Annex 15

Weighbridge Control System

15 Weighbridge Control System

15.1 Description of the Installed Weighbridge

The present final disposal amount is one of the most important information to understand the present actual situation correctly. Based on these data we can estimate the present refuse collection rate, the present density of waste, the performance of refuse collection vehicles, etc. To continue to monitor them let us to perceive the change of refuse compositions. They can show us lots of valuable information in solid waste management. Therefore, a weighbridge was installed at Vingunguti where sole landfill for Dar es Salaam exists.

A electric load cell type weighbridge was installed at the corner of Nyerere road and Vingunguti road.

Figure 15-1 shows the general plan for the weighbridge installed.

The main features of the system are as follows.

- Road vehicle weighbridge: 50,000 kg x 10 kg
- Platform size: 12 m x 3 m
- Digital weighbridge indicator system
- Ticket printer system

The specifications of the weighbridge installed are also included.

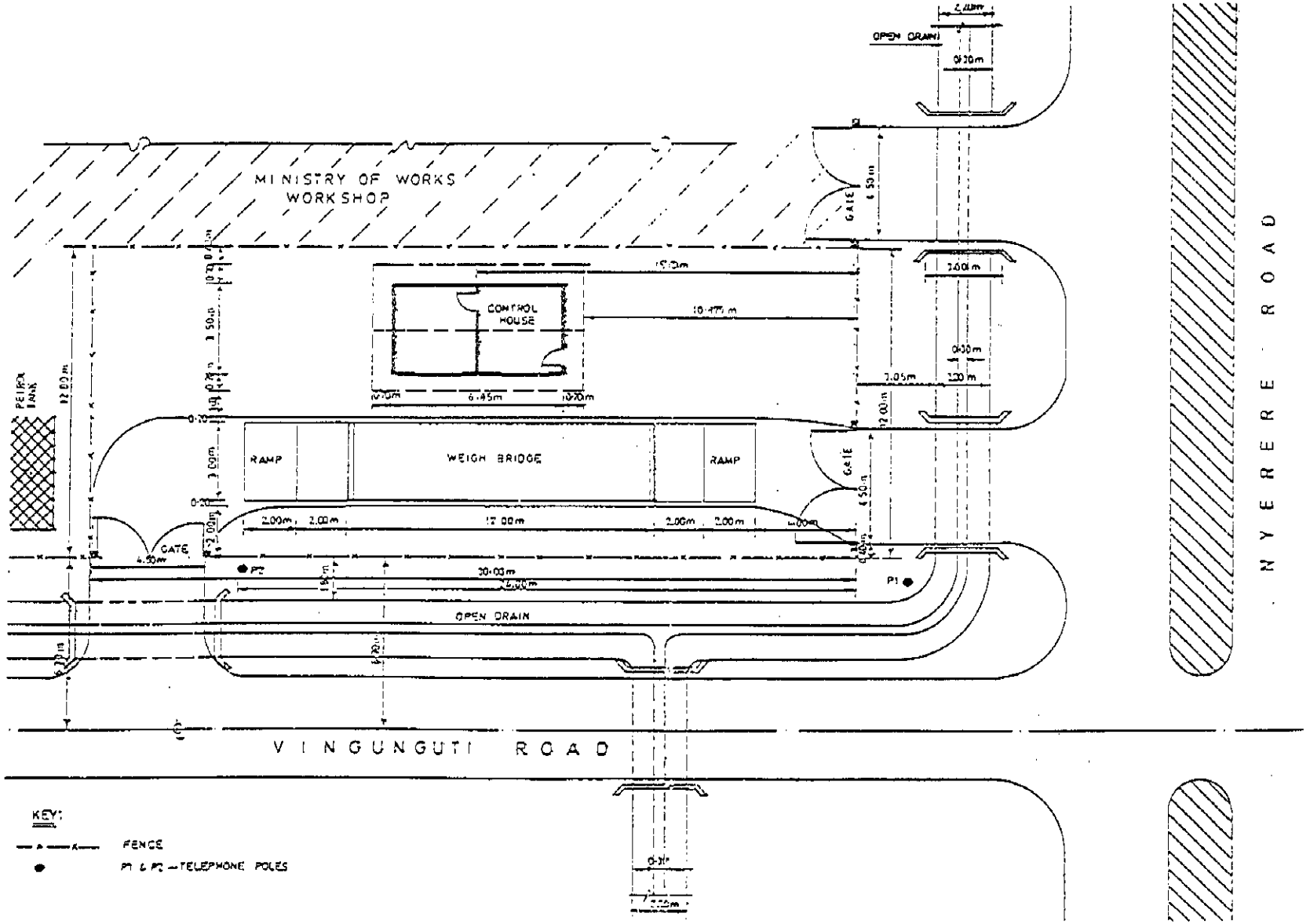

Figure 15-1: General Plan of Vingunguti Weighbridge

Table 15-1: Weighbridge Record

		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total	Revised Total	Average
DCC	tons	58	44	35	33	97	83	48	26	39	61	74	114	97	85	92	100	81	45	1,212	1,212	67.3
	trips	22	16	15	14	31	25	21	9	13	23	24	33	38	28	30	31	28	17	418	418	23.2
Multinet Africa	tons	22	28	33	29	30	12	31	30	33	40	33	31	12	41	36	32	32	38	543	815	45.3
	trips	9	12	12	14	14	7	14	13	15	21	16	14	6	17	17	14	15	19	249	374	20.8
Mazingira	tons	1	0	4	2	0	0	0	3	5	4	8	3	4	9	8	7	9	8	75	75	4.2
	trips	1	0	2	1	0	0	0	2	3	2	4	2	2	4	3	4	4	5	39	39	2.2
Alyson's	tons	0	2	0	0	3	0	2	0	0	0	1	0	0	1	0	0	0	1	10	10	0.6
Traders	trips	0	1	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	1	6	6	0.3
Kimangele	tons	0	4	2	0	0	2	4	0	0	5	0	3	0	4	0	0	3	0	27	27	1.5
	trips	0	3	3	0	0	1	3	0	0	3	0	2	0	3	0	0	2	0	20	20	1.1
Bandari	tons	0	4	3	6	0	0	6	0	5	3	4	0	0	0	2	5	0	4	42	42	2.3
	trips	0	3	2	3	0	0	3	0	2	2	3	0	0	1	2	2	0	1	24	24	1.3
NBC	tons	0	2	0	0	0	0	1	0	2	0	0	0	1	1	1	1	0	0	9	9	0.5
	trips	0	1	0	0	0	0	1	0	1	0	0	0	1	1	1	1	0	0	7	7	0.4
TCC LTD	tons	0	1	2	1	1	0	1	1	1	2	4	1	1	1	1	1	1	1	21	21	1.2
	trips	0	1	2	2	1	0	2	1	1	3	4	2	1	2	1	1	1	1	26	26	1.4
TTCL	tons	0	2	1	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	6	6	0.3
	trips	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	4	4	0.2
Kariakoo	tons	10	5	7	8	10	6	10	8	6	10	9	8	9	7	9	8	9	7	146	146	8.1
Market	trips	4	2	3	3	4	3	4	3	2	4	3	3	3	3	4	4	4	3	59	59	3.3
Individual	tons	8	70	8	13	16	4	8	14	9	7	7	10	9	18	11	21	11	9	253	253	14.1
	trips	9	28	8	9	2	4	13	8	7	7	9	9	7	14	9	17	7	8	175	175	9.7
Total	tons	99	162	95	92	157	107	111	82	100	134	140	170	133	167	160	176	146	113	2,344	2,616	145.3
	trips	45	68	48	46	53	40	62	36	44	66	64	65	58	74	67	75	61	55	1,027	1,152	64.0

Note: Multinet Africa, Mazingira, Alyson's Traders and Kimangele are authorised private refuse collection companies.

15.2 Findings from the Weighbridge Data

a. Findings from Measured Data

Through analysis of the disposal amount measured by the weighbridge installed at the Vinguguti disposal site, the Team obtained the following findings:

- The data measured by the Vinguguti weighbridge between 11 and 28 February 1997 shows that the amount of disposal waste at the Vinguguti landfill site is 145 tonnes/day on average, corresponding to 8.2% of the total waste generation amount, 1,772 tonnes/day. The amount of disposal waste estimated in the first phase of this study based on the number of refuse trucks carrying waste into the landfill was 167 tonnes/day, equivalent to 9.4% of the total generation amount.
- DCC is using 4 tonnes of waste per 8 ton truck and 3 tonnes of waste per 6 ton truck as conversion factors to convert the number of trips to waste disposal amount in tonnes. The average refuse collection amounts carried by trucks measured with the Vinguguti weighbridge were 3.2 tonnes per 8 ton truck and 2.2 tonnes per 6 ton truck. The difference between the estimated waste amount in the phase one and the actual amount measured this time is considered to be mainly because of the errors in the conversion factors.
- The breakdown of waste disposal amount according to carrier was DCC: 46 %, authorised private refuse collection companies: 35 % and direct haulage waste from dischargers: 19 %.
- Although the number of private refuse collection companies was increased from one to five in July 1996 with expansion of private collection areas, one of these five companies had stopped its operation before February 1997. In addition the area serviced by Multinet Africa which had been working since 1994 was reduced from 10 to 5 wards, which is exactly the same number of wards they had been servicing until July 1996. Therefore, the increase in the waste collection amount achieved by the private refuse collection service expansion plan was found to be only 6 tonnes/day, equivalent to 4 % of the total refuse collection amount.

b. Technical Feasibility

Discussion was made when selecting the type of weighbridge to be installed. Although mechanical type of weighbridge is dominant in DSM, we could identify three electronic weighbridge in DSM. Since we predicted that electronic type of weighbridge would get more popular in future, we decided to installed an electronic type of weighbridge. We found the following facts.

- An electronic type of weighbridge could be operated by staff in DCC.
- Operation of the computer control system associates with difficulties for staff in DCC because of too few staff having knowledge on computer.
- The weighbridge system including computer system should have stand by batteries for emergency and a stabiliser because electricity supply is not so reliable. It is intermittent and its current is not so constant.

- The number of weighbridge to be installed at a landfill site should be one even though the total number of incoming refuse trucks exceed the capacity of one weighbridge. In this case, only spot checking or weighing only direct haulage trucks should be done. To attempt to weigh all incoming refuse trucks precisely is considered to be too high standard for Dar es Salaam taking general situations into account.
- The actual number of incoming trucks of Multinet Africa was expected to be 1.5 times of the measured number at the weighbridge office because the operation hour of weighbridge does not cover the working hour of private contractors. The weighbridge control office should be open to cover the working hour of private contractors so that all incoming trucks will be recorded.
- Exit of some trucks which entered the landfill site could not be identified. They seemed to exit from other routes. These happened because the weighbridge locates 1.2 km away from the landfill. The weighbridge should locates at the just entrance to the landfill and be guarded safely.

15.3 Operation Manual for Weighbridge Control System

The operation manual for weighbridge control system is attached.

Operator's manual

WEIGHTBRIDGE

SYSTEM

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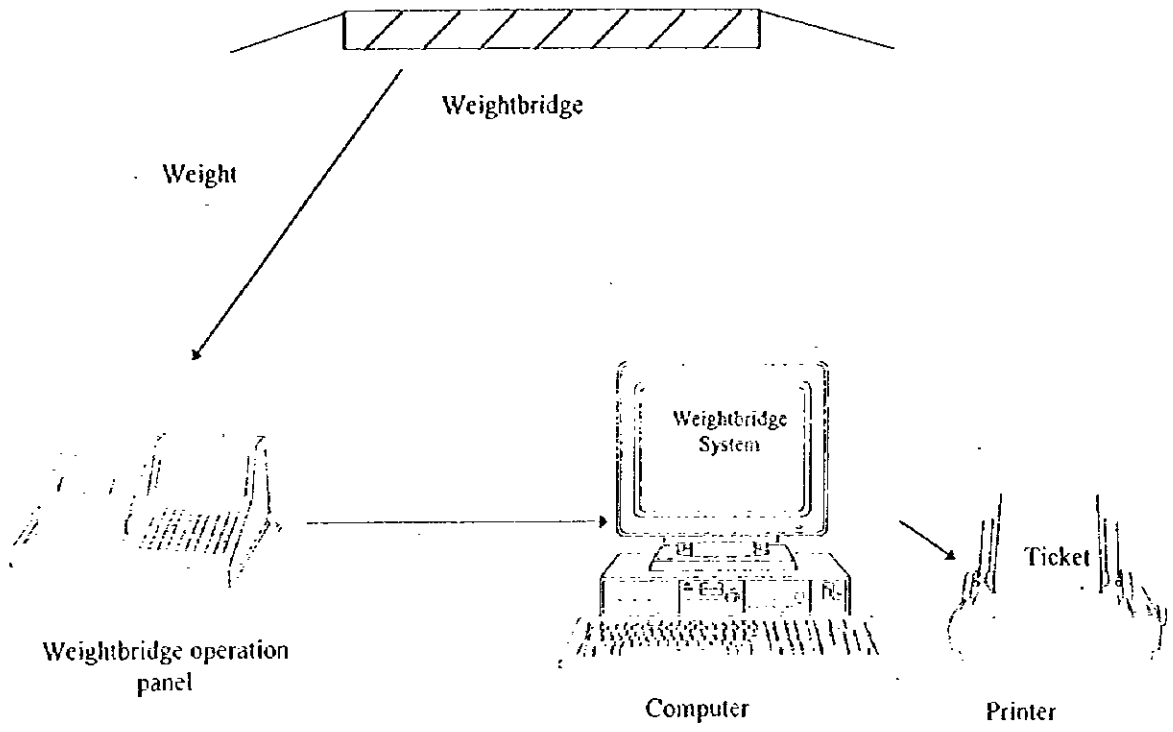
I. System specifications



The computer system of control for waste registration was developed to serve purpose as follow:

- To create a database of all movement in the landfill.
- To know the exactly amount of waste which is brought to the dump site.
- To analyze data which are potential for planing of solid waste management.

II. First

A. To begin

- In the DOS prompt type WB and the press **<ENTER>**, and then show up the next screen

The Study On The Solid Waste Management In
Dar Es Salaam City
in
The Republic of Tanzania

Date(dd/mm/aaaa) :
Operator :
Date(dd/mm/aaaa) :

1. Enter today data and press **<ENTER>**.
2. Enter code of operator and then your password.
3. Show the main menu of the system.

