19	153
17	68	18	19	14	119
18	40	15	6	12	73
19	52	42	21	26	141
20	24	24	17	30	95
21	8	6	2	0	16
22	8	6	8	17	39
23	12	21	14	20	67
24	44	48	20	3	115
25	72	27	10	4	113
26	8	39	22	17	86
27	36	42	21	22	121
28	4	45	21	24	94
29	24	42	28	17	111
Tot.	1316	753	564.5	413	3047
Avg.	45.4	26.0	19.5	14.2	105.1

Table 8-27: Categorised Vingunguti Disposal Site Data for March 1996

Mar-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	7	16	11	6	40
2	24	13	16	5	58
3	39	6	4	1	50
4	29	10	14	8	61
5	16	19	14	5	54
6	25	14	17	5	61
7	7	16	13	6	42
8	6	18	15	5	44
9	12	19	12	3	46
10	38	10	13	1	62
11	26	16	14	5	61
12	21	15	14	5	55
13	10	13	15	8	46
14	8	8	18	6	40
15	7	16	17	5	45
16	30	19	17	5	71
17	31	6	12	0	49
18	26	20	25	4	75
19	15	18	2	3	38
20	20	23	8	5	56
21	3	26	14	6	49
22	7	24	21	4	56
23	18	19	10	3	50
24	3	9	6	1	19
25	9	19	5	4	37
26	11	24	12	4	51
27	17	18	11	6	52
28	13	14	8	4	39
29	9	21	10	6	46
30	25	16	15	1	57
31	4	8	8	2	22
Tot.	516	493	391	132	1532
Avg.	16.6	15.9	12.6	4.3	49.4

Mar-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	28	48	14	19	109
2	96	39	24	17	176
3	156	18	7	4	185
4	116	30	23	27	196
5	64	57	20	12	153
6	100	42	35	17	194
7	28	48	28	15	119
8	24	54	20	14	112
9	48	57	17	6	128
10	152	30	20	1	203
11	104	48	19	14	185
12	84	45	26	17	172
13	40	39	29	23	131
14	32	24	29	15	100
15	28	48	25	15	116
16	120	57	29	14	220
17	124	18	17	0	159
18	104	60	36	10	210
19	60	54	4	9	127
20	80	69	14	14	177
21	12	78	25	15	130
22	28	72	33	13	146
23	72	57	14	9	152
24	12	27	8	4	51
25	36	57	8	13	114
26	44	72	16	13	145
27	68	54	14	12	148
28	52	42	11	13	118
29	36	63	14	12	125
30	100	48	20	5	173
31	16	24	14	8	62
Tot.	2064	1479	613	380	4536
Avg.	66.6	47.7	19.8	12.3	146.3

Table 8-28: Categorised Vingunguti Disposal Site Data for April 1996

Apr-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	11	16	13	6	46
2	2	19	15	10	46
3	31	20	14	9	74
4	18	21	8	4	51
5	18	14	11	0	43
6	3	20	14	1	38
7	25	5	2	0	32
8	1	0	5	0	6
9	27	16	11	2	56
10	18	15	17	6	56
11	12	16	12	10	50
12	28	14	13	7	62
13	20	15	8	5	48
14	0	4	5	2	11
15	12	12	17	6	47
16	4	12	17	8	41
17	1	28	11	3	43
18	1	23	6	9	39
19	3	20	11	5	39
20	20	27	7	4	58
21	18	12	0	4	34
22	16	24	7	4	51
23	21	28	8	3	60
24	36	26	15	4	81
25	0	24	10	6	40
26	0	18	4	1	23
27	4	20	8	3	35
28	13	10	6	1	30
29	17	18	7	1	43
30	0	18	9	2	29
Tot.	380	515	291	126	1312
Avg.	12.7	17.2	9.7	4.2	43.7