III. Main Menu

Control	Abmc	Today	Report	Tools	Quit

A. Control

Control	Abmc	Today	Report	Tools	Quit

- IN/OUT(Manual)
- IN/OUT(Auto)
- Cancel(IN/OUT)
- Vehicle(Without exit)

B. Abmc

Control	Abmc	Today	Report	Tools	Quit

- Operator
- User/Vehicle
- Tare weight

C. Data

Control	Abmc	Today	Report	Tools	Quit

- Report
- Copy
- Modify

D. Report

Control	Abmc	Today	Report	Tools	Quit

- Daily
- Monthly
- Vehicle

E. *Tools*

Control	Abmc	Data	Report	Tools	Quit
				Reindex File	

F. *Quit*

Control	Abmc	Data	Report	Tools	Quit

IV. Databases of the system

A. *DAY_DATA.DBF*

Name	DAY_DATA.DBF		
Detail	Registrations of daily trucks movement.		
	Fields		
Name	*Type*	*Width*	*Description*
M_PLATE	Character	10	
M_CODUSER	Numeric	2	
M_DATE	Date	8	
M_TIME	Character	8	
M_WGROSS	Numeric	5	
M_WTARE	Numeric	5	

B. *HIS_DATA.DBF*

Name	HIS_DATA.DBF		
Detail	Registrations of historical movement.		
	Fields		
Name	*Type*	*Width*	*Description*
M_PLATE	Character	10	
M_CODUSER	Numeric	2	
M_DATE	Date	8	
M_TIME	Character	8	
M_WGROSS	Numeric	5	
M_WTARE	Numeric	5	

C. *OPERATOR.DBF*

Name	OPERATOR.DBF		
Detail	Registrations of the operator.		
	Fields		
Name	*Type*	*Width*	*Description*
O_COD	Character	2	
O_NAME	Character	35	
O_ADDRESS	Character	35	
O_PHONE	Character	17	

D. OUT.DBF

Name	OUT.DBF		
Detail	Exit registrations of the truck.		
Fields			
Name	Type	Width	Description
OU_REG	Numeric	7	
OU_PLATE	Character	10	
OU_DATE	Date	8	
OU_TIME	Character	8	
OU_OK	Character	1	

E. USERS.DBF

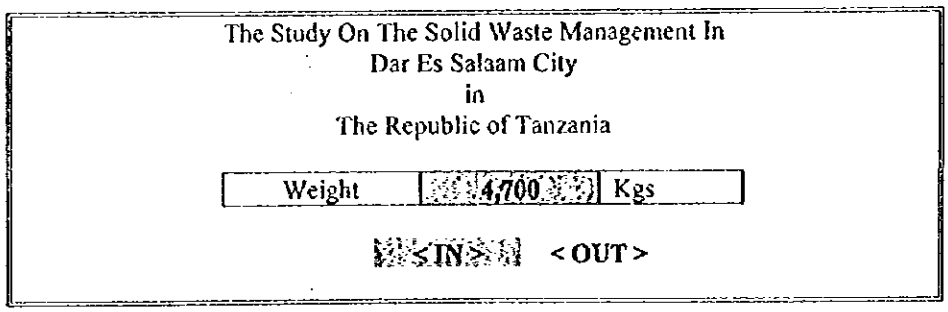
Name	USERS.DBF		
Detail	Registrations of the users.		
Fields			
Name	Type	Width	Description
U_COD	Numeric	2	
U_NAME	Character	25	
U_ADDRESS	Character	35	
U_PHONE	Character	17	

F. VEHICLE.DBF

Name	VEHICLE.DBF		
Detail	Registrations of the every vehicles.		
Fields			
Name	Type	Width	Description
V_PLATE	Character	10	
V_TYPE	Character	20	
V_MAKE	Character	20	
V_MODEL	Character	20	
V_YEAR	Numeric	4	
V_CAPAC	Character	10	
V_WTARE	Numeric	5	
V_CODUSE	Numeric	2	
V_DATE	Date	8	
V_USE	Character	1	

V. Control of the movement of vehicles

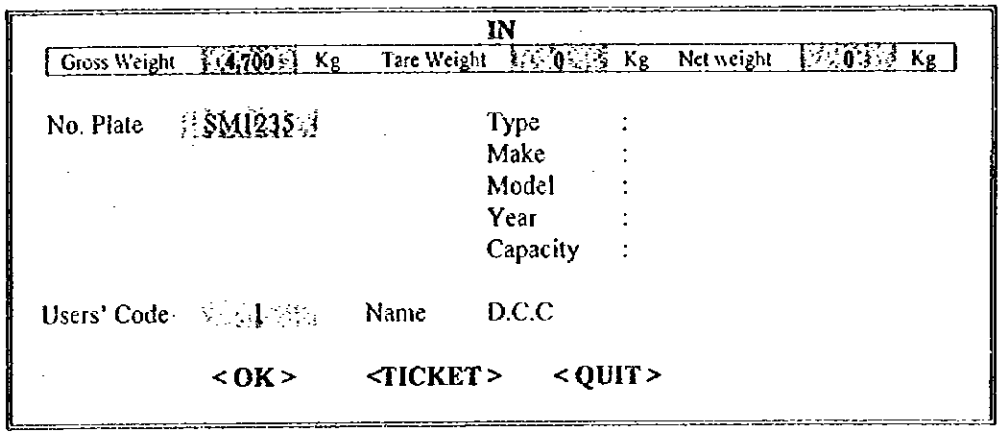
- The control of vehicles movement refers to the control of every vehicle entering to the dumping site.
- The identification code of the vehicle is the no. plate.
- If the vehicle is new to the dumping site it will be registered while going to dump and when back from the dumping and then it will be registered.
- If the vehicle if already registered then it will be registered during the entrance only.
- Select **<Control>** from the main menu and then select **<IN/OUT (manual)>** and then show up the next screen.



- Enter the weight and then select; **<IN>**, to register the entrance or **<OUT>**, to register the exit.

A. Registration of the vehicles entrance

- To register the entrance select **<IN>** from the previous screen, and then show up the next screen.

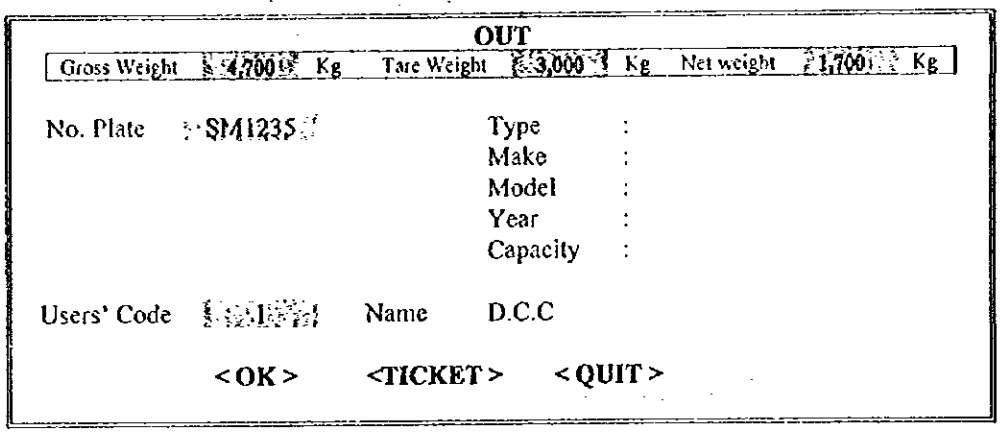


1. Enter the no. plate of the vehicle and then press **<Enter>**, the system will verify if the vehicle has been registered.
2. If the vehicle is not registered it must registered after dumping to obtain the tare weight..
3. If the vehicle registered it not necessary to register after dumping..
   a) Tare weight will not be more than gross weight.
4. Enter the code of users.
   a) If you know the code you can enter the code and press **<Enter>**.
   b) You can get the users code from the name by pressing **<F7>**.
5. Verify every data and select **< OK >** and press **<Enter>**, to save the data.
6. Select **<TICKET>**, and press **<Enter>** if you want a ticket.
7. To end select **<QUIT>** and press **<Enter>**, and go back to the previous screen.

B. Registration of vehicle exit

- To register the vehicles exit select **<OUT>** from the previous screen, and then show up the next screen.

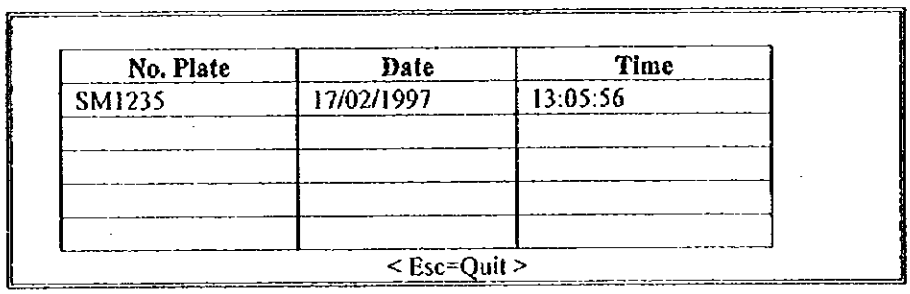
•



1. Enter the no. plate of the vehicle exit and then press **<Enter>**, the system will verify if the vehicle is new and has been registered at the entrance.
2. Verify every data and select **< OK >** and press **<Enter>**, to register the vehicle.
3. Select **<TICKET>**, and press **<Enter>** if you want a ticket.
4. To end select **<QUIT>** and press **<Enter>**, and go back to the previous screen.

C. To verify the new vehicles which have not registered for the exit

- Select **<Control>**, from the main menu then select **<Vehicles(Without exit)>** and press **<Enter>**, and show up the next screen. To end press **<Esc>**.

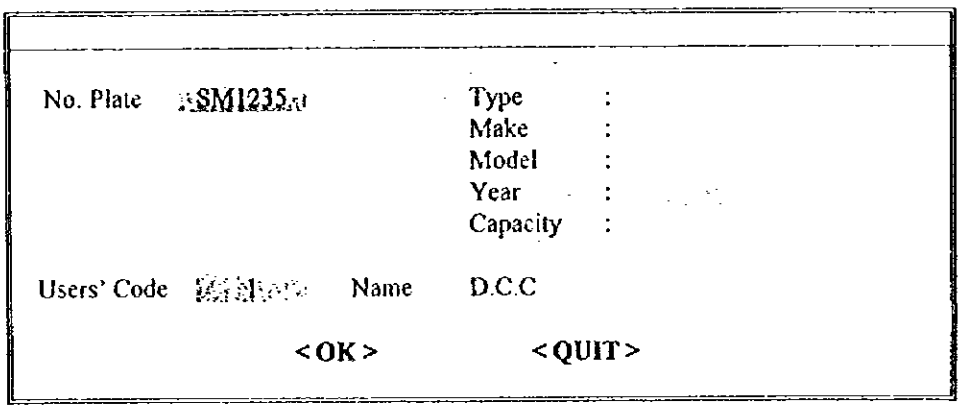


No. Plate	Date	Time
SM1235	17/02/1997	13:05:56

< Esc=Quit >

D. Delete new vehicle without exit

- Select **<Control>**, from the main menu then select **<Cancel(IN/OUT)>** and show up the next screen.



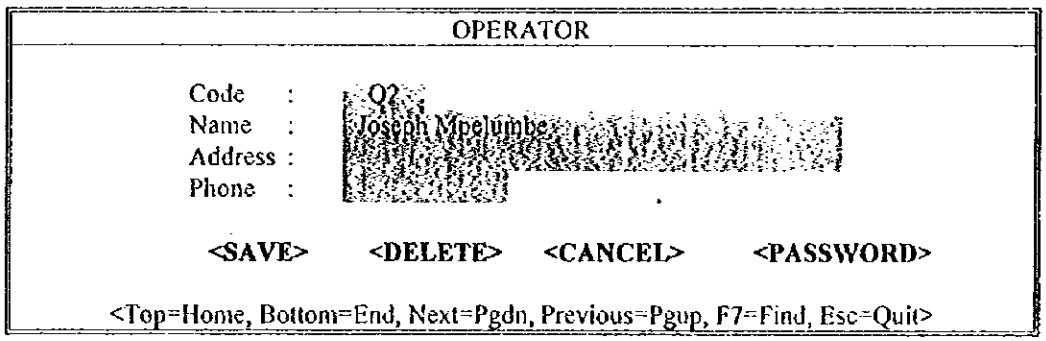
1. Enter the no. plate of the vehicle you want to eliminated then press **<Enter>**, the system will show the every data corresponding to the vehicle.
2. Verify every data and select **< OK >** and then press **<Enter>**, to delete the new vehicle without exit.

a) This process is done when the vehicle has been registered during entrance and the left the site without exit registration..

3. To end select **<QUIT>**, and then press **<Enter>**.

VI. Operator

- The operator is a person authorized to utilize to use the system.
- Select **<Abme>**, from the main menu and then select **<Operator>** to show up the next screen.



A. *To register new operator*

1. Enter code of the new operator and then press **<Enter>**.
   a) Enter the name of the operator.
   b) Enter the address of the operator.
   c) Enter the phone of the operator.
2. Verify every data and then select **<SAVE>** and press **<Enter>** to save.
   a) The system will request the password for the new operator. Enter password with a maximum of 8 characters and then press <Enter>.
   b) Then will request the confirmation of the password.
   c) If the password is correct, the system will accept the new operator.
3. To end press **<ESC>**.

B. *To delete a operator*

1. Enter the code of the operator to be eliminated and then press **<Enter>**.
2. Verify every data and select **<DELETE>** and then press **<Enter>** to delete.
   a) The system will request the password of the operator to be deleted.
   b) Enter the password and then confirm to delete.
3. To end press **<ESC>**.

C. *Modification of operators' data*

1. Enter operator code to be modified and then press **<Enter>**.
2. Go to the fields of operators' data which have to be modify.
   a) You can modify the name, address, and phone.
3. To end press **<ESC>**.

D. *To consult*

1. To consult the data of the operator refer as follows.
   a) Enter the code of operator if you know it.
   b) Go to the first operator by pressing **<HOME>**.
   c) Go to the last operator by pressing **<END>**.
   d) Go to the next operator by pressing **<PGDW>**.
   e) Go to the previous operator by pressing **<PGUP>**.
   f) Press **<F7>**, to find by name.
2. To end press **<ESC>**.

VII. Users

- Select **<Abme>** from the main menu and then select **<User/Vehicle>** , and then show up the next screen.
- Select Users and press **<Enter>**

Abme: USERS

Code	Name	Address	Phone	
1	D.C.C.			
2	Multinet Africa Ltd.			
3	Mazingira			
4	Allison's Traders			
5	T.C.C Ltd.			

< F5=New, F8=Delete, F7=Find, Esc=Quit >

A. Register new users

1. Press **<F5>**.
2. Enter the new code and then press **<Enter>**.
3. Then enter the name, address, phone etc.
4. To end press **<ESC>**.

B. Deleted

1. Press **<F8>**, and the users will be eliminated.

C. Modification

1. Go to the fields of users' data which have to be modify.
   a) *You can not modify the users code.*

D. To consult

1. You can consul users by pressing **<Up>**, **<Dn>**, **<Pgup>** **<Pgdn>**.
2. Press **<F7>**, to find by name.

VIII. Vehicles

- Select **<Abme>** from the main menu and then select **<User/Vehicle>** .
- Press **<Enter>**, and select Vehicle.

Abme: VEHICLES

Plate	Cod.	Users	Type	Make	Model
SM1235	1	D.C.C.			
SM1236	1	D.C.C.			
TZ1234	3	Mazingira			
TZ1235	4	Allison's Traders			
TZ1236	5	T.C.C Ltd.			

< F7=Find, Esc=Quit >

A. *Modifications*

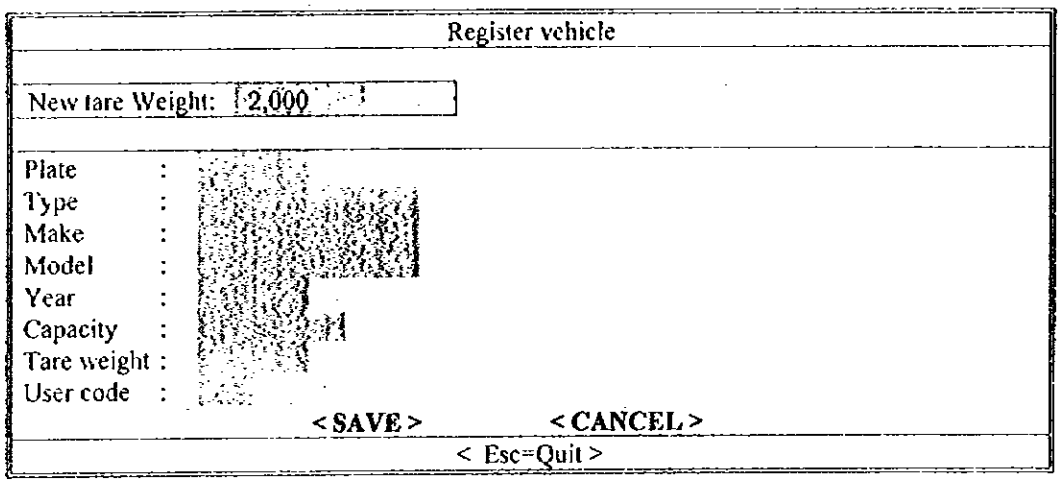
1. Go to the fields of vehicles' data which have to be modify.
   a) *You can not modify the no. plate.*

B. *To consult*

1. You can consult by pressing **<Up>**, **<Dn>**, **<Pgup>** **<Pgdn>**.
2. Press **<F7>**, to find by no. plate.

IX. Registration of vehicles

- If you know the tare weight of the new vehicle you can register within this program.
- The tare weight of the registered vehicle can be modify when there is change.
- Select **<Abme>** from the main menu and then select **<Register Vehicle>** and show up the next screen.



A. *To register new vehicle*

1. Weigh the truck without waste.
2. Enter weight of the vehicle and then press **<Enter>**.
3. Enter the no. plate and the system will confirm if the vehicle if new.
4. Enter the detail of the vehicle.
5. Select **<SAVE>**, and then press **<Enter>** to register the vehicle.
6. To cancel select **<CANCEL>**, and press **<Enter>**.

B. *To modify the tare weight of the registered vehicle.*

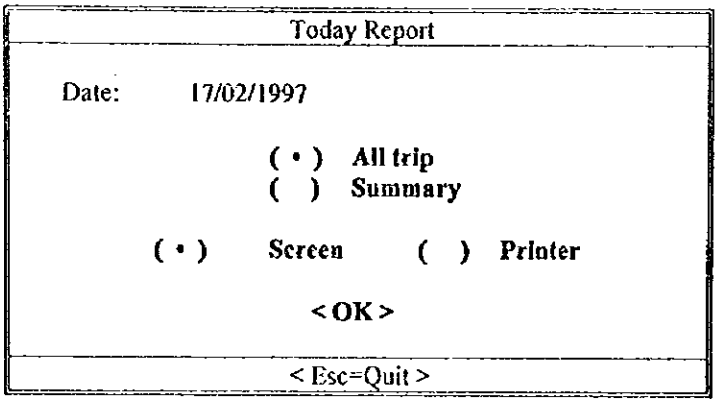
1. Weigh the vehicle without waste.
2. Enter the vehicle's weight and press **<Enter>**.
3. Enter the no. plate of the vehicle and the system show the data corresponding to the vehicle.
4. Select **<SAVE>**, and press **<Enter>** to modify the actual tare weight.
5. To cancel select **<CANCEL>**, and press **<Enter>**.

X. Daily data

- The system will registered daily movement in a database.
- At the end of every day the daily data will be copied to the historic database.

A. Today report

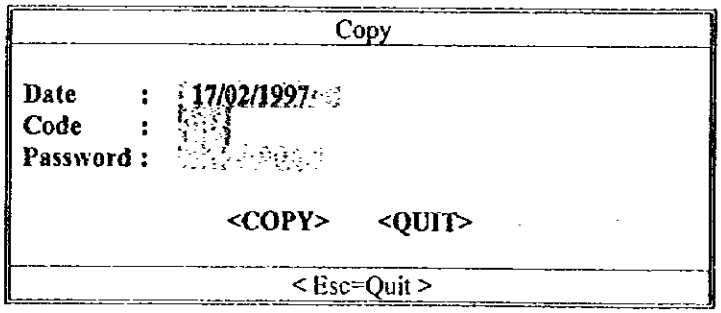
- To obtain today information, select **<Today>** from the main menu and then select **<Report>** and then show up the next screen.



1. Select the type of information you want by pressing **<Enter>**.
   a) All trip, is a detail information of every today registration.
   b) Summary
2. Select the dispositive where you want the information.
3. Select **<OK>**, and then press **<Enter>** to obtain the information.
4. To end press **<Esc>**.

B. To copy today data

- To copy all the daily data, select **<Today>** from the main menu and then select **<Copy>** and then show up the next screen.



1. Enter today date.
   a) You can not the today data when there is a vehicle without exit.
2. Enter the code of operator and then the password.
3. Select **<COPY>** and press **<Enter>** and confirm to copy.
4. Press **<Y>** or **<N>**.
5. To end select **<QUIT>**.

C. Modification of daily data

- You can modify the error of the daily data.
- Be careful when you modify the data.

- Select **<Today>** from the main menu and then select <Modify> and the show up the next screen.

Modify data

Date : 17/02/1997
Code :
Password :

<MODIFY>

Plate	User code	Date	Time	Gross	Tare	Net
SM1235	1	17/02/97	12:09:12	4,000	2,300	1,700

< Esc=Quit >

1. Enter today date.
2. Enter the operators' code and the password.
3. Will show all the data in the screen.
   a) You can modify: User code, date, Gross y tare.
4. Verify the modification.
5. To end press **<Esc>**.

XI. Report

- You can obtain daily, monthly and vehicle information.

A. Daily report

- Select **<Report>** from the main menu and then select **<Daily>** and then show up the next screen.

Daily Report

Date(dd/mm/aa): 17/02/1997

<SELECT>

(•) All trip
( ) Summary

(•) Screen ( ) Printer

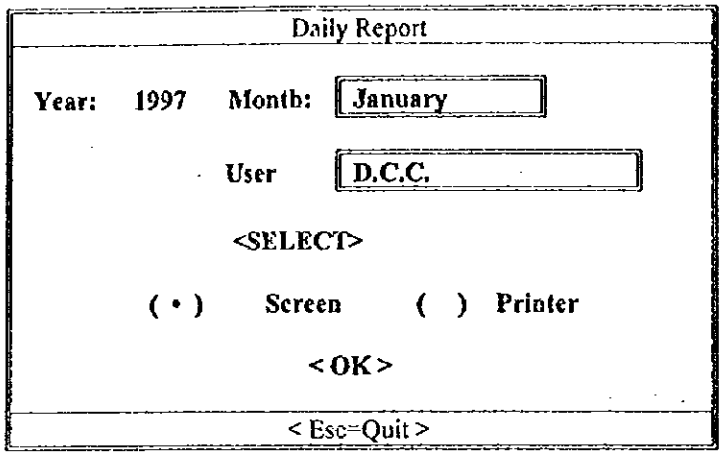
< OK >

< Esc=Quit >

1. Enter the date of the information and press **<Enter>**.
2. Select the type of information you want by pressing **<Enter>**.
   a) All trip, is a detail information of every today registration.
   b) Summary
3. Select the dispositive where you want the information.
4. Select **<OK>**, and then press **<Enter>** to obtain the information.
5. To end press **<Esc>**.Select **<SELECT>** and then press **<Enter>** to select data.

B. Monthly report

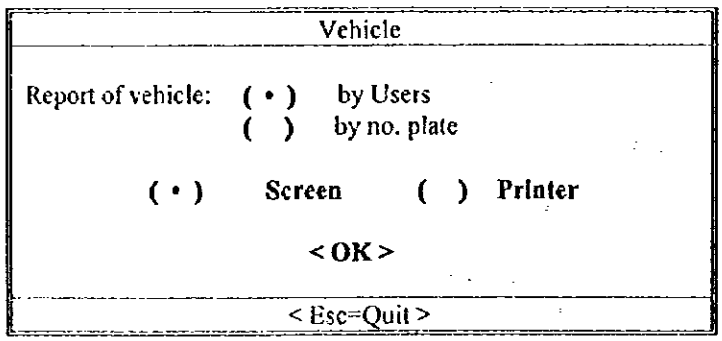
- Select **<Report>** from the main menu and then select **<Monthly>** and then show up the next screen.



1. Enter the year.
2. Select the month by pressing **<Enter>**.
3. Select the users by pressing **<Enter>**.
4. Select **<SELECT>** and press **<Enter>** to select date
5. Select the dispositive where you want the information.
6. Select **<OK>**, and then press **<Enter>** to obtain the information.
7. To end press **<Esc>**.

C. Vehicles report

- Select **<Report>** from the main menu and then select **<Vehicle>** and then show up the next screen.



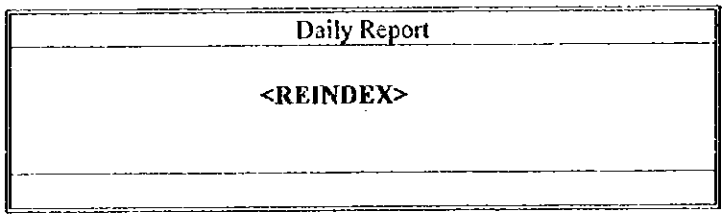
1. Select the type of information you want by pressing **<Enter>**.
2. Select the dispositive where you want the information.
3. Select **<OK>**, and then press **<Enter>** to obtain the information.
4. To end press **<Esc>**.

XII. Tools

- In this section you can Reindex databases and create databases to be used by other application

A. *Reindex*

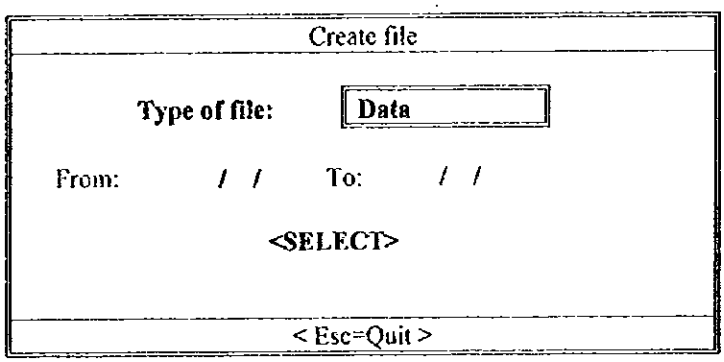
- Select **<Tools>** from the main menu and then select **<Reindex>** and then show up the next screen.



1. Select **<REINDEX>** and press **<Enter>** to reindex database.

B. *Create file*

- You can create database of the daily registration, vehicles and users.
- Select **<Tools>** from the main menu and then select **<Create file>** and then show up the next screen.



1. To create registered data file.
   a) Select **<Data>**, and then press **<Enter>**.
   b) Enter the initial date.
   c) Enter the final date.
   d) Select **<SELECT>** and press **<Enter>**.
   e) The system will create (.DBF) type file, with the name "DATA", in the directory C:\SYS\DARWB\FILE\.
   f) This file you can read with other applications(Excel) to analyze and create specific information.
   g) To end press **<Esc>**.

2. To create a vehicle file.
   a) Select **<Vehicle>**, and then press **<Enter>**.
   b) Select **<SELECT>** and press **<Enter>**.
   c) The system will create (.DBF) type file, with the name "VEHICLE", in the directory C:\SYS\DARWB\FILE\.
   d) This file you can read with other applications(Excel) to analyze and create specific information.
   e) To end press **<Esc>**.

3. To create a user file.
   a) Select **<User>**, and then press **<Enter>**.
   b) Select <SELECT> and press <Enter>.
   c) The system will create (.DBF) type file, with the name "USERS", in the directory C:\SYS\DARWB\FILE\.
   d) This file you can read with other applications(Excel) to analyze and create specific information.

XIII. QUIT

- To end the system select **<Quit>** and press **<Enter>**.

XIV. Installation

- To install the system follow this procedure:
  1. Create the follow directory
     a) C:\SYS\DARWB\DATA. and copy follow files.
        (1) DAY_DATA.DBF
        (2) DAY_DATA.CDX
        (3) HIS_DATA.DBF
        (4) HIS_DATA.CDX
        (5) OPERATOR.DBF
        (6) OPERATOR.CDX
        (7) OUT.DBF
        (8) OUT.CDX
        (9) USERS.DBF
        (10) USERS.CDX
        (11) VEHICLE.DBF
        (12) VEHICLE.CDX

     b) C:\SYS\DARWB\FILE.

     c) C:\SYS\DARWB\PRG, and copy follow files.
        (1) WB.EXE
  2.

Annex 16

Master Plan based on the Financial Case Studies for the Concession Type of Contract

16 Master Plan based on the Financial Case Studies for the Concession Type of Contract

16.1 Introduction

The master plan proposed in the interim report was formulated based on the strategy of using concessionaires for refuse collection services as much as possible.

The basic concept of the master plan was: the waste collection services in Area A will be provided by concessionaires; and the services in Area B will be provided by DCC.

This chapter includes the result of financial evaluation conducted for the five cases after cost estimation.

16.2 Conceptual Design and Cost Estimation

This section estimates costs required of the master plan. They are as follows.

1) Storage and discharge system
2) Primary collection System
3) Secondary collection and transportation system
4) Final disposal system
5) General expenses of DCC
6) Expenses for the monitoring agency
7) Subsidy for NGOs and CBOs

16.2.1 Design Conditions

a. The Period and Projects in the SWM Master Plan to be examined

The period and projects in the SWM Master Plan to be examined here is all projects which are planned to be implemented or operated from the year 2000 until 2005; in other word, all SWM projects after the existing disposal site is shifted.

b. Key Design Data

- ASG of waste when it is transported by refuse vehicles without compaction: 390 kg/m^3
- ASG of waste when it is transported by refuse vehicles with compaction: 585 kg/m^3
- ASG of waste when it is compacted at a disposal site: 900 kg/m^3
- Average waste transportation distance: 18 km
- Operation rate of refuse vehicle: 0.8
- Operation time of waste collection time: 7.5 hours/day
  6 days/week

c. Life Year

- Human handcart 3 years
- Skip containers: 7 years

- Tipper trucks, skip trucks and heavy equipment: 7 years
- Machinery: 15 years
- Building and Civil works: 30 years

d. Remained Life Year of Existing Equipment

The life years of most existing equipment which is being operated by DCC have been expired. It was therefore assumed that existing equipment would be operational until 2000.

e. Waste Collection Amount

Table 16-1 shows the waste collection amount per day based on 7 days collection per week.

Table 16-1: Waste Collection Amount per Day based on 7 days per Week

unit: tons/day

		Household	Commercial	Institution	Market	Street	Informal	Total
1996	DSM	185	20	8	27	1	55	297
	Area A	181	19	8	20	1	55	285
	Area B	4	1	-	7	0	-	12
1997	DSM	217	25	8	35	1	62	349
	Area A	198	25	8	26	1	61	319
	Area B	19	-	-	9	0	1	30
1998	DSM	280	31	9	42	2	73	437
	Area A	240	31	9	33	1	70	384
	Area B	40	-	-	9	0	3	53
1999	DSM	355	37	9	51	2	85	540
	Area A	291	37	9	39	2	81	459
	Area B	64	-	-	12	0	4	81
2000	DSM	492	61	14	70	4	105	747
	Area A	377	46	10	48	4	98	582
	Area B	115	16	4	23	0	8	165
2001	DSM	646	72	15	82	5	127	946
	Area A	474	54	11	56	4	116	716
	Area B	172	18	4	25	0	11	230
2002	DSM	817	82	17	93	5	151	1,164
	Area A	581	63	12	65	5	135	862
	Area B	235	19	5	28	0	15	302
2003	DSM	1,046	97	18	109	5	181	1,457
	Area A	728	75	14	77	5	160	1,058
	Area B	319	23	5	32	0	21	399
2004	DSM	1,303	113	20	124	6	214	1,780
	Area A	891	87	15	88	5	187	1,274
	Area B	412	26	5	36	0	27	505
2005	DSM	1,587	128	21	140	6	251	2,133
	Area A	1,073	99	16	100	6	217	1,511
	Area B	514	29	5	40	0	33	622

16.2.2 Storage and Discharge System

In Area A, plastic sacks which are given for items by a shop when shopping are proposed to be used for storage and discharge in the Master Plan. Hence, no cost for storage and discharge in Area A is involved.

In Area B, skip containers are used for communal containers. The number of required containers and the cost are estimated in the section of secondary collection and transportation because they are related to the required number of skip trucks.

16.2.3 Primary Collection System

a. Introduction

In the skip truck collection system, people carry and discharge waste in skip containers placed beside streets. People living near places of containers can easily carry waste to containers for discharging by themselves; however people living away from places of containers have some difficulties to do so. Therefore, the people living away from the places of containers require primary collection services which carry waste from people's home to containers. People who are willing to pay for the better services such as door-to-door collection will probably use primary collection service as well. Therefore, the cost of collection service is estimated.

The Master plan proposed that 1,572 containers will be placed in the area where waste is collected by skip truck system. The are covered by the skip truck system consists of approximately a half of Area A and whole of Area B. Supposing 1,572 containers are distributed and placed evenly in this area, the density of containers was estimated in about 10 containers per square kilometre, as calculated as follows.

$$D = \frac{1{,}572 \times 0.9}{93.2 + 2 + 94.7} = 10.0 \; nos \; per \; squ. \; km$$

Therefore, the waste catchment area per container was estimated as 0.1 km^2.

Assuming the shape of waste catchment area of a container is circle, its radius will be 178 metres. In other word, the direct distance which people have to carry waste for longest distance is 178 metres and this can be walked in 3 minutes and 34 seconds. This distance is likely to be accepted by most people for co-operating to carry waste to containers.