Apr-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	44	48	20	15	127
2	8	57	20	31	116
3	124	60	20	33	237
4	72	63	10	16	161
5	72	42	13	0	127
6	12	60	21	4	97
7	100	15	4	0	119
8	4	0	10	0	14
9	108	48	22	5	183
10	72	45	30	21	168
11	48	48	18	31	145
12	112	42	21	19	194
13	80	45	14	18	157
14	0	12	8	8	28
15	48	36	20	20	124
16	16	36	24	20	96
17	4	84	24	9	121
18	4	69	8	21	102
19	12	60	15	14	101
20	80	81	12	9	182
21	72	36	0	16	124
22	64	72	8	16	160
23	84	84	19	12	199
24	144	78	19	13	254
25	0	72	15	21	108
26	0	54	7	1	62
27	16	60	13	6	95
28	52	30	11	1	94
29	68	54	12	1	135
30	0	54	11	8	73
Tot.	1520	1545	449	389	3903
Avg.	50.7	51.5	15.0	13.0	130.1

Table 8-29: Categorised Vingunguti Disposal Site Data for May 1996

May-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	18	17	4	0	39
2	20	20	8	1	49
3	14	14	11	3	42
4	11	24	15	1	51
5	17	10	1	2	30
6	8	20	11	8	47
7	16	22	11	5	54
8	23	23	7	6	59
9	9	23	8	2	42
10	8	22	13	8	51
11	17	13	8	0	38
12	10	8	2	2	22
13	17	14	10	5	46
14	7	20	8	4	39
15	7	24	13	3	47
16	7	14	9	4	34
17	2	17	3	0	22
18	12	21	7	0	40
19	0	10	5	1	16
20	0	13	10	4	27
21	2	20	6	5	33
22	12	24	3	1	40
23	0	27	5	6	38
24	8	23	5	6	42
25	6	25	4	2	37
26	2	12	6	2	22
27	3	14	7	4	28
28	13	23	8	2	46
29	3	26	6	5	40
30	13	27	9	9	58
31	6	29	12	3	50
Tot.	291	599	235	104	1229
Avg.	9.4	19.3	7.6	3.4	39.6

May-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	72	51	8	0	131
2	80	60	10	1	151
3	56	42	16	9	123
4	44	72	20	1	137
5	68	30	2	8	108
6	32	60	15	23	130
7	64	66	23	14	167
8	92	69	18	18	197
9	36	69	14	5	124
10	32	66	20	20	138
11	68	39	14	0	121
12	40	24	4	8	76
13	68	42	14	14	138
14	28	60	15	10	113
15	28	72	22	9	131
16	28	42	13	8	91
17	8	51	6	0	65
18	48	63	10	0	121
19	0	30	10	1	41
20	0	39	15	10	64
21	8	60	16	11	95
22	48	72	5	1	126
23	0	81	9	21	111
24	32	69	9	15	125
25	24	75	7	5	111
26	8	36	11	8	63
27	12	42	11	10	75
28	52	69	18	2	141
29	12	78	10	14	114
30	52	81	14	27	174
31	24	87	24	9	144
Tot.	1164	1797	403	282	3646
Avg.	37.5	58.0	13.0	9.1	117.6

Table 8-30: Categorised Vingunguti Disposal Site Data for June 1996

Jun-96	A. Number of trips				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	3	27	2	2	34
2	2	12	5	0	19
3	1	27	5	0	33
4	7	19	9	6	41
5	4	29	11	7	51
6	7	24	9	5	45
7	16	23	0	9	48
8	3	25	10	3	41
9	3	12	1	3	19
10	17	24	6	6	53
11	9	19	4	6	38
12	17	23	8	3	51
13	16	22	7	2	47
14	18	24	7	6	55
15	4	16	10	4	34
16	2	8	5	1	16
17	28	23	7	10	68
18	23	24	9	8	64
19	15	23	7	3	48
20	27	24	14	7	72
21	19	24	12	7	62
22	1	23	5	4	33
23	0	12	2	3	17
24	21	24	12	6	63
25	27	23	11	8	69
26	24	24	10	4	62
27	17	16	15	7	55
28	22	13	10	6	51
29	10	8	11	7	36
30	0	10	4	3	17
Tot.	363	605	228	146	1342
Avg.	12.1	20.2	7.6	4.9	44.7

Jun-96	B. Tonnage of Waste per day				
Date	DCC	Multinet	Direct Haulage	Industrial	Total
1	12	81	4	5	102
2	8	36	10	0	54
3	4	81	10	0	95
4	28	57	16	21	122
5	16	87	16	22	141
6	28	72	12	14	126
7	64	69	0	33	166
8	12	75	11	9	107
9	12	36	2	12	62
10	68	72	6	15	161
11	36	57	6	18	117
12	68	69	8	3	148
13	64	66	10	2	142
14	72	72	10	19	173
15	16	48	16	7	87
16	8	24	8	4	44
17	112	69	11	25	217
18	92	72	26	23	213
19	60	69	12	12	153
20	108	72	31	16	227
21	76	72	16	19	183
22	4	69	10	13	96
23	0	36	4	9	49
24	84	72	21	18	195
25	108	69	23	26	226
26	96	72	14	13	195
27	68	48	24	16	156
28	88	39	14	18	159
29	40	24	16	22	102
30	0	30	7	10	47
Tot.	1452	1815	374	424	4065
Avg.	48.4	60.5	12.5	14.1	135.5

8.8 Waste Generation Amounts and Waste Stream Breakdown

The Masterplan anticipates dividing the city into two refuse collection areas: Area A (UA and SUPA) and Area B (SUUA and RA). Furthermore, it is possible that in the foreseeable future, DSM could be split into three municipalities: Ilala, Kinondoni and Temeke, corresponding to the present three districts into which the city is divided. For these reasons, it is necessary to:

- break down the present waste generation amount for DSM on an area basis (UA, SUPA, SUUA, RA) and district basis (Ilala, Kinondoni, Temeke).
- break down the present waste stream for DSM on a district basis.

These breakdowns must be done in such a way that facilitates forecasting of future waste generation amounts and the waste stream by area and district.

8.8.1 Breakdown of Waste Generation Amount

The methodology and results for each category of waste are explained in this section. Table 8-39 shows the population breakdown for DSM according to area and district which is used in some of the calculations in the following sections.

a. Household Waste

The following procedure was used:

1. The weighted average household WAGR of 0.698 g/cap/d was used in all calculations.
2. The population data from Table 8-2 of P/R (2) was sorted to obtain the population in each district in each area category.
3. The population in each sub-category was then multiplied by the WAGR to estimate the amount of waste produced in each district in each area category.

The results are tabulated in Table 8-31.

Table 8-31: Household Waste Generation Amount Breakdown

Unit: t/d

District	UA	SUPA	SUUA	RA	Total
Ilala	39.7	128.1	133.0	51.0	351.8
Kinondoni	0.0	256.3	320.5	84.9	661.6
Temeke	0.0	157.2	218.3	27.3	402.9
Total	**39.7**	**541.6**	**671.8**	**163.2**	**1416.3**

Note: 1. In Table 6-3 of Annex 6, the population is categorised according to income and area. This breakdown was used to estimate the amount of waste produced by each income category in each area using the appropriate WAGRs for high, middle and low income households and hence to get the total amount of waste produced in each area category as shown in Table 6-5 of Annex 6. It is not justified to use the same approach here as this adds undue complexity to the calculation and makes forecasting difficult as no data is available showing how the percentage of high, middle and low income households will vary in each area category in the future. Instead, the weighted average household WAGR was used to simplify the calculation and to facilitate forecasting as it is assumed that the WAGR remains constant at 698 g/cap/d until 2005 and the population forecast data is available in terms of district and area categories. Furthermore, the differences in the waste amount results for each area category for the two

methods (Table 6-5 and Table 8-31) are not significant, being 8%, 1%, 1% and 1% for UA, SUPA, SUUA and RA areas respectively and the total waste generation amount is the same.

2. For waste forecasting purposes it is assumed:

- The WAGR remains constant at 0.698 g/cap/d.
- All wards in the Study area remain in the same area category. It is possible that some wards may change status. For example, infrastructural development of the city could change a SUPA into a UA while a SUUA could become a SUPA if the Council redevelops it. However, it is not possible to predict such changes.

b. Commercial Waste

In the calculation of the waste generation amount for each category of commercial waste (restaurant, guesthouse/hotel, other), the nature of the data used was different in each case. Hence, each category of commercial waste has to be broken down separately and then combined to get the overall commercial waste breakdown.

b.1 Restaurant Waste

The available data states that there are 365 restaurants in DSM in 1996. Furthermore, it is known that in 1994, 236 restaurants were located in the ten central city wards. Six of these wards are located in the UA category while four are in the SUPA category (all ten in Ilala district). It is assumed:

- the 1994 data can be directly applied to 1996.
- 75% and 25% of the 236 restaurants are in the 6 UA and 4 SUPA wards.
- The remaining 129 restaurants are assumed to be distributed amongst the remaining 9 wards in the SUPA category and all wards in the SUUA and RA area categories in proportion to the population in these categories.