However, this will not happen actually. In DSM the sites for containers will be restricted by the accessibility of the road, and therefore the distance of the primary collection and transportation will be much longer than that.

b. Basic Assumptions

b.1 Productivity per Day

Since the average transportation distance of primary collection is too difficult to be determined, the conditions were assumed as follows.

$$Tr = \frac{60 \times t1 - t2 \times E}{D \div V + t3 + t4}$$

Tr: Number of trips per day (trips)
D: Travel distance per trip (m): 1000m
V: Velocity of a vehicle (km/h): 30m/min
t1: Working hours per day (hours): 7.5 hours
t2: Time of daily meeting, etc. (min): 30 min

t3: Time of loading waste (min): 4 min x 12 = 42 min.
t4: Time of unloading waste (min): 10 min
E: Work efficiency: 0.8

Hence, the number of trip per day is 3.6 trips. Say it 3 trips.

$$Qd = 10.5kg \times 12\,homes \times 3trips = 378kg / d$$

b.2 Number of Users

Taking the condition described in the introduction in this section, it is assumed that 25 % of dischargers will use primary collection.

c. Cost Estimation

Table 16-2: Cost Estimation for Primary Collection

Items	Unit	1999	2000	2001	2002	2003	2004	2005
1.Waste collection amount								
Collected by skip trucks	t/d	81	165.0	230.0	302.0	399.0	505.0	622.0
Collected by primary collection(25%)	t/d		41.3	57.5	75.5	99.8	126.3	155.5
Collected by primary by 6 days/week	t/d		48.1	67.1	88.1	116.4	147.3	181.4
2.Investment								
Required number of push cart	units		127	177	233	308	390	480
Procurement schedule	units	127	50	56	202	132	146	246
Purchase push cart	M.Tsh	23	9	10	36	24	26	44
Unit investment cost	Tsh/ton		600	476	1,320	652	570	781
3.O & M Cost								
Worker	M.Tsh/y		79	111	145	192	243	299
Repair, maintenance, etc.	M.Tsh/y		5	6	8	11	14	17
Total O & M	M.Tsh/y		84	117	154	203	257	317
Unit O & M cost	Tsh/ton		5,581	5,581	5,581	5,581	5,581	5,581
4.Total Unit Cost	Tsh/ton		6,181	6,057	6,901	6,233	6,151	6,362

Table 16-2 shows that the approximate unit cost of primary collection is about 7,000 Tsh per ton of waste.

16.2.4 Collection and Transportation System

a. Productivity of Refuse Collection Vehicles

This section compares six different refuse collection trucks in terms of unit collection cost.

a.1 Equation for Productivity Calculation

The following equations were adopted for computing their productivity.

$$Tr = \frac{60 \times t1 - t2 \times E}{D \div V + t3 + t4}$$

Tr: Number of trips per day (trips)
D: Travel distance per trip (km)
V: Velocity of a vehicle (km/h)
t1: Working hours per day (hours)
t2: Time of daily service for inspection and fuelling, etc. (min)

t3: Time of loading waste (min)
t4: Time of unloading waste (min)
E: Work efficiency

$$Qd = q \times d \times f \times Tr$$

q: Volume capacity of a skip container or a tipping truck (m^3)
d: Density of waste when it is being transported (ton/m^3)
f: Wok efficiency

a.2 Proposed Collection System

The proposed collection systems are as follows.

- Area A: Curb collection by 6 ton tipper trucks
- Area B: Container collection by skip trucks

This factor was taken into account in the time of loading waste.

a.3 Productivity Determination

Table 16-3: Productivity Determination

Items	unit	Skip truck			Tipper truck			Compactor
Capacity in weight	t	4	8	10	4	6	8	4
Capacity in volume	m^3	5	8	12	6	10	15	8
One trip distance	km	36	36	36	36	36	36	36
Velocity of vehicle	km/h	40	40	40	40	40	40	40
Density of waste when transported	t/m^3	0.39	0.39	0.39	0.39	0.39	0.39	0.585
t1:Working hour	h	7.5	7.5	7.5	7.5	7.5	7.5	7.5
t2:Daily service time	min	30	30	30	30	30	30	30
t3:Loading time per trip	min	5	5	5	66	110	165	64
t4:Unloading time	min	5	5	5	10	10	10	10
E:Working efficiency of transport		0.8	0.8	0.8	0.8	0.8	0.8	0.8
f:Work efficiency of transportation		0.8	0.8	0.8	0.8	0.8	0.8	0.8
Nos of trips per day	times	5.25	5.25	5.25	2.58	1.93	1.47	2.63
Waste carried per day	t/d	8.19	13.10	19.66	4.84	6.02	6.87	9.83

b. Cost Estimation

b.1 Area A

Table 16-4: Estimation of Waste Collection for Area A

	Item	unit	1999	2000	2001	2002	2003	2004	2005
1	Collection amount per day (7days/week)	t/d		582	716	862	1,058	1,274	1,511
	Tipper truck, 6 ton	t/d		582	716	862	1,008	1,219	1,451
	Compactor truck	t/d		-	-	-	50.0	55.0	60.0
	Total	t/d		582	716	862	1,058	1,274	1,511
2	Tipper Truck Collection								
	Collection per day (7d/week)	t/d		582.0	716.0	862.0	1,008.0	1,219.0	1,451.0
	Collection per day (6d/week)	t/d		679.0	835.3	1,005.7	1,176.0	1,422.2	1,692.8
2.1	Investment								
	Required number of truck	units		112.8	138.8	167.1	195.3	236.2	281.2
	Procurement Schedule	units	113	26	28	28	41	45	46
	Investment Schedule		6,870	1,581	1,702	1,702	2,493	2,736	2,797
2.2	O & M Cost								
	Required Quantity								
	Labour, one driver	per/d		113	139	167	195	236	281
	Labour, six collectors	per/d		565	695	835	975	1,180	1,405
	Diesel	l/d		3,277	4,031	4,843	5,655	6,844	8,149
	Cost								
	Labour, driver	M.Tsh/y		81	100	120	140	170	202
	Labour, collectors	M.Tsh/y		271	334	401	468	566	674
	Diesel	M.Tsh/y		282	347	417	487	589	701
	Lubricant	M.Tsh/y		28	35	42	49	59	70
	Maintenance and repair	M.Tsh/y		840	1,033	1,244	1,455	1,760	2,094
	Total	M.Tsh/y		1,503	1,849	2,224	2,599	3,144	3,742
3	Compactor Truck Collection								
	Collection per day (7d/week)	t/d	-	-	-	-	50.0	55.0	60.0
	Collection per day (6d/week)	t/d	-	-	-	-	58.3	64.2	70.0
3.1	Investment								
	Required number of truck	units	-	-	-	-	5.9	6.5	7.1
	Procurement Schedule	units				6.0	1.0	-	1.0
	Investment Schedule	th USD	-	-	-	485	81	-	81
3.2	O & M Cost								
	Required Quantity								
	Labour, driver	per/d	-	-	-	-	6	7	7
	Labour, collectors	per/d	-	-	-	-	18	21	21
	Diesel	l/d	-	-	-	-	174	203	203
	Cost								
	Labour, driver	M.Tsh/y	-	-	-	-	4	5	5
	Labour, collectors	M.Tsh/y	-	-	-	-	9	10	10
	Diesel	M.Tsh/y	-	-	-	-	15	17	17
	Lubricant	M.Tsh/y	-	-	-	-	1	2	2
	Maintenance and repair	M.Tsh/y	-	-	-	-	74	81	88
	Total	M.Tsh/y	-	-	-	-	103	115	123
4	Summary for Area A								
4.1	Investment								
	Tipper truck	th USD	6,870	1,581	1,702	1,702	2,493	2,736	2,797
	Compactor truck	th USD	-	-	-	485	81	-	81
	Total	th USD	6,870	1,581	1,702	2,188	2,574	2,736	2,878
4.2	O & M								
	Tipper truck collection	M.Tsh/y	1,184	1,503	1,849	2,224	2,599	3,144	3,742
	Compactor truck collection	M.Tsh/y	-	-	-	-	103	115	123
	Total	M.Tsh/y	1,184	1,503	1,849	2,224	2,701	3,259	3,865

b.2 Area B

Table 16-5: Estimation of Waste Collection for Area B

	Item	unit	1999	2000	2001	2002	2003	2004	2005
1.	Collection amount per day (7days/week)	t/d	81	165	230	302	399	505	622
	Skip 8ton	t/d	-	165.0	230.0	302.0	399.0	505.0	622.0
2.	Skip Truck Collection								
	Collection per day (7d/week)	t/d	-	165.0	230.0	302.0	399.0	505.0	622.0
	Collection per day (6d/week)	t/d	-	192.5	268.3	352.3	465.5	589.2	725.7
2.1	Investment								
	Required number of truck	units	-	14.7	20.5	26.9	35.5	45.0	55.4
	Procurement Schedule								
	Skip truck	units	15	5	7	9	9	10	5
	Container, 8m^3	nos	150	50	70	90	90	100	50
	Investment Schedule								
	Skip truck	th USD	1,283	428	599	770	770	855	428
	Container, 8m^3	th USD	1,095	365	511	657	657	730	365
	Total		2,378	793	1,110	1,427	1,427	1,585	793
2.2	O & M Cost								
	Required Quantity								
	Labour, driver	per/d	-	15	20	27	36	45	55
	Labour, collectors	per/d	-	-	-	-	-	-	-
	Diesel	l/d	-	735	980	1,323	1,764	2,205	2,695
	Cost								
	Labour, driver	M.Tsh/y	-	11	14	19	26	32	40
	Labour, collectors	M.Tsh/y	-	-	-	-	-	-	-
	Diesel	M.Tsh/y	-	63	84	114	152	190	232
	Lubricant	M.Tsh/y	-	6	8	11	15	19	23
	Maintenance and repair	M.Tsh/y	-	154	215	282	372	471	580
	Total	M.Tsh/y	-	234	322	426	565	712	875
3.	Summary for Area B								
3.1	Investment								
	Skip truck	th USD	1,283	428	599	770	770	855	428
	Container	th USD	1,095	365	511	657	657	730	365
	Total	th USD	2,378	793	1,110	1,427	1,427	1,585	793
3.2	O & M								
	Skip truck collection	M.Tsh/y	-	234	322	426	565	712	875
	Total	M.Tsh/y	-	234	322	426	565	712	875

c. Summary of Cost Estimation

Table 16-6: Summary of Investment Schedule

Description		Vehicle	unit	1999	2000	2001	2002	2003	2004	2005
Schedule	A	Tipper truck	units	113	26	28	28	41	45	46
		Compactor truck	units				6	1		1
	B	Skip truck	units	15	5	7	9	9	10	5
		Skip container	units	150	50	70	90	90	100	50
Investment Schedule	A	Tipper truck	1000 USD	6,870	1,581	1,702	1,702	2,493	2,736	2,797
		Compactor truck	1000 USD				485	81		81
		Sub-total	1000 USD	6,870	1,581	1,702	2,188	2,574	2,736	2,878
	B	Skip truck	1000 USD	1,283	428	599	770	770	855	428
		Skip container	1000 USD	1,095	365	511	657	657	730	365
		Sub-total	1000 USD	2,378	793	1,110	1,427	1,427	1,585	793
	Total		1000 USD	9,428	2,374	2,812	3,615	4,001	4,321	7,342

Table 16-7: Summary of O & M Schedule for Refuse Collection

Area	unit	1999	2000	2001	2002	2003	2004	2005
Area A	M.Tsh/y		1,503	1,849	2,224	2,701	3,259	3,865
Area B	M.Tsh/y	-	234	322	426	565	712	875
Total	M.Tsh/y	-	234	322	426	565	712	875

16.2.5 Final Disposal System

a. Master Plan of Final Disposal System

A sanitary landfill is the essential element for modern solid waste management because a considerable quantity of waste has to be disposed of even if efforts are provided to reuse, recycling or utilise (incineration, composting) waste. As a first step towards modern solid waste management, DCC is recommended to strengthen the landfill activity to minimise environmental impacts. Having the requirements for the sanitary landfill clarified and proper design and operation implemented, it is possible to draw the attention to other treatment method.

The Master Plan of final disposal system is summarised as follows.

- Until the end of 1999, the existing Vingunguti disposal site will be operated.
- At the beginning of 2000, the new disposal site to be constructed in Kunduchi New MECCO quarry will commence its operation. It will receive all wastes collected from DSM from 2000 until 2002.
- At the beginning of 2003, the two disposal sites for Ilala and Temeke districts will commence its operation and each site of the three will receive all wastes collected from its district.
- The sanitary operational level of new disposal sites will be designed and operated in accordance with the requirement of the 3rd sanitary level which consists an elementary leachate treatment system.

b. Conditions for Cost Estimation

This section presents the conceptual layouts and cost estimates for landfills in accordance with the concept of the alternative plans.

b.1 Commencement of operation of disposal sites

- Kinondoni district: after 2000
- Ilala district: after 2003
- Temeke district: after 2003

b.2 Sanitary level of proposed disposal operation

Level 3, sanitary landfill with elementary leachate treatment.

b.3 The ratio of coverage soil volume

The ratio of coverage soil volume to the waste volume was set up 12 %.

b.4 Required Capacity of Disposal Sites

Based on the waste disposal amount forecast, the volume of waste received for each disposal site was estimated as follows.

Table 16-8: Yearly Waste Amount Received at Disposal Sites (1)

Year	Collection				Disposal				
Site	Kunduchi	Ilala	Temeke	Total	Vingunguti	Kunduchi	Ilala	Temeke	Total
unit	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y	t/y
1996	24,090	69,350	14,600	108,040	108,040	-	-	-	108,040
1997	32,120	75,920	19,345	127,385	127,385	-	-	-	127,385
1998	43,070	90,155	26,280	159,505	159,505	-	-	-	159,505
1999	55,845	106,945	34,310	197,100	197,100	-	-	-	197,100
2000	82,125	137,970	52,560	272,655	-	272,655	-	-	272,655
2001	106,215	169,360	69,715	345,290	-	345,290	-	-	345,290
2002	132,495	204,035	88,330	424,860	-	424,860	-	-	424,860
2003	163,885	255,135	112,785	531,805	-	163,885	255,135	112,785	531,805
2004	198,195	311,710	139,795	649,700	-	198,195	311,710	139,795	649,700
2005	234,330	374,490	169,360	778,180	-	234,330	374,490	169,360	778,180

Table 16-9: Yearly Waste Volume Received at Disposal Sites (2)

Year	Disposal				
Site	Vingunguti	Kunduchi	Ilala	Temeke	Total
unit	m3/y	m3/y	m3/y	m3/y	m3/y
1996	120,044	-	-	-	120,044
1997	141,539	-	-	-	141,539
1998	177,228	-	-	-	177,228
1999	219,000	-	-	-	219,000
2000	-	302,950	-	-	302,950
2001	-	383,656	-	-	383,656
2002	-	472,067	-	-	472,067
2003	-	182,094	283,483	125,317	590,894
2004	-	220,217	346,344	155,328	721,889
2005	-	260,367	416,100	188,178	864,644

Table 16-10: Accumulated Waste Volume at Disposal Sites

Year	Accumulated Disposal Amount				
Site	Vingunguti	Kunduchi	Ilala	Temeke	Total
unit	m3	m3	m3	m3	m3
1996	120,044	-	-	-	120,044
1997	261,583	-	-	-	261,583
1998	438,811	-	-	-	438,811
1999	657,811	-	-	-	657,811
2000	657,811	302,950	-	-	960,761
2001	657,811	686,606	-	-	1,344,417
2002	657,811	1,158,672	-	-	1,816,483
2003	657,811	1,340,767	283,483	125,317	2,407,378
2004	657,811	1,560,983	629,828	280,644	3,129,267
2005	657,811	1,821,350	1,045,928	468,822	3,993,911
2006		2,003,485	1,150,521	515,704	4,393,302
2007		2,203,834	1,265,573	567,275	4,832,632
2008		2,424,217	1,392,130	624,002	5,315,896
2009		2,666,639	1,531,343	686,403	5,847,485
2010		2,933,302	1,684,477	755,043	6,432,234
2011		3,226,633	1,852,925	830,547	7,075,457
2012		3,549,296	2,038,217	913,602	7,783,003

The capacities of proposed disposal sites were therefore set up as shown in Table 16-11.

Table 16-11: Proposed Capacities of Disposal Sites

District	Capacity (million m^3)	Reserve for Waste (million m^3)	Volume for Coverage Soil (million m^3)	Life years (years)	Operation Period
Kinondoni	3	2.64	0.36	9	2000 - 2008
Ilala	2	1.76	0.24	8	2003 - 2010
Temeke	1	0.88	0.12	8	2003 - 2010

c. Cost Estimate

c.1 Investment

c.1.1 Construction of Disposal Site

The estimation for the initial investment cost for the disposal site is presented in Table 16-12.