Detailed calculations are shown in Section 8.8.3 (b). The results are tabulated in Table 8-32.

Table 8-32: Restaurant Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	48.5	18.2	3.5	1.4	71.6
Kinondoni	0.0	6.8	8.6	2.3	17.7
Temeke	0.0	4.2	5.8	0.7	10.7
Total	**48.5**	**29.2**	**17.9**	**4.4**	**100.0**

b.2 Commercial (Other) Enterprises Waste

The only available data lists the total number of other commercial enterprises in DSM. It is assumed that the distribution of other commercial enterprises is the same as that for restaurants and hence the waste generation amount breakdown is as shown in Table 8-32.

b.3 Guesthouse and Hotel Waste

The available data for guesthouses states there are 143, 84 and 95 guesthouses in Temeke, Kinondoni and Ilala respectively. To calculate the number of guesthouses in each area category it is assumed that the number of guesthouses in each area is

proportional to the population in that area. Detailed calculations are shown in Section 8.8.3 (c). and the results in Table 8-33.

Table 8-33: Guesthouse Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	3.4	10.6	11.2	4.4	29.6
Kinondoni	0.0	9.9	12.7	3.4	26.0
Temeke	0.0	17.4	23.9	3.1	44.4
Total	**3.4**	**37.9**	**47.8**	**10.9**	**100.0**

The available hotel data lists there being 51 hotels in DSM, all of which charged a minimum of 700 Tsh. per bednight in 1994. The majority of hotels of this type are found in the central city area (UA, Ilala district), Kawe and Msasani wards (SUPA, Kinondoni district) and on the beachfront in Kunduchi ward (RA, Kinondoni district). These observations are used to estimate the percentages of hotels in each area category in each district which are shown in Table 8-34.

Table 8-34: Hotel Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	60.0	5.0	0.0	0.0	65.0
Kinondoni	0.0	10.0	0.0	25.0	35.0
Temeke	0.0	0.0	0.0	0.0	0.0
Total	**60.0**	**15.0**	**0.0**	**25.0**	**100.0**

b.4 Commercial Waste

For each area category in each district, the percentage values for each type of commercial waste were converted to actual waste generation amounts by multiplying by the waste generation amounts (13.7, 12.0, 0.5 and 1.1 t/d for restaurant, other, hotel and guesthouse waste respectively) and corresponding values were added together to get the total amount of waste in each area category in each district. These were then converted to percentages as shown in Table 8-35.

Table 8-35: Commercial Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	47.0	17.7	3.7	1.5	69.9
Kinondoni	0.0	7.0	8.6	8.6	18.3
Temeke	0.0	4.6	6.4	0.8	11.8
Total	**47.0**	**29.3**	**18.7**	**5.0**	**100.0**

c. Institutional Waste

The only available data lists the total number of institutions and institutional workers in DSM. As the WAGR is expressed in terms of the number of institutional workers it is more appropriate to discuss the distribution of institutional workers rather than institutions in this case. Most institutional workers are based in the central city area (UA

and SUPA) although there is also a large number of institutional workers in the university area. However, it is expected that the distribution of institutional workers can be approximated to that of restaurants and hence the waste generation amount breakdown is as shown in Table 8-32.

d. Markets

The distribution of markets throughout DSM is quite different from other categories and a precise analysis would involve considerable work. Instead, a simplified approach was taken using the existing data obtained from the Market Census survey and market data obtained from DCC. Detailed calculations are set out in Section 8.8.3 (d) and this procedure is summarised below:

1. Markets surveyed in the Market Census survey were sorted into categories according to district and area. The number of wholesale and retail operators in each sub-category was then counted from the survey results and converted to a waste generation amount.
2. The number of wholesale and retail operators in other unsurveyed markets was estimated on a district basis and then on an area basis. These estimates were converted to waste generation amounts.
3. These two sets of data were combined to get total waste generation amounts in each category which were then converted to percentages as shown in Table 8-36.

Table 8-36: Market Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	33.2	7.5	5.2	1.9	47.8
Kinondoni	0.0	17.2	10.6	5.2	33.1
Temeke	0.0	9.6	8.0	1.5	19.1
Total	**33.2**	**34.4**	**23.8**	**8.6**	**100.0**

e. Street Sweeping Waste

At the time of WACS, street sweeping was only carried out in the urban area in Ilala district. Hence the waste generation amount distribution is as shown in Table 8-37. However, this situation may change in the future.

Table 8-37:Street Sweeping Waste Generation Amount Breakdown

Unit: % of Waste Generation Amount

District	UA	SUPA	SUUA	RA	Total
Ilala	100.0	0.0	0.0	0.0	100.0
Kinondoni	0.0	0.0	0.0	0.0	0.0
Temeke	0.0	0.0	0.0	0.0	0.0
Total	**100.0**	**0.0**	**0.0**	**0.0**	**100.0**

f. Informal Sector Waste

The available data does not describe the distribution of informal sector activity throughout DSM. However, most informal sector activity is located in the central city

area (UA and SUPA). It is expected that the distribution of informal sector operations is similar to that for restaurants and hence the waste generation amount breakdown is as shown in Table 8-32.

8.8.2 Breakdown of Present Waste Stream

The present waste stream was broken down into three separate waste streams, one for each district of DSM as follows:

1. Each component of the present waste stream (e.g. discharge amount, recycling amount, etc.) was expressed as a percentage of the total waste generation amount.
2. It was assumed that these percentages are the same for each district's waste stream. Hence, the magnitude of each component for each district waste stream is calculated using these percentages and the total district waste generation amount.

As such, these district waste streams are theoretical in nature rather than reflecting the real situation. This data is shown in Table 8-38.

Table 8-38: Waste Stream Breakdown by District

Waste Stream		DSM WGA	DSM WGA	Waste Amount by District (t/d)		
Component	Sub-component	(t/d)	(%)	Ilala	Kinondoni	Temeke
Generation	Household	1416.3		351.8	661.6	402.9
	Commercial	27.3		19.1	5.0	3.2
	Institutional	10.7		7.7	1.9	1.2
	Market	33.9		16.2	11.2	6.5
	Street Sweeping	1.3		1.3	0.0	0.0
	Informal Sector	282.7		202.4	50.0	30.3
	Total	1772.2	100.0	598.5	729.7	444.1
Discharge		299.3	16.89	101.1	123.2	75.0
Collection		296.2	16.71	100.0	122.0	74.2
Self-disposal	Proper	392.9	22.17	132.7	161.8	98.5
	Improper	260.5	14,70	88.0	107.3	65.3
	Total	653.4	36.87	220.7	269.0	163.7
Illegal Dumping	- from generation	704.3	39.74	237.9	290.0	176.5
	- from collection	152.7	8.62	51.6	62.9	38.3
	- less recycling	10.1	0.57	3.4	4.2	2.5
	Total	846.9	47.79	286.0	348.7	212.2
Final Disposal	- from collection	143.5	8.10	48.5	59.1	36.0
	- less recycling	2.1	0.12	0.7	0.9	0.5
	Total	141.4	7.98	47.8	58.2	35.4
Recycling	- from generation	115.2	6.50	38.9	47.4	28.9
	- from discharge	3.1	0.17	1.0	1.3	0.8
	- from illegal dumping	10.1	0.57	3.4	4.2	2.5
	- from final disposal	2.1	0.12	0.7	0.9	0.5
	Total	130.5	7.36	44.1	53.7	32.7

8.8.3 Detailed Calculations

a. Population Breakdown

The population data presented in Table 8-39 was used in the waste generation amount calculations.

Table 8-39: Population Breakdown (1996)

District	UA	SUPA	SUUA	RA	Total
Ilala	56,880	183,660	190,616	73,141	504,297
Kinondoni	0	367,342	459,396	121,682	948,420
Temeke	0	225,353	313,003	39,154	577,510
Total	56,880	776,355	963,015	233,97	2,030,227

Note: 1. *Whole number* population data for each ward was taken from Table 8-2 in Progress Report (2) and sorted to obtain the total population in each district in each area category as tabulated above.
2. The SUPA, SUUA, RA and total populations differ from the figures in Table 8-2 in Progress Report (2). In Table 8-2 the population data was calculated from 1988 census data and the data is rounded off to the nearest whole number. However, the summation process used in the spreadsheet to get the total population in each area category and overall population used the calculated values as stored in the spreadsheet (i.e. unrounded values). Hence, the difference is due to round-off error. The effect of this error on the calculation of waste generation amounts is negligible.