Table 16-12: Estimation of Initial Investment for Disposal site for 2.64 million tons of Waste

	Description	Unit	Unit Rate (1000 Tsh)	Quantity	Amount (1000 Tsh)
1	*Earthwork*				
1.1	Site clearing	m	700	250,000	175,000
1.2	Enclosing bund	m	150,000	1,860	279,000
1.3	Divider	m	17,000	3,535	60,095
2	Drainage				-
2.1	Side drain	m	13,000	3,000	39,000
2.2	On-site surface drain	m	1,875	4,000	7,500
2.3	On-site culvert drain	m	60	44,000	2,640
3	*Access*				-
3.1	Tarmaced access road	m	86,100	500	43,050
3.2	Gravel access road (W=6M)	m	28,800	1,200	34,560
3.3	Subgrade work	m	12,500	1,700	21,250
4	*Environmental protection facilities*				-
4	Buffer zone (w=10m)	m	20,000	100	2,000
4.2	Litter prevention	L.S.	1,500,000	1	1,500
4.3	Gas removal	nos	360,000	86	30,960
4.4	Leachate collection	m	30,000	8,000	240,000
4.5	Elementary leachate treatment plant	L.S.	120,000,000	1	120,000
4.6	Impermeable bottom clay	m2	2,700	200,000	540,000
4.7	Sand layer	m2	1,700	200,000	340,000
5	*Building and accessories*				-
5.1	Site office	m2	500,000	150	75,000
5.2	Weigh bridge	L.S.	60,000,000	1	60,000
5.3	Storage	m2	300,000	100	30,000
5.4	Fence	m2	5,000	20,000	100,000
5.5	Gate	nos	1,000,000	2	2,000
5.6	Monitoring facilities	nos	6,000,000	4	24,000
5.7	Car wash	L.S.	8,000,000	1	8,000
5.8	Well	L.S.	10,000,000	1	10,000
	Total Direct Cost				*2,245,555*
	General Expenses and Overhead		25%		561,389
	Total Construction Cost				*2,806,944*
	Design and Supervision		10%		280,694
	Total Project Cost				*3,087,638*
	Unit Investment Cost (Tsh per ton)				*1,170*

Hence, the initial investment for the disposal site was estimated in 1,170 Tshs per ton of waste.

Based on this unit initial investment, the initial investment of disposal sites are estimated as follows.

Table 16-13: Estimated Investment for Disposal Sites

Disposal Site for	Capacity for Waste Received		Investment
	million m^3	million tons	million Tsh
Kinondoni:	2.64	2.376	3,088
Ilala	1.76	1.584	2,059
Temeke	0.88	0.792	1,030

c.1.2 Investment for Equipment for Disposal Operation

Work capacity of bulldozer and tipper truck are calculated below.

Bulldozer, 210 Hp class

Bulldozer will work for pushing, spreading, levelling and compacting wastes at disposal sites. Its productivity is estimated below.

Probable cycle time (Cm)

Pushing: 15 m @ 60 m/min	= 0.250 min
Returning: 15 m @ 80 m/min	= 0.188 min
Fixed time, loading and shifting gears	= 0.320 min
Total cycle time	= 0.785 min

Output

$$Qh = \frac{60 \times q \times f \times E}{Cm}$$

Qh: Output per hour	(m^3/h)
q: Output per pushing	(m^3/h)
f: Conversion factor of waste	1.0
E: Operation efficiency	0.5

Hence, Qh is 133.6 m^3/h.

Qd = 133.6 m^3/h x 7 h/d = 935 m^3/d

= 935 m^3/d x 0.39 tons/m^3 = 365 tons/d

Tipper truck, 8 tons

A main task for tipper trucks at disposal sites is to carry soil for covering wastes from outside to disposal sites. Its productivity is estimated below.

Probable cycle time (Cmt)

Carrying: 1 km @ 15 km/60 min	= 4.0 min
Returning: 1 km @ 20 km/60 min	= 3.0 min
Loading:	= 5.0 min
Dumping:	= 1.0 min
Total	= 13.0 min

Output

$$Qh = \frac{60 \times C \times f \times Et}{Cmt}$$

Qh: Output per hour	(m^3/h)
C: Output per trip	(m^3/h)
f: Conversion factor of waste	1.0
E: Operation efficiency	0.5

Hence, Qh is 40 tons per hour.

Qd = 40 tons/h x 7 h/d = 280 tons/d

Based on the estimated productivity of equipment in principle, the required number of equipment were estimated as shown in Table 16-14.

Table 16-14: Required Number and Procurement Schedule of Disposal Equipment

Disposal Site	Equipment	1999	2000	2001	2002	2003	2004	2005
Vingunguti	Bulldozer	2						
Kinondoni	Bulldozer		3	3	3	2	2	2
	Tipper truck		3	3	3	2	2	2
	Excavator		1	1	1	1	1	1
	Pickup		1	1	1	1	1	1
Ilala	Bulldozer					2	3	3
	Tipper truck					2	2	2
	Excavator					1	1	1
	Pickup					1	1	1
Temeke	Bulldozer					1	2	2
	Tipper truck					2	2	2
	Excavator					1	1	1
	Pickup					1	1	1
Total	Bulldozer	2	3	3	3	5	7	7
	Tipper truck		3	3	3	6	6	6
	Excavator		1	1	1	3	3	3
	Pickup		1	1	1	3	3	3
Procurement Schedule	Bulldozer	3			2	2		
	Tipper truck	3			3			
	Excavator	1			2			
	Pickup	1			2			

c.2 Interim Investment

Sanitary landfill operation requires some construction works intermittently, for example extension of gas removal, extension of leachate collection, provision of impermeable clay layer for slope, etc. These costs are regarded as a part of operation and maintenance cost since its characteristic is similar to them.

c.3 Operation and Maintenance Cost

The required number of equipment and staff were summarised in Table 16-15.

Table 16-15: Required Number of Equipment and Staff

	Year	2000	2001	2002	2003	2004	2005
Equipment	Bulldozer	3	3	3	5	7	7
	Excavator	1	1	1	3	3	3
	Tipper truck	3	3	3	6	6	6
	Pickup	1	1	1	3	3	3
Labour	Landfill manager	1	1	1	3	3	3
	Foreman	2	2	2	5	5	5
	Operator	8	8	8	17	19	19
	Weighbridge staff	6	6	6	18	18	18
	Mechanic	1	1	1	3	3	3
	General worker	10	10	10	19	19	19
	Watchmen	6	6	6	18	18	18
Material	Diesel	640	640	640	1,272	1,560	1,560
Others	Leachate and gas removal	1	1	1	3	3	3

Table 16-16: O & M Cost Schedule

unit: 1000 USD

	Year	unit	2000	2001	2002	2003	2004	2005
Waste Amount Disposed		ton/year	272,655	345,290	424,860	531,805	649,700	778,180
Equipment	Bulldozer 210 HP	thou USD	105	105	105	175	245	245
	Excavator 0.7m3	thou USD	31	31	31	92	92	92
	Tipper truck 8 ton	thou USD	36	36	36	73	73	73
	Pickup	thou USD	3	3	3	8	8	8
	Sub-total	thou USD	175	175	175	348	418	418
Labour	Landfill manager	mill Tsh	1	1	1	4	4	4
	Foreman	mill Tsh	1	1	1	4	4	4
	Operator	mill Tsh	6	6	6	12	14	14
	Weighbridge staff	mill Tsh	3	3	3	9	9	9
	Mechanic	mill Tsh	1	1	1	2	2	2
	General worker	mill Tsh	5	5	5	9	9	9
	Watchmen	mill Tsh	3	3	3	9	9	9
Material	Diesel	mill Tsh	55	55	55	109	134	134
	Lubricant oil	mill Tsh	6	6	6	11	13	13
Others	Leachate and Gas Removal, etc.	mill Tsh	27	35	42	53	65	78
Total		mill Tsh	457	465	473	918	1,099	1,112
		thou USD	175	175	175	348	418	418
Total O & M Cost		mill Tsh	565	572	580	1,131	1,355	1,368
Unit Cost		Tsh/ton	2,070	1,656	1,365	2,127	2,086	1,758

c4. Schedule of Investment and O & M for disposal

The investment and O & M costs to be required for disposal by the master plan were summarised in Table 16-17.

Table 16-17: Expenditure Schedule

unit: million Tsh

	1999	2000	2001	2002	2003	2004	2005
Investment							
Equipment	1,060			959	350		
Landfill for Kinondoni	3,088						
Landfill for Ilala				2,059			
Landfill for Temeke				1,030			
Sub-total	4,449			4,274	502		
O & M		565	572	580	1,131	1,355	1,368
Total Expenditure	8,597	565	572	8,902	1,983	1,355	1,368

d. Unit Disposal Cost

The following two kinds of unit disposal cost are determined.

- Case 1: All costs are included.
- Case 2: Investment for construction of landfill and equipment for landfill operation are granted.

Table 16-18: Unit Disposal Costs

Item	Unit	Case 1	Case 2
Investment for construction	Tsh/ton	1,170	0
Investment for equipment	Tsh/ton	422	0
Average O & M cost	Tsh/ton	1.855	1,855
Overhead for DCC	Tsh/ton	172	93
Unit disposal cost	**Tsh/ton**	**3,620**	**1,948**

16.2.6 Maintenance of Vehicles and Equipment

The improvement of the existing Mwananyamala workshop is included in the Master plan. The design conditions were summarised as follows.

Design Conditions

- Location: DCC Mwananyamala depot, Kinondoni
- Area of Premises: 10,200 m^2
- Function of the workshop: Preventive services
- Number of refuse collection vehicles to be services: 160 units of 6-8 tons class vehicles

Cost Estimation

- Building Work: 600,000 USD
- Maintenance machinery: 200,000 USD
- Total 800,000 USD

16.3 Financial Evaluation

16.3.1 Objectives and Methods of Financial Evaluation

a. Objectives

This evaluation process will be carried out mainly to assess the financial benefits of the master plan based on estimated revenues and expenditures. The financial evaluation for area A, where waste disposal services will be provided by concession by tendering, will be separately conducted from the evaluation for area B, where services will be provided by DCC with the cooperation of the recipient local communities. There are currently 39

wards in the study area, as shown in Figure A-1, and the basic features of area A and B are illustrated in Figure A-2.

In area A, financial evaluation will be conducted to identify the commercial viability of the concessionaires. Although several concessionaires might be contracted for the services, the evaluation was made assuming that DCC will only grant the services to one enterprise. On the other hand, financial evaluation for area B will be conducted to identify the economic viability of DCC.

b. Methods

b.1 FIRR

The financial viability of the master plan shall be determined using the financial internal rate of return (FIRR) as a parameter. Table 7-21 shows the 5 cost assumption case studies for FIRR conducted for area A and B.

Table 16-19: Five Cases for Financial Analysis

Area		Area A		Area B		
Case		A-1	A-2	B-1	B-2	B-3
Final Disposal	All costs included	X		X		
	All investment costs granted		X		X	X
Collection & Transport	All costs included	X	X	X	X	
	First 3-year investment cost granted					X

b.2 Sensitivity Analysis

Sensitivity analysis was performed on the three risk cases assumed from the above 5 case studies (base case).

Table 16-20: Sensitivity Analysis for Area A

Risk	Tariff = Tsh. 1400	Tariff = Tsh. 1200
RCC Collection Rate = 80%	Base Case	Risk 1
RCC Collection Rate = 60%	Risk 2	Risk 3

Table 16-21: Sensitivity Analysis for Area B

Risk	Tariff = Tsh. 1100	Tariff = Tsh. 900
RCC Collection Rate = 60%	Base Case	Risk 1
RCC Collection Rate = 40%	Risk 2	Risk 3

The FIRR of the following 20 cases will be financially evaluated.

A-1 (Base Case)	A-2 (Base Case)	B-1 (Base Case)	B-2 (Base Case)	B-3 (Base Case)
(Risk 1)	(Risk 1)	(Risk 1)	(Risk 1)	(Risk 1)
(Risk 2)	(Risk 2)	(Risk 2)	(Risk 2)	(Risk 2)
(Risk 3)	(Risk 3)	(Risk 3)	(Risk 3)	(Risk 3)

c. Financial Planning

It is necessary to create a balance between the revenues and expenditures to make SWM in area A and B financially sustainable. Accordingly, the financial plan should be designed based on this premise. A financial planning table shall be made to illustrate the calculation of the cash balance from the following costs and revenues.

c.1 Cost

This category covers the following investment cost and operation and maintenance cost in Phase I and Phase II.

Table 16-22: Summary of Project Costs

Unit: million Tsh.

Project Component	Area	Phase I 1999-2001	Phase II 2002-2005
Collection and Transport Improvement	Area A	6,219	4,592
	Area B	2,663	2,805
Final Disposal Site Construction	Kinondoni	4,449	0
	Ilala	0	3,184
	Temeke	0	1,592
Maintenance Shop		442	0
Total		13,773	12,173

Table 16-23: Components of Project Costs

Unit: million Tsh.

Area	Cost Item	Phase I 1999-2001	Phase II 2002-2005
Area A	Labour	1,064	2,784
	Fuel	936	2,468
	Repair	2,536	6,796
Area B	Labour (Primary + Secondary)	215	996
	Fuel (Primary + Secondary)	161	756
	Repair (Primary + Secondary)	380	1,755
	Repair Shop	64	128

c.2 Revenue

As will be discussed later, SWM revenues will be primarily derived from RCC for household, commercial, institutional and market wastes. RCC will not be imposed on wastes generated from the informal sector and from road sweeping services.

16.3.2 Parameters for financial evaluation

The following parameters are employed as major variables in financial evaluation.

a. Prices and Exchange Rate

All prices relevant to the financial evaluation will be converted to Tsh., and the rate of Tsh. to the USD, in case the foreign portion for the expenses of the master plan is to be converted, will be set at Tsh. 612.5 = USD 1, which is the mean rate adopted by commercial banks as of the 31st of July, 1996.

b. Project Life Span

The master plan will start in 1999 upon the delivery of the first required number of vehicles procured and will end in 2005 when these vehicles lose their residual values. Accordingly, the project life of the master plan to be used in the financial evaluation shall be 7 years (1999 to 2005).

c. Waste Amount and Waste Collection Rate

The estimated waste generation amount, waste collection amount, and waste collection rate for area A are respectively shown in Tables A-1, A-2 and A-3. Those for area B are respectively shown in Tables A-4, A-5 and A-6. The tables suggest that the waste collection rate in area A in 1999 is estimated at 33.2% and 70.8 % in 2005. In area B, the rate is estimated at 7.6 % in 1999 and 41.0 % in 2005.

d. Tariff Setting

The amount of tariff to be imposed shall be determined based on the residents' willingness to pay and the marginal collection costs in each area. According to the results of the POS, areas A and B are respectively willing to pay Tsh. 1,445.6 and Tsh. 1,016.1/month/household for waste disposal services. Meanwhile, the unit marginal costs of the waste disposal services/month/household in areas A and B are estimated at Tsh. 980.0 and Tsh. 781.8, respectively. Figure A-3 and Figure A-4 illustrate the statistical distribution of the residents' willingness to pay and the marginal cost which is based on the operation and maintenance cost.

The figure indicates that, for area A, the tariff setting zone, which is supposed to be in the duplicate zone of both the willingness to pay and the marginal cost based on the operation and maintenance cost, should range from a minimum of Tsh. 1,057.6/month/household to a maximum of Tsh. 1,368.0/month/household, while for area B, it should range from a minimum of Tsh. 625.6/month/household and Tsh. 1,172.3/month/household. On the other hand, Figure A-5 and Figure A-6 illustrate the statistical distribution of the willingness to pay and the marginal cost based on the total cost, indicating that area A and area B are respectively willing to pay Tsh. 1,368.0 and Tsh. 1,290.4/household for waste disposal services. Taking the above factors into account, the level of the proposed tariff for the household waste is fixed at Tsh. 1,400/month/household for area A, and Tsh. 1100/month/household for area B.