b. Restaurant Waste

The steps followed in the calculation of restaurant waste are shown below:

1. 177 (=75% of 236) restaurants are in the 6 UA wards which constitute the urban area (Kariakoo, Kisutu, Kivukoni, Mchafukoge, Upanga East, Upanga West). This is equal to 48.5% of the total number of restaurants in DSM.
2. 59 (=25% of 236) are in the other 4 central city wards which are in the SUPA area (Gerezani, Ilala, Jangwani and Mchikichini). This is equal to 16.2% of the total number of restaurants in DSM.
3. The remaining restaurants (35.3%) are assumed to be distributed amongst the remaining wards in the SUPA area and SUUA and RA areas in proportion to the population in each category as shown in Table 8-40.

Table 8-40: Percentage of Restaurants in other Categories

Category	Population	% of total population	% of restaurants
SUPA (remaining wards)	699,282	36.9	13.0
SUUA	963,015	50.8	17.9
RA	233,977	12.3	4.4
Total	1,896,274	100.0	35.3

Note: 1. The population for SUPA excludes the 4 wards already considered in step 2.
2. The restaurant percentages in each category are calculated as (% of total population in category) x (total restaurant %). e.g. For SUPA, 13.0 = 0.369 x 35.3.
3. For SUPA, adding 13.0 to the 16.2% calculated in Step 2 gives a total of 29.2% of restaurants in SUPA.

4. For each area category, the breakdown into districts is calculated by assuming the number of restaurants is proportional to the population in each ward as shown in Table 8-41.

Table 8-41: Percentage of Restaurants by district

SUPA	Population	% of total population	% of restaurants
Ilala	106,587	15.2	2.0
Kinondoni	367,342	52.5	6.8
Temeke	225,353	32.2	4.2
Total	699,282	100.0	13.0
SUUA	Population	% of total population	% of restaurants
Ilala	190,616	19.8	3.5
Kinondoni	459,396	47.7	8.6
Temeke	313,003	32.5	5.8
Total	963,015	100.0	17.9
RA	Population	% of total population	% of restaurants
Ilala	73,141	31.3	1.4
Kinondoni	121,682	52.0	2.3
Temeke	39,154	16.7	0.7
Total	233,977	100.0	4.4

Note: 1. The population in Ilala district in SUPA excludes the 4 wards already considered in step 2.
2. The total percentage for Ilala district in SUPA is 16.2 + 2.0 = 18.2%.

c. Guesthouse Waste

For the guesthouse waste generation amount breakdown into area categories for each district, it is assumed that the number of guesthouses in each area is proportional to the population in that area. The results are shown in Table 8-42.

Table 8-42: Percentage of Guesthouses in each Category

Ilala	Population	% of total population	No. of Guesthouses	% of Guesthouses
UA	56,880	11.3	11	3.4
SUPA	183,660	36.4	34	10.6
SUUA	190,616	37.8	36	11.2
RA	73,141	14.5	14	4.4
Total	**504,297**	**100.0**	**95**	**29.6**
Kinondoni	Population	% of total population	No. of Guesthouses	% of Guesthouses
UA	0	0.0	0	0.0
SUPA	367,342	38.7	32	9.9
SUUA	459,396	48.4	41	12.7
RA	121,682	12.8	11	3.4
Total	**948,420**	**100.0**	**84**	**26.0**
Temeke	Population	% of total population	No. of Guesthouses	% of Guesthouses
UA	0	0	0	0.0
SUPA	225,353	39.0	56	17.4
SUUA	313,003	54.2	77	23.9
RA	39,154	6.8	10	3.1
Total	**577,510**	**100.0**	**143**	**44.4**

Note: 1. No. of guesthouses in an area = % of total population in area x total no. of guesthouses in district.

d. Market Waste

The steps followed to breakdown the market waste generation amount are described below.

1. From Table 6-17 in Annex 6, the number of wholesale and retail operators in markets in each district and area were counted.
2. Table 6-18 of Annex 6 was used to estimate the number of wholesale and retail operators in the remaining unsurveyed markets in DSM as shown in Table 8-43.