The tariff to be imposed on area A for commercial, institutional, and market wastes, is estimated to be twice as much as the tariff for household waste. In area B, the tariff is estimated to be 1.5 times as much as the tariff for household waste. The tariffs for household, commercial, institutional and market wastes are shown in Table A-10, Table A-11, Table A-12 and Table A-13, and summarised below.

Table 16-24: Tariff Used for Financial Analysis

Category	Area A	Area B
Household Wastes (Tsh/month/household)	1,400	1,100
Commercial, Institutional, Market (Tsh/ton)	36,000	24,000
Informal and Road Sweeping (Tsh/ton)	Nil.	Nil.

e. RCC Collection Rate

The RCC (Refuse Collection Charge) collection rate is one of the most important parameters for FIRR. Taking into account the degree of willingness to pay in each area, the rate is fixed at 80 % for area A and 60 % for area B, respectively.

f. Scrap Value

The vehicles procured after 1999 will have some residual value in the completion of the project in the year 2005. The scrap value of these vehicles will be accordingly included as revenues in 2006.

g. Indirect Cost and Tax

The percentages of the indirect cost and the relevant taxes to the total cost in each project year are estimated at 10 % and 5 %, respectively.

h. Cut-off Rate

A cut-off rate, also known as an opportunity cost of capital (OCC) is also one of the parameters used to assess the financial viability of the project. As discussed in Chapter 4, the rate is fixed at 13.2 %, which is equivalent to the real interest rate in the capital market of Tanzania.

16.3.3 Financial Evaluation

a. FIRRs and Sensitivity Analysis

a.1 Area A

The financial planning tables for Case A-1, together with the three sensitivity sub-cases, are shown from Table A-14 to Table A-17, and the financial planning tables for Case A-2, together with the three sensitivity sub-cases, are shown from Table A-18 to Table A-21. Based on these financial planning tables, the FIRR for the base cases and the sensitivity cases are calculated below. The cash flows for the calculation of the FIRR are shown in Table A-34, Table A-35, Table A-39, Table A-40, Table A-44, Table A-45, Table A-49, and Table A-50.

Table 16-25: Summary of FIRR for Area A

Case	Base Case	Risk 1	Risk 2	Risk 3
Case A-1	-7.63%	-14.97%	-19.71%	-24.88%
Case A-2	5.56%	-2.71%	-7.97%	-14.21%

The major findings are:

a) With an FIRR of minus 7.63%, Case A-1 is not financially feasible because, with the inclusion of the investment cost for the disposal sites, the project cost will be too expensive.

b) Only the base case for Case A-2 recorded a positive FIRR at 5.56%, which is lower than the cut-off rate of 13.2 %, indicating that the awarded concessionaires will not

be able to provide their waste disposal services by borrowing the necessary costs from banking institutions based on the commercial lending rate;

c) Case A-2 proved to be the most promising. In order to compensate for the gap between the FIRR and the cut-off rate, some kind of financial strategy such as leasing of the municipal vehicles to the concessionaires will be required.

a.2 Area B

The financial planning tables for Case B-1, together with the three sensitivity sub-cases, are shown from Table A-22 to Table A-25. The financial planning tables for Case B-2, together with the three sensitivity sub-cases, are shown from Table A-26 to Table A-29, and the financial planning tables for Case B-3, together with the three sub-cases, are shown from Table A-30 to Table A-33. Based on these financial planning tables, the FIRR for the base cases and their respective sensitivity cases are calculated and shown below. The cash flows for the calculation of the FIRRs are shown in Table A-36, Table A-37, Table A-38, Table A-41, Table A-42, Table A-43, Table A-46 and Table A-47, and Table A-48.

Table 16-26: Summary of FIRRs for Area B

Case	Base Case	Risk 1	Risk 2	Risk 3
Case B-1	-20.47%	-24.43%	-27.55%	-29.92%
Case B-2	-12.61%	-16.99%	-20.48%	-23.15%
Case B-3	-4.63%	-14.23%	-20.56%	-24.90%

The major findings are:

a) With an FIRR of minus 20.47%, Case B-1 is not financially feasible because with the inclusion of the investment cost for the final disposal sites, the project cost will be too expensive;

b) Since the FIRR for Case B-2 is still negative at minus 12.61 %, it is not financially feasible even if it is subsidised by an organisation extending development assistance;

c) Even in Case B-3, the FIRR was at minus 4.63 %, which is lower than the break-even FIRR (0%) for the public, indicating that DCC will not be able to provide waste disposal services.

d) Case B-3 proved to be the most promising. In order to compensate for the gap between the FIRR and the break-even FIRR, some kind of financial assistance, such as subsidy from Area A, will be required.

b. Break-even Point Analysis

The FIRR calculations were carried out assuming that the RCC collection rates in area A and area B are 80.0 % and 60.0 %, respectively. Table A-54 and Figure A-11 illustrate the FIRR under different RCC collection rates for area A, and Table A-55 and Figure A-12 illustrate the FIRR under different RCC collection rates for area B.

b.1 Break-even Point for Area B

The FIRR for Case A-1, the most promising case for Area A, fluctuates approximately in proportion to the RCC collection rates as shown below.

Table 16-27: Break-even Points for Area B

RCC	60%	70%	80%	90%	100%
FIRR	-8.57%	-1.71 %	5.56 %	13.22 %	21.28 %

The table indicates that the RCC collection rate under which the FIRR would be equivalent to a cut-off rate of 13.2 % is 90 %. In other words, the concessionaires will be able to independently provide waste disposal services if the RCC collection rate exceeds 90 %, otherwise they will require subsidy if only a rate of 80% is achieved.

b.2 Break-even Point for Area A

The FIRR for Case B-2, the most promising case for Area B that will not require grant-aid assistance, fluctuates approximately in proportion to the RCC collection rates as shown below.

Table 16-28: Break-even Points for Area A

RCC	60%	70%	80%	90%	100%
FIRR	-20.47 %	-16.65 %	-12.64 %	-8.48 %	-4.17 %

The table indicates that the break-even FIRR of zero percent for the public sector might not be achieved even under an RCC collection rate of 100 %. In other words, DCC will not be able to independently provide waste disposal services even with an RCC collection rate of 100 %. DCC shall require a large subsidy to be able to conduct the services at the given RCC collection rate of 60 %.

16.3.4 Feasible Options for Financial Arrangement

a. Required Financial Assistance

Since both case A and Case B do require external subsidies, the required financial assistance will be calculated by means of increasing the given tariff level as shown below.

a.1 Area A

Table A-56 estimated that in order to achieve a 13.2% FIRR, which is the cut-off rate for the commercial operation of waste disposal services, the given tariff level should be increased from Tsh. 1,400/month/household to Tsh. 1,560/month/household, thereby demanding a subsidy of Tsh. 2,709 million (USD 4,423 thousand) for Case A-2.

a.2 Area B

Table A-57 estimated that in order to achieve the break-even FIRR of zero percent for waste disposal services by the public sector, the given tariff level should be increased from Tsh. 1,100/month/household to Tsh. 2,000/month/household, demanding a subsidy of Tsh. 3,938 million (USD 6,428 thousand) for Case B.

b. Possible Option and Conditions

b.1 Possible Option

One of the possible financial options in the master plan for area A is the provision of the grant aid assistance required by DCC, thereby making it possible to rent out vehicles to private concessionaires at a rate cheaper than the rate in the market, which is calculated based on the actual cost of the procured vehicles. On the other hand, the option for area B is through the implementation of a cross subsidy system with area A: the services for area B shall be financed partly using the grant aid assistance extended to area A and the revenues gained from the rental of the vehicles of DCC.

b.2 Conditions for the realisation of the options

However, the following conditions are necessary when implementing these options:

a) In case of the provision of grant aid assistance, the ownership and administrative rights for the vehicles should be given to DCC;

b) The private concessionaires should use the vehicles only for waste disposal services;

c) The tariff should be fixed based on the subsidised leasing fees;

d) DCC, in cooperation with the private concessionaires, should strive hard to keep the RCC collection rate higher than the given rate and to increase tariff.

16.4 Financial Estimates

The financial estimates sheets prepared for this financial evaluation are included in this section.

Figure A-1 Location of Area A and Area B in the Study Area

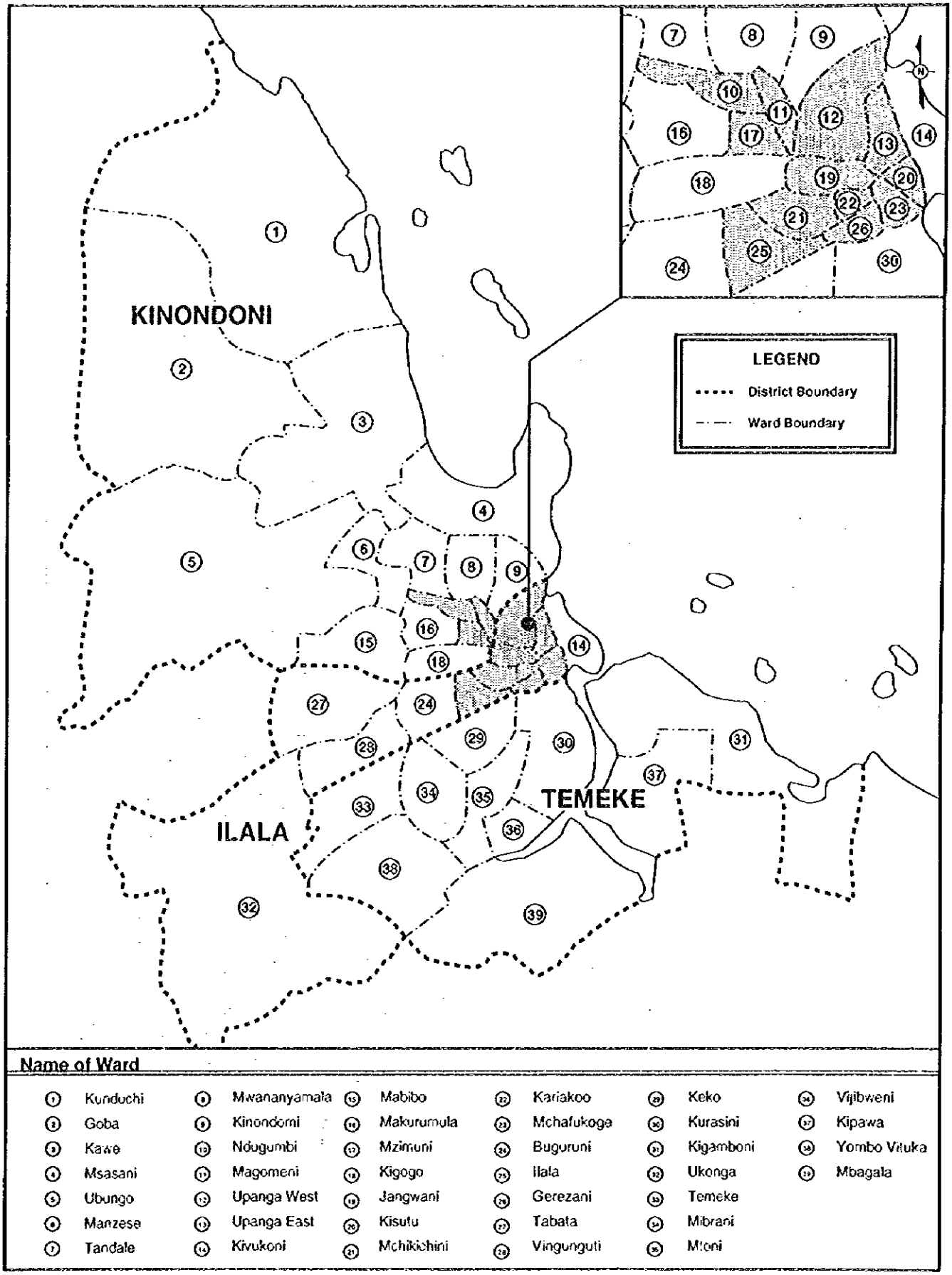


Figure A-2 Basic Features of Area A and Area B

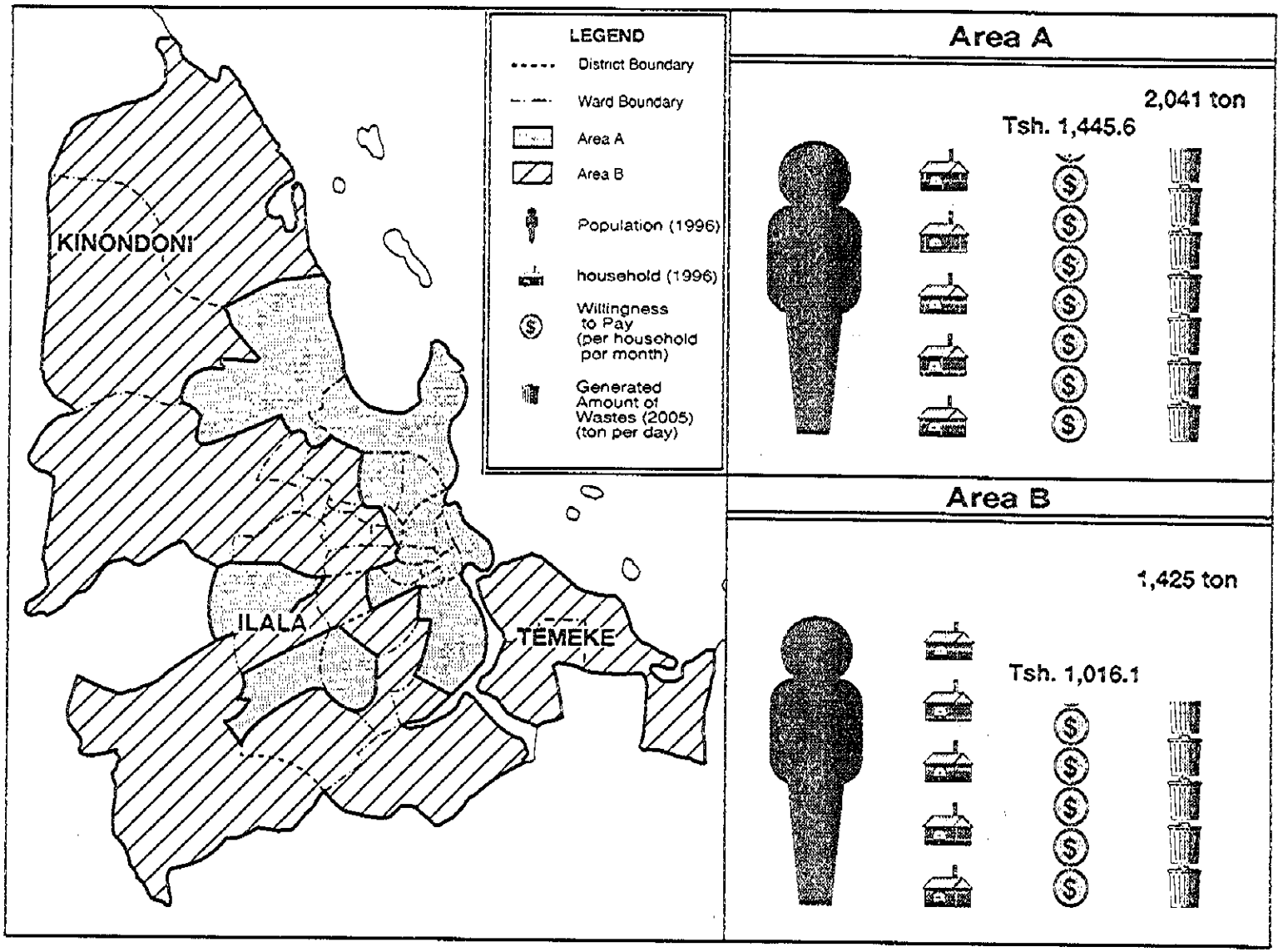


Figure A-3 Proposed Tariff based on Willingness to Pay (WTP) and Marginal Cost (MC) (Area A)

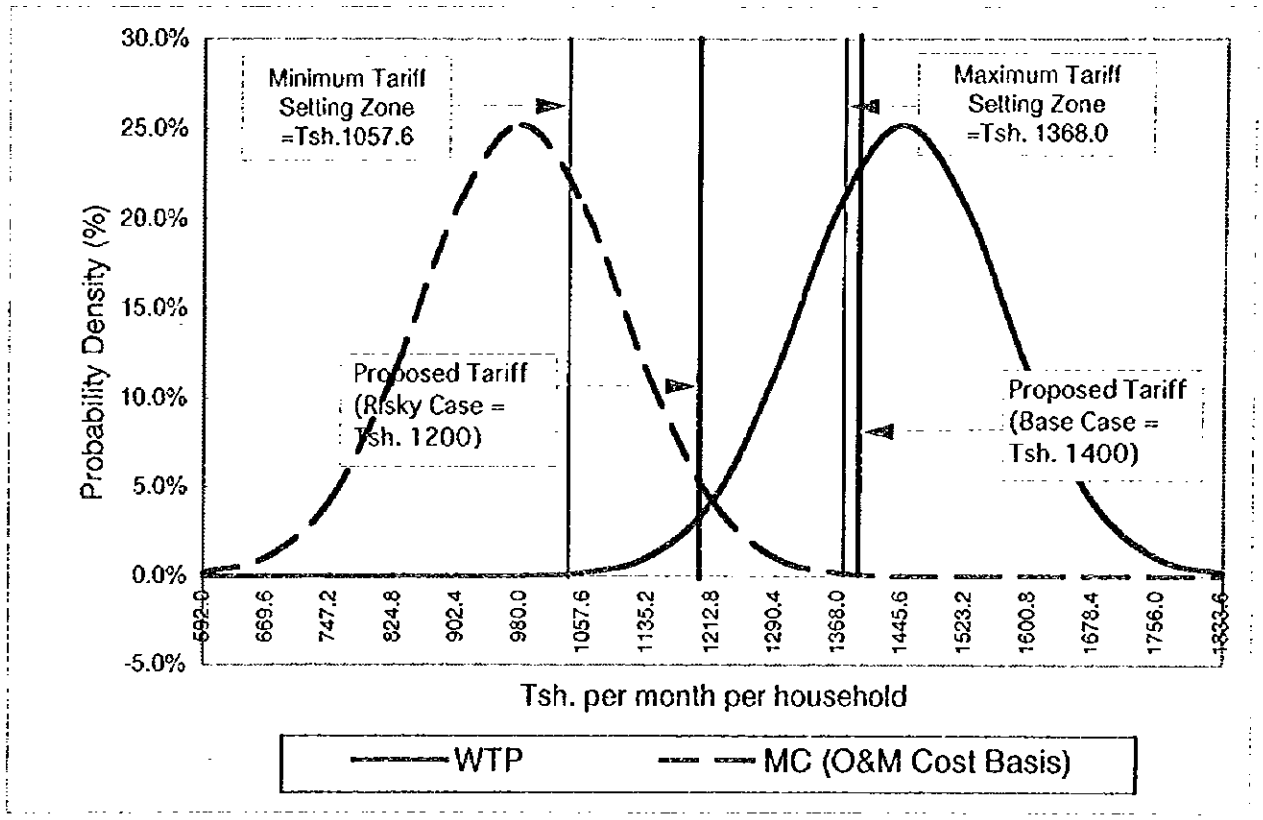


Figure A-4 Proposed Tariff based on Willingness to Pay (WTP) and Marginal Cost (MC) (Area B)

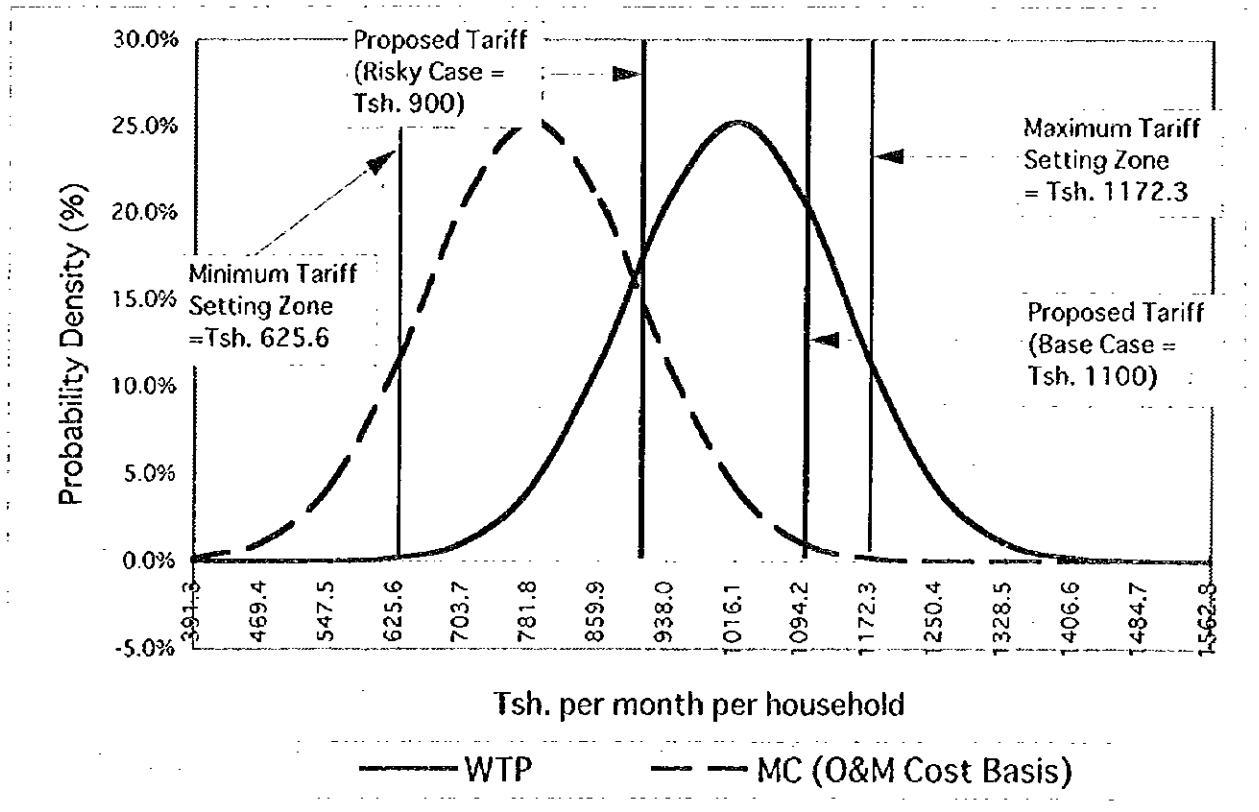


Figure A-5 Shift of Marginal Cost from O&M-Cost Basis to All-Cost Basis (Area A)

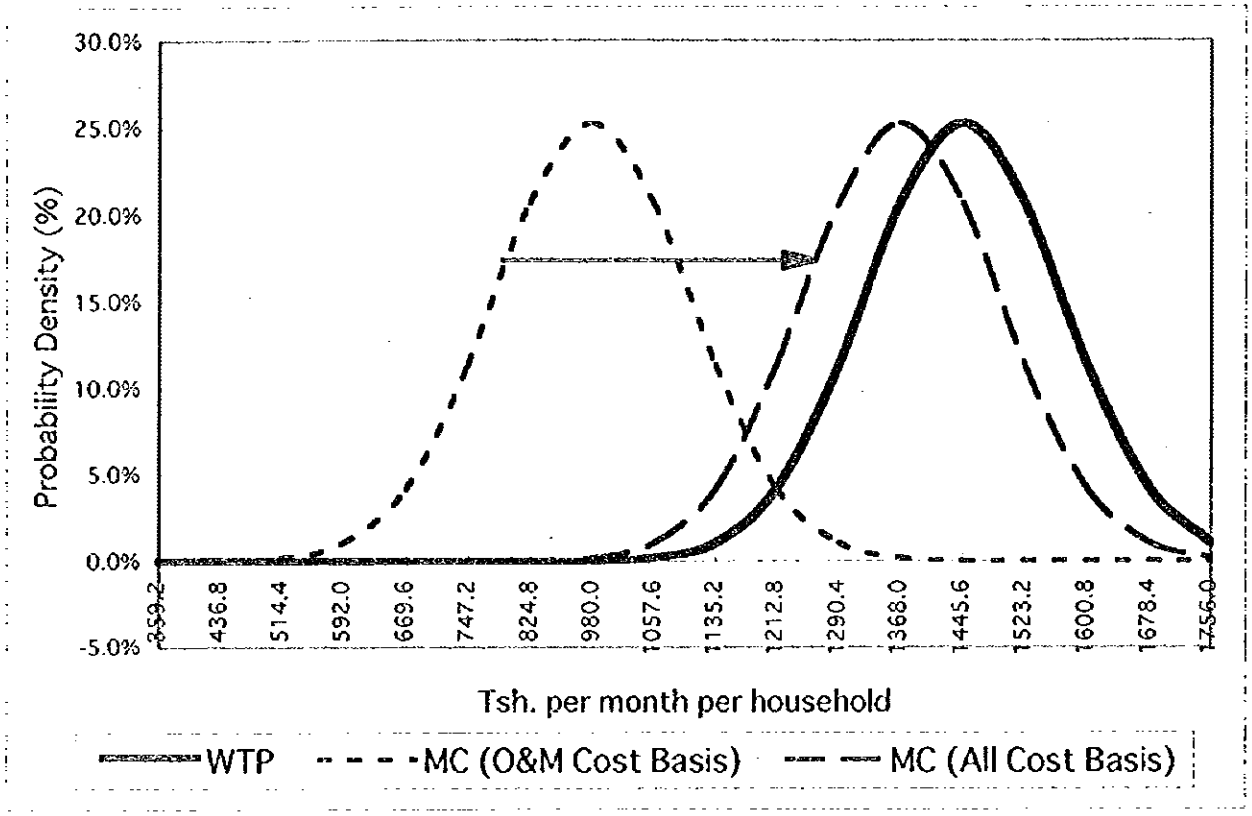


Figure A-6 Shift of Marginal Cost from O&M-Cost Basis to All-Cost Basis (Area B)

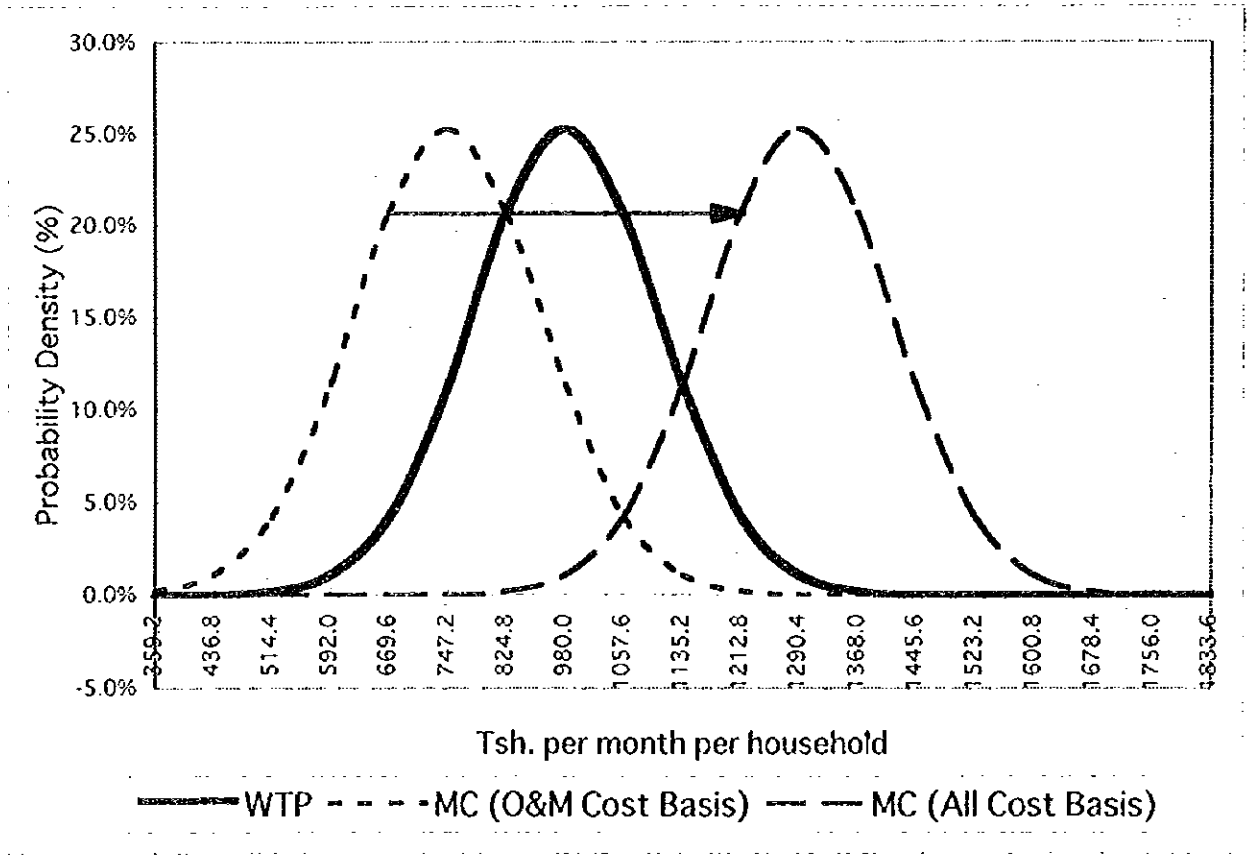


Table A-1 Transtion of Waste Generation Amount (Area A) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	715	19	8	20	1	204	967
1997	768	25	8	26	1	211	1040
1998	822	31	9	33	1	218	1114
1999	876	37	9	39	2	225	1188
2000	958	46	10	48	4	235	1300
2001	1040	54	11	56	4	245	1411
2002	1122	63	12	65	5	255	1523
2003	1252	75	14	77	5	272	1694
2004	1383	87	15	88	5	288	1867
2005	1515	99	16	100	6	305	2041

Table A-2 Transition of Waste Collection Rate (Area A) (Unit: %)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	25.3%	100.0%	100.0%	100.0%	100.0%	27.0%	29.5%
1997	25.8%	100.0%	100.0%	100.0%	100.0%	38.4%	30.7%
1998	29.2%	100.0%	100.0%	100.0%	100.0%	32.1%	34.5%
1999	33.2%	100.0%	100.0%	84.6%	50.0%	36.0%	38.6%
2000	39.4%	100.0%	100.0%	100.0%	100.0%	47.7%	53.2%
2001	46.9%	111.1%	109.1%	116.1%	50.0%	51.0%	53.4%
2002	46.2%	104.8%	108.3%	109.2%	60.0%	53.7%	53.1%
2003	58.6%	106.7%	92.9%	105.2%	60.0%	45.2%	61.0%
2004	57.7%	102.3%	93.3%	103.4%	60.0%	47.6%	60.7%
2005	57.5%	100.0%	100.0%	100.0%	66.7%	50.2%	60.9%

Table A-3 Transition of Waste Collection Amount (Area A) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	181	19	8	20	1	55	285
1997	198	25	8	26	1	81	319
1998	240	31	9	33	1	70	384
1999	291	37	9	33	1	81	459
2000	377	46	10	48	4	112	691
2001	488	60	12	65	2	125	753
2002	518	66	13	71	3	137	809
2003	734	80	13	81	3	123	1034
2004	798	89	14	91	3	137	1133
2005	871	99	16	100	4	153	1243

Table A-4 Transtion of Waste Generation Amount (Area B) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	702	8	3	13	0	78	804
1997	747	10	3	15	0	80	856
1998	792	12	3	18	0	82	906
1999	837	14	3	20	0	83	957
2000	897	16	4	23	0	86	1025
2001	957	18	4	25	0	88	1092
2002	1018	19	5	28	0	90	1159
2003	1097	23	5	32	0	93	1250
2004	1176	26	5	36	0	96	1338
2005	1253	29	5	40	0	98	1425

Table A-5 Transition of Waste Collection Rate (Area B) (Unit: %)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1998	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1999	5.4%	35.7%	33.3%	135.0%	0.0%	18.1%	9.7%
2000	19.1%	75.0%	75.0%	69.6%	0.0%	30.2%	22.1%
2001	22.4%	77.8%	75.0%	76.0%	0.0%	35.2%	25.7%
2002	25.7%	84.2%	80.0%	78.6%	0.0%	40.0%	29.2%
2003	45.4%	100.0%	80.0%	96.9%	0.0%	41.9%	47.6%
2004	50.1%	100.0%	100.0%	97.2%	0.0%	45.8%	52.3%
2005	53.5%	100.0%	100.0%	100.0%	0.0%	50.0%	55.6%