Table 8-43: Estimation of Retail/Wholesale Market Operators in Unsurveyed Markets

District	No. of Operators in 42 unsurveyed markets having data	Corrected Number of Operators[1]	No. of Operators in unsurveyed markets without data[2]	Total	No. of Wholesale Operators	No. of Retail Operators
Ilala	304	365	25	390	20	370
Kinondoni	953	1,144	63	1,207	20	1,187
Temeke	392	471	12	483	20	463
Total	1,649	1,980	100	2,080	60	2,020

Note: 1. The number of operators was first corrected as explained in P/R (2) to account for the DCC data underestimating the total number of market operators.
2. There were 8 DCC markets for which there was no operator data (2 in Ilala, 5 in Kinondoni, 1 in Temeke). It was assumed that the number of operators in these markets was 100 and that each market had the same number of operators, giving the numbers shown above for each district.
3. It was estimated that there were 60 wholesale operators in these markets, equally distributed between the 3 districts.

3. The total number of wholesale and retail operators in each district was then calculated using data from steps 1 and 2 as shown in Table 8-44.

Table 8-44: Market Waste Generation Breakdown by District

District	Source	Wholesale Operators	Retail Operators	Waste Generation Amount (t/d)
Ilala	Census Survey	1,530	2,158	
	DCC data	20	370	
	Total	**1,550**	**2,528**	16.20 (47.8%)
Kinondoni	Census Survey	113	2,177	
	DCC data	20	1,187	
	Total	**133**	**3,364**	11.21 (33.1%)
Temeke	Census Survey	100	1,411	
	DCC data	20	463	
	Total	**120**	**1,874**	6.49 (19.15)
Total		1,803	7,766	33.89 (100.05)

Note: 1. Waste generation amounts were calculated using wholesale and retail WAGRs of 5.36 and 3.12 kg/op/d respectively.

4. The market census survey operator data for each area category in each district was converted to market waste generation amounts. Approximately half of the unsurveyed markets were located in terms of area (i.e. UA, SUPA, etc.) and this information was used to estimate from which areas in each district most of the remaining market waste was being generated in. The market waste generation

amounts in these areas were then estimated by comparison of the market census survey data and the total market waste generation amount in each district tabulated above and using the following assumptions. The results are shown in Table 8-45

- For Ilala, it was assumed that the unsurveyed markets are in SUUA and RA areas and the same amount of market waste is produced in both areas.
- For Kinondoni and Temeke, it was assumed that the unsurveyed markets are in SUPA, SUUA and RA areas and each area produces the same amount of waste.

Table 8-45: Breakdown of Market Waste Generation Amount

District	Parameter	UA	SUPA	SUUA	RA	Total
Ilala	**Census Survey**					
	Wholesale Operators	1,506	15	9	0	
	Retail Operators	1,016	792	350	0	
	WGA (t/d)	11.24	2.55	1.14	0.00	
	Other mkts WGA (t/d)	0.00	0.00	0.63	0.63	
	Total	**11.24**	**2.55**	**1.77**	**0.63**	**16.20**
	%	**33.2%**	**7.5%**	**5.2%**	**(1.9%)**	**(47.8%)**
Kinondoni	**Census Survey**					
	Wholesale Operators	0	13	100	0	
	Retail Operators	0	1444	577	156	
	WGA (t/d)	0.00	4.58	2.34	0.49	
	Other mkts WGA (t/d)	0.00	1.27	1.27	1.27	
	Total	**0.00**	**5.85**	**3.61**	**1.76**	**11.21**
	%	**0.0%**	**17.2%**	**10.6%**	**5.2%**	**(33.1%)**
Temeke	**Census Survey**					
	Wholesale Operators	0	100	0	0	
	Retail Operators	0	705	706	0	
	WGA (t/d)	0.00	2.74	2.20	0.00	
	Other mkts WGA (t/d)	0.00	0.52	0.52	0.52	
	Total	**0.00**	**3.25**	**2.72**	**0.52**	**6.49**
	%	**0.0%**	**9.6%**	**8.0%**	**1.5%**	**(19.1%)**
Total		**11.24**	**11.65**	**8.10**	**2.91**	**33.89**
		(33.2%)	**(34.4%)**	**(23.8%)**	**(8.6%)**	