Table A-6 Transition of Waste Collection Amount (Area B) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1999	45	5	1	27	0	15	93
2000	171	12	3	16	0	26	227
2001	214	14	3	19	0	31	281
2002	262	16	4	22	0	36	339
2003	498	23	4	31	0	39	595
2004	589	26	5	35	0	44	700
2005	670	29	5	40	0	49	793

Table A-7 Transtion of Waste Generation Amount (Overall) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	1417	27	11	33	1	282	1771
1997	1516	35	11	42	1	291	1896
1998	1614	43	12	50	2	299	2020
1999	1713	51	12	59	2	308	2145
2000	1855	61	14	70	2	320	2323
2001	1998	72	15	82	3	333	2502
2002	2140	82	17	93	3	345	2680
2003	2349	97	18	109	3	364	2941
2004	2559	113	20	124	4	384	3203
2005	2768	128	21	140	4	403	3464

Table A-8 Transition of Waste Collection Rate (Overall) (Unit: %)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	12.2%	81.5%	81.8%	81.8%	100.0%	22.7%	16.7%
1997	14.7%	85.7%	90.9%	164.3%	100.0%	28.9%	21.9%
1998	17.0%	86.0%	83.3%	220.0%	100.0%	34.4%	26.6%
1999	18.9%	88.2%	91.7%	257.6%	100.0%	39.9%	30.6%
2000	33.6%	108.2%	100.0%	105.7%	100.0%	43.1%	39.5%
2001	35.1%	102.8%	100.0%	102.4%	100.0%	46.8%	41.3%
2002	36.4%	100.0%	100.0%	100.0%	100.0%	50.1%	42.8%
2003	52.5%	105.2%	94.4%	102.8%	100.0%	44.5%	55.4%
2004	54.2%	101.8%	95.0%	101.6%	100.0%	47.4%	57.2%
2005	55.7%	100.0%	100.0%	100.0%	100.0%	50.1%	58.8%

Table A-9 Transition of Waste Collection Amount (Overall) (Unit: ton per day)

Year	Household	Commercial	Institution	Market	Street	Informal	Total
1996	173	22	9	27	1	64	296
1997	223	30	10	69	1	84	416
1998	274	37	10	110	2	103	537
1999	324	45	11	152	2	123	657
2000	624	66	14	74	2	138	918
2001	702	74	15	84	3	156	1033
2002	780	82	17	93	3	173	1148
2003	1233	102	17	112	3	162	1629
2004	1387	115	19	126	4	182	1832
2005	1541	128	21	140	4	202	2036

Table A-10 Tariff Step for Household Wastes (Area A)

Year	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inflation Rate	%	20.0	20.0	18.0	18.0	16.0	16.0	14.0	14.0	12.0	12.0
Present Tariff	Tsh./month/household	900.0	1080.0	1274.4	1503.8	1744.4	2023.5	2306.8	2629.7	2945.3	3298.8
Willingness to Pay	Tsh./month/household	1445.6	1734.7	2047.0	2415.4	2801.9	3250.2	3705.2	4224.0	4730.8	5298.5
Marginal Cost	Tsh./month/household	975.0	1170.0	1380.6	1629.1	1889.8	2192.1	2499.0	2848.9	3190.8	3573.6
Proposed Tariff	Tsh./month/household	1400.0	1680.0	1982.4	2339.2	2713.5	3147.7	3588.3	4090.7	4581.6	5131.4

Table A-11 Tariff Step for Household Wastes (Area B)

Year	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inflation Rate	%	20.0	20.0	18.0	18.0	16.0	16.0	14.0	14.0	12.0	12.0
Present Tariff	Tsh./month/household	150.0	180.0	212.4	250.6	290.7	337.3	384.5	438.3	490.9	549.8
Willingness to Pay	Tsh./month/household	1016.1	1219.3	1438.8	1697.8	1969.4	2284.5	2604.4	2969.0	3325.3	3724.3
Marginal Cost	Tsh./month/household	783.3	940.0	1109.2	1308.8	1518.2	1761.1	2007.7	2288.8	2563.4	2871.0
Proposed Tariff	Tsh./month/household	1100.0	1320.0	1557.6	1838.0	2132.0	2473.2	2819.4	3214.1	3599.8	4031.8

Table A-12 Tariff Step for Commercial, Institution and Market Wastes (Area A)

Year	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inflation Rate	%	20.0	20.0	18.0	18.0	16.0	16.0	14.0	14.0	12.0	12.0
Marginal Cost	Tsh./ton	24000.0	28800.0	33984.0	40101.1	46517.3	53960.1	61514.5	70126.5	78541.7	87966.7
Proposed Tariff	Tsh./ton	36000.0	43200.0	50976.0	60151.7	69775.9	80940.1	92271.7	105189.8	117812.5	131950.0

Table A-13 Tariff Step for Commercial, Institution and Market Wastes (Area B)

Year	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inflation Rate	%	20.0	20.0	18.0	18.0	16.0	16.0	14.0	14.0	12.0	12.0
Marginal Cost	Tsh./ton	24000.0	28800.0	33984.0	40101.1	46517.3	53960.1	61514.5	70126.5	78541.7	87966.7
Proposed Tariff	Tsh./ton	24000.0	28800.0	33984.0	40101.1	46517.3	53960.1	61514.5	70126.5	78541.7	87966.7

Table A-14 Financial Planning Table (Case A-1), (Base Case = Tariff Tsh. 1400 and RCC Collection Rate 80%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6487	3640	4323	5291	6389	7468	6767	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	606	769	946	1139	1396	1683	1996	0
1.4 Indirect Cost	million Tsh.	179	227	280	336	410	494	586	0
1.5 Tax	million Tsh.	309	173	206	252	304	356	322	0
2. Revenues	million Tsh.	2410	3021	3680	4519	5370	6400	7612	4653
2.1 RCC from Households	million Tsh.	1295	1660	2086	2587	3187	3905	4774	0
2.1.1 Tariff	Tsh./month/household	1400	1400	1400	1400	1400	1400	1400	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	80.0	80.0	80.0	80.0	80.0	80.0	80.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton/day	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4077	-619	-642	-772	-1018	-1068	844	4653

Table A-15 Financial Planning Table (Case A-1), (Risk 1 = Tariff Tsh. 1200 and RCC Collection Rate 80%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6487	3640	4323	5291	6389	7468	6767	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	606	769	946	1139	1396	1683	1996	0
1.4 Indirect Cost	million Tsh.	179	227	280	336	410	494	586	0
1.5 Tax	million Tsh.	309	173	206	252	304	356	322	0
2. Revenues	million Tsh.	2225	2784	3382	4149	4915	5842	6930	4653
2.1 RCC from Households	million Tsh.	1110	1423	1788	2217	2732	3348	4092	0
2.1.1 Tariff	Tsh./month/household	1200	1200	1200	1200	1200	1200	1200	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	80.0	80.0	80.0	80.0	80.0	80.0	80.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4262	-856	-940	-1142	-1474	-1626	162	4653

Table A-16 Financial Planning Table (Case A-1), (Risk 2 = Tariff Tsh. 1400 and RCC Collection Rate 60%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6487	3640	4323	5291	6389	7468	6767	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	606	769	946	1139	1396	1683	1996	0
1.4 Indirect Cost	million Tsh.	179	227	280	336	410	494	586	0
1.5 Tax	million Tsh.	309	173	206	252	304	356	322	0
2. Revenues	million Tsh.	2086	2606	3420	3872	4573	5423	6418	4653
2.1 RCC from Households	million Tsh.	971	1245	1825	1940	2390	2929	3580	0
2.1.1 Tariff	Tsh./month/household	1400	1400	1400	1400	1400	1400	1400	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	60.0	60.0	70.0	60.0	60.0	60.0	60.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4401	-1034	-903	-1419	-1815	-2044	-349	4653

Table A-17 Financial Planning Table (Case A-1), (Risk 3 = Tariff Tsh. 1200 and RCC Collection Rate 60%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6487	3640	4323	5291	6389	7468	6767	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	606	769	946	1139	1396	1683	1996	0
1.4 Indirect Cost	million Tsh.	179	227	280	336	410	494	586	0
1.5 Tax	million Tsh.	309	173	206	252	304	356	322	0
2. Revenues	million Tsh.	1948	2428	2936	3595	4232	5005	5907	4653
2.1 RCC from Households	million Tsh.	832	1067	1341	1663	2049	2511	3069	0
2.1.1 Tariff	Tsh./month/household	1200	1200	1200	1200	1200	1200	1200	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4539	-1212	-1387	-1696	-2157	-2463	-861	4653

Table A-18 Financial Planning Table (Case A-2), (Base Case = Tariff Tsh. 1400 and RCC Collection Rate 80%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6163	3230	3818	4683	5645	6570	5702	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	326	414	509	613	752	906	1074	0
1.4 Indirect Cost	million Tsh.	151	192	236	284	345	417	494	0
1.5 Tax	million Tsh.	293	154	182	223	269	313	272	0
2. Revenues	million Tsh.	2410	3021	3680	4519	5370	6400	7612	4653
2.1 RCC from Households	million Tsh.	1295	1660	2086	2587	3187	3905	4774	0
2.1.1 Tariff	Tsh./month/household	1400	1400	1400	1400	1400	1400	1400	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	80.0	80.0	80.0	80.0	80.0	80.0	80.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton/day	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-3753	-209	-138	-165	-275	-170	1909	4653

Table A-19 Financial Planning Table (Case A-2), (Risk 1 = Tariff Tsh. 1200 and RCC Collection Rate 80%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6163	3230	3818	4683	5645	6570	5702	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	326	414	509	613	752	906	1074	0
1.4 Indirect Cost	million Tsh.	151	192	236	284	345	417	494	0
1.5 Tax	million Tsh.	293	154	182	223	269	313	272	0
2. Revenues	million Tsh.	2225	2784	3382	4149	4915	5842	6930	4653
2.1 RCC from Households	million Tsh.	1110	1423	1788	2217	2732	3348	4092	0
2.1.1 Tariff	Tsh./month/household	1200	1200	1200	1200	1200	1200	1200	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	80.0	80.0	80.0	80.0	80.0	80.0	80.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-3938	-446	-436	-534	-730	-728	1227	4653

Table A-20 Financial Planning Table (Case A-2), (Risk 2 = Tariff Tsh. 1400 and RCC Collection Rate 60%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6163	3230	3818	4683	5645	6570	5702	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	326	414	509	613	752	906	1074	0
1.4 Indirect Cost	million Tsh.	151	192	236	284	345	417	494	0
1.5 Tax	million Tsh.	293	154	182	223	269	313	272	0
2. Revenues	million Tsh.	2086	2606	3420	3872	4573	5423	6418	4653
2.1 RCC from Households	million Tsh.	971	1245	1825	1940	2390	2929	3580	0
2.1.1 Tariff	Tsh./month/household	1400	1400	1400	1400	1400	1400	1400	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	60.0	60.0	70.0	60.0	60.0	60.0	60.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4077	-624	-398	-811	-1071	-1147	716	4653

Table A-21 Financial Planning Table (Case A-2), (Risk 3 = Tariff Tsh. 1200 and RCC Collection Rate 60%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	6163	3230	3818	4683	5645	6570	5702	0
1.1 Investment Cost	million Tsh.	4208	968	1042	1340	1577	1676	0	0
1.1.1 Tipper Truck	million Tsh.	4208	968	1042	1042	1527	1676	0	0
1.1.2 Compactor Truck	million Tsh.	0	0	0	297	50	0	0	0
1.2 Operation and Maintenance	million Tsh.	1185	1502	1849	2224	2702	3259	3863	0
1.2.1 Labour	million Tsh.	278	352	434	521	621	751	891	0
1.2.2 Fuel	million Tsh.	244	310	382	459	552	667	790	0
1.2.3 Repair	million Tsh.	663	840	1033	1244	1529	1841	2182	0
1.3 Disposal Fee	million Tsh.	326	414	509	613	752	906	1074	0
1.4 Indirect Cost	million Tsh.	151	192	236	284	345	417	494	0
1.5 Tax	million Tsh.	293	154	182	223	269	313	272	0
2. Revenues	million Tsh.	1948	2428	2936	3595	4232	5005	5907	4653
2.1 RCC from Households	million Tsh.	832	1067	1341	1663	2049	2511	3069	0
2.1.1 Tariff	Tsh./month/household	1200	1200	1200	1200	1200	1200	1200	0
2.1.2 Number of Households	numbers	290208	313459	340336	371596	408173	451220	501697	0
2.1.3 Waste Collection Rate	%	33.2	39.4	45.6	51.8	58.1	64.4	70.8	0.0
2.1.4 RCC Collection Rate	%	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
2.2 RCC from Others	million Tsh.	1115	1361	1595	1932	2183	2494	2838	0
2.2.1 Tariff	Tsh./ton	36000	36000	36000	36000	36000	36000	36000	0
2.2.2 Amount of Waste Collected	ton	312	343	370	420	443	483	528	0
2.2.3 Waste Collection Rate	%	27.2	30.2	32.8	35.0	37.5	39.3	40.9	0.0
2.2.4 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Scrap Value	million Tsh.	0	0	0	0	0	0	0	4653
3. Balance		-4216	-802	-883	-1089	-1413	-1565	204	4653

Table A-22 Financial Planning Table (Case B-1), (Base Case = Tariff Tsh. 1100 and RCC Collection Rate 60%)

Year	Unit	1999	2000	2001	2002	2003	2004	2005	2006
1. Costs	million Tsh.	2045	1148	1580	2072	2424	2915	2352	0
1.1 Investment Cost	million Tsh.	1922	495	690	910	898	997	0	0
1.1.1 Skip Truck	million Tsh.	786	262	367	472	472	524	0	0
1.1.2 Container	million Tsh.	671	224	313	402	402	447	0	0
1.1.3 Push Cart	million Tsh.	23	9	10	36	24	26	0	0
1.1.4 Maintenance Shop	million Tsh.	442	0	0	0	0	0	0	0
1.2 Operation and Maintenance	million Tsh.	0	350	470	611	800	1001	1223	0
1.2.1 Labour (Primary)	million Tsh.	0	79	111	145	192	243	299	0
1.2.2 Repair (Primary)	million Tsh.	0	5	6	8	11	14	17	0
1.2.3 Labour (Secondary)	million Tsh.	0	11	14	19	26	32	40	0
1.2.4 Fuel (Secondary)	million Tsh.	0	69	92	125	167	209	255	0
1.2.5 Repair (Secondary)	million Tsh.	0	154	215	282	372	471	580	0
1.2.6 Maintenance Shop	million Tsh.	0	32	32	32	32	32	32	0
1.3 Disposal Fee	million Tsh.	107	218	304	399	527	667	822	0
1.4 Indirect Cost	million Tsh.	16	85	116	152	199	250	307	0
2. Revenues	million Tsh.	272	675	860	1050	1357	1661	1995	2727
2.1 RCC from Households	million Tsh.	167	298	449	616	831	1074	1347	0
2.1.1 Tariff	Tsh./month/household	1100	1100	1100	1100	1100	1100	1100	0
2.1.2 Number of Households	numbers	277153	294312	314826	336878	360769	386270	414931	0
2.1.3 Waste Collection Rate	%	7.6	12.8	18.0	23.1	29.1	35.1	41.0	0.0
2.1.4 RCC Collection Rate	%	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
2.2 RCC from Others	million Tsh.	105	376	412	434	525	587	648	0
2.2.1 Tariff	Tsh./ton	24000	24000	24000	24000	24000	24000	24000	0
2.2.2 Amount of Waste Collected	ton/day	120	129	135	142	153	163	172	0
2.2.3 Waste Collection Rate	%	10.0	33.3	34.8	34.9	39.2	41.1	43.0	0.0
2.2.2 RCC Collection Rate	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
2.3 Subsidy from Disposal Fee	million Tsh.	0	0	0	0	0	0	0	0
2.4 Subsidy from Leasing Fee	million Tsh.	0	0	0	0	0	0	0	0
2.5 Scrap Value	million Tsh.	0	0	0	0	0	0	0	2727
3. Balance		-1773	-473	-720	-1021	-1067	-1254	-356	2